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Okui

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(54) **LIQUID EJECTING APPARATUS AND LIQUID DISCHARGING METHOD**

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B41J 2/175 (2006.01)

(52) **U.S. Cl.**
CPC ***B41J 2/17596*** (2013.01)

(58) **Field of Classification Search**
CPC B41J 2/17596; B41J 2/175; B41J 2/18
See application file for complete search history.

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(57) **ABSTRACT**

A liquid ejecting apparatus includes: nozzles; individual flow paths communicating with each of the nozzles; a liquid storage portion storing liquid; a supply flow path for supplying the liquid from the liquid storage portion to the individual flow paths; a recovery flow path for recovering the liquid from the individual flow paths to the liquid storage portion; a bypass flow path that couples the supply flow path and the recovery flow path; and an on-off valve configured to close and open the recovery flow path, in which the on-off valve is disposed between the bypass flow path and the liquid storage portion in the recovery flow path, and a pressurization discharge operation of discharging the liquid from each of the nozzles by pressurizing the liquid in the supply flow path in a state in which the recovery flow path is closed by the on-off valve is executed.

20 Claims, 16 Drawing Sheets

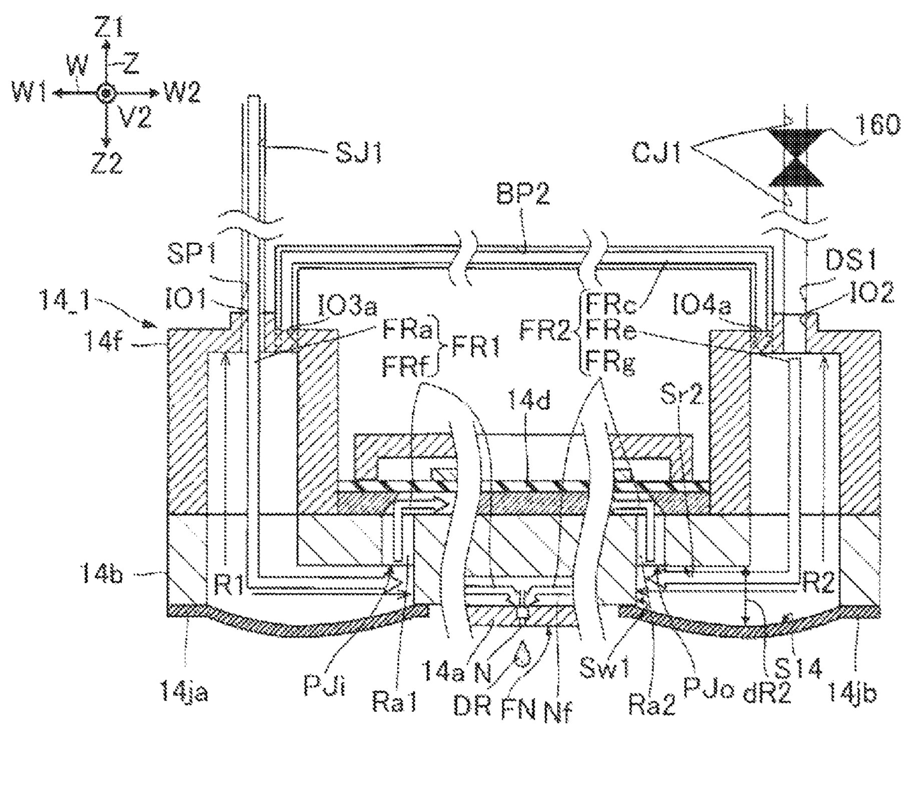


FIG. 1

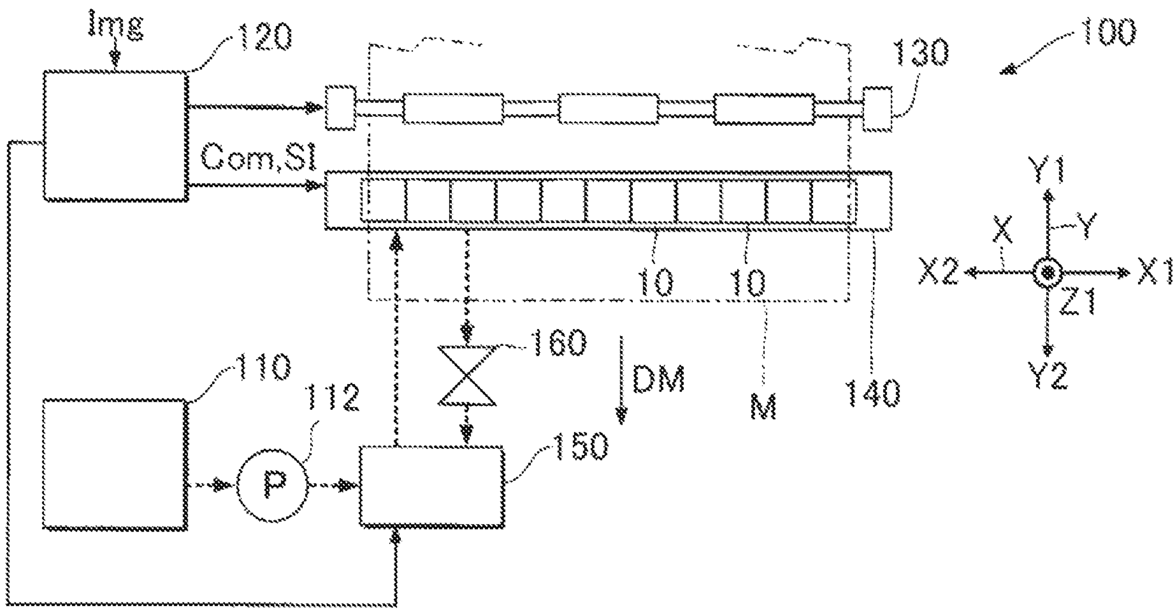

Img
120
100
130
Com,SI
Y1
Y
X
X2
X1
Z1
Y2
10
10
140
M
160
DM
110
112
P
150

FIG. 2

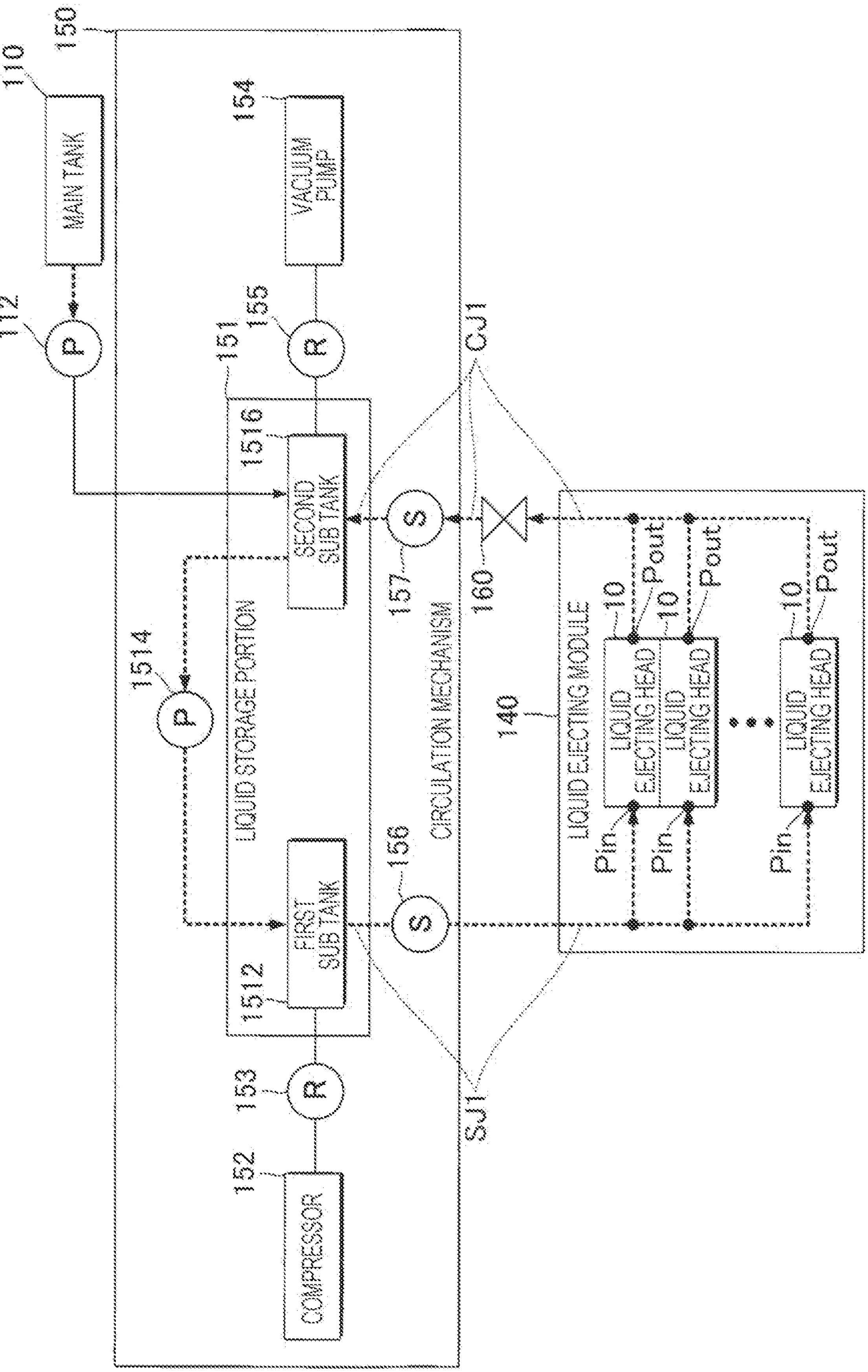

100
110
MAIN TANK
112
P
150
154
VACUUM PUMP
155
R
151
1516
SECOND SUB TANK
1514
P
LIQUID STORAGE PORTION
1512
FIRST SUB TANK
153
R
152
COMPRESSOR
156
S
157
S
CIRCULATION MECHANISM
160
CJ1
SJ1
140
LIQUID EJECTING MODULE
10
LIQUID EJECTING HEAD
Pout
Pin

FIG. 3

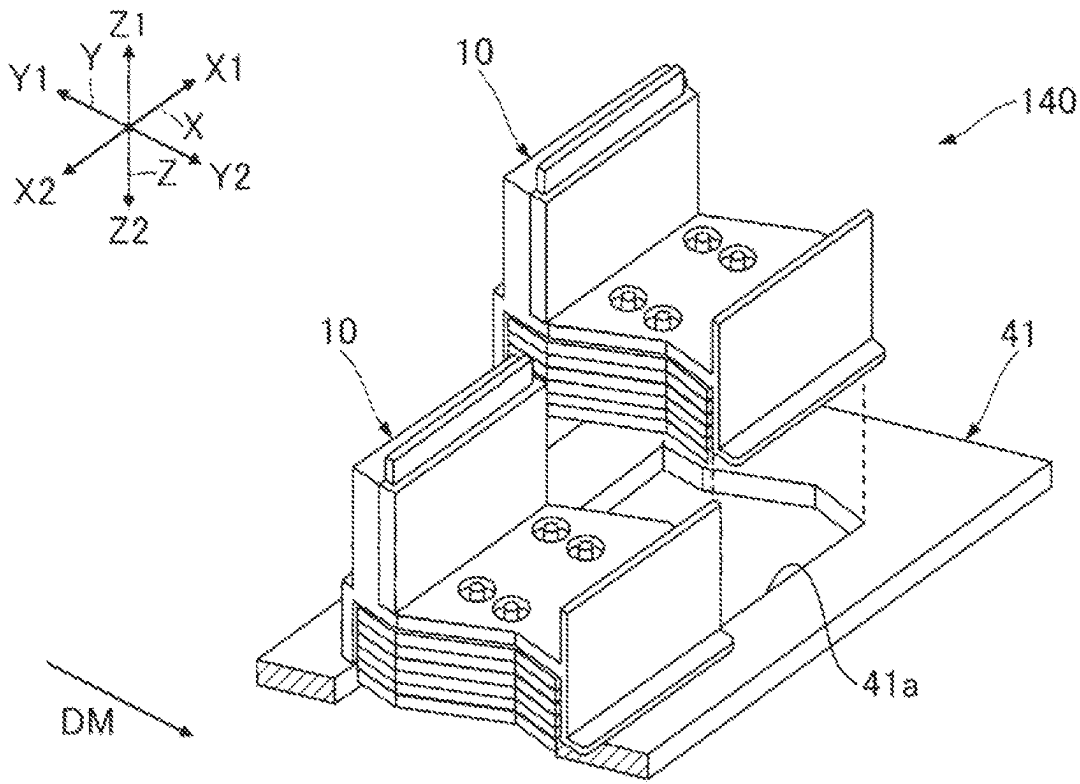
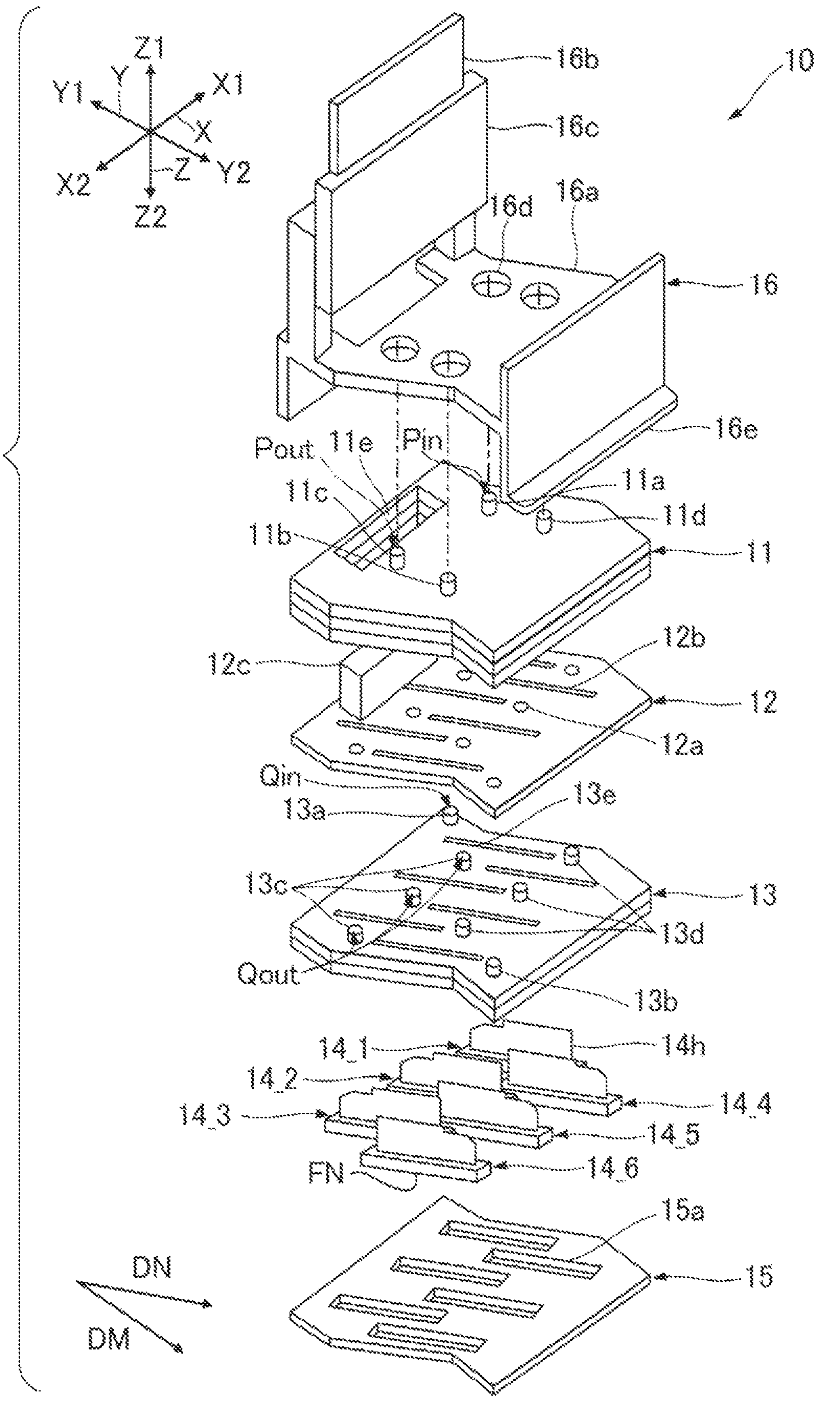


FIG. 4



Z1
Y1
Y
X1
X
X2
Z
Y2
Z2
10
16b
16c
16d
16a
16
16e
Pout
11e
Pin
11a
11c
11d
11b
11
12c
12b
12
12a
Qin
13a
13e
13c
13
13d
Qout
13b
14_1
14h
14_2
14_4
14_3
14_5
FN
14_6
15a
DN
15
DM

FIG. 5

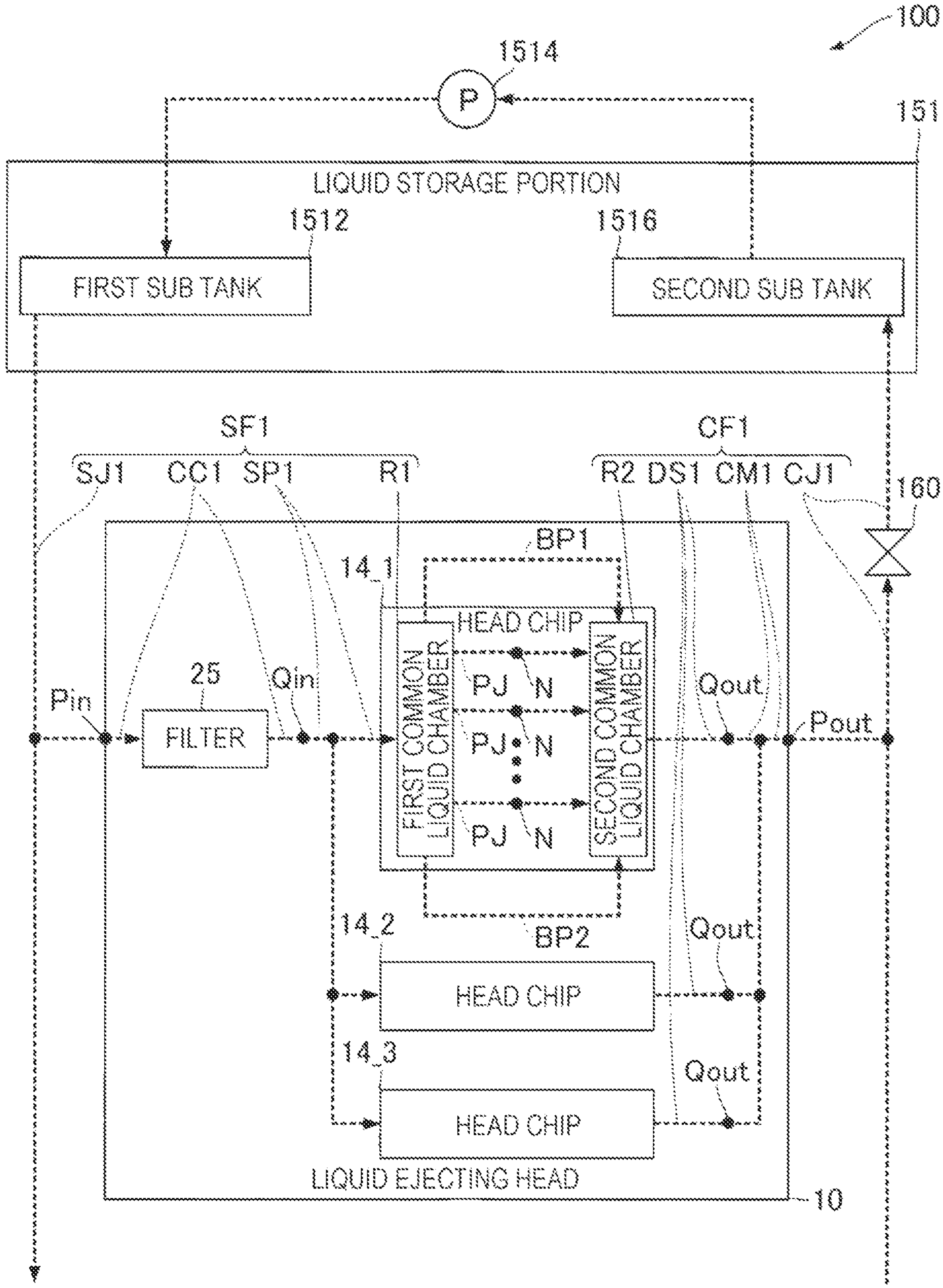
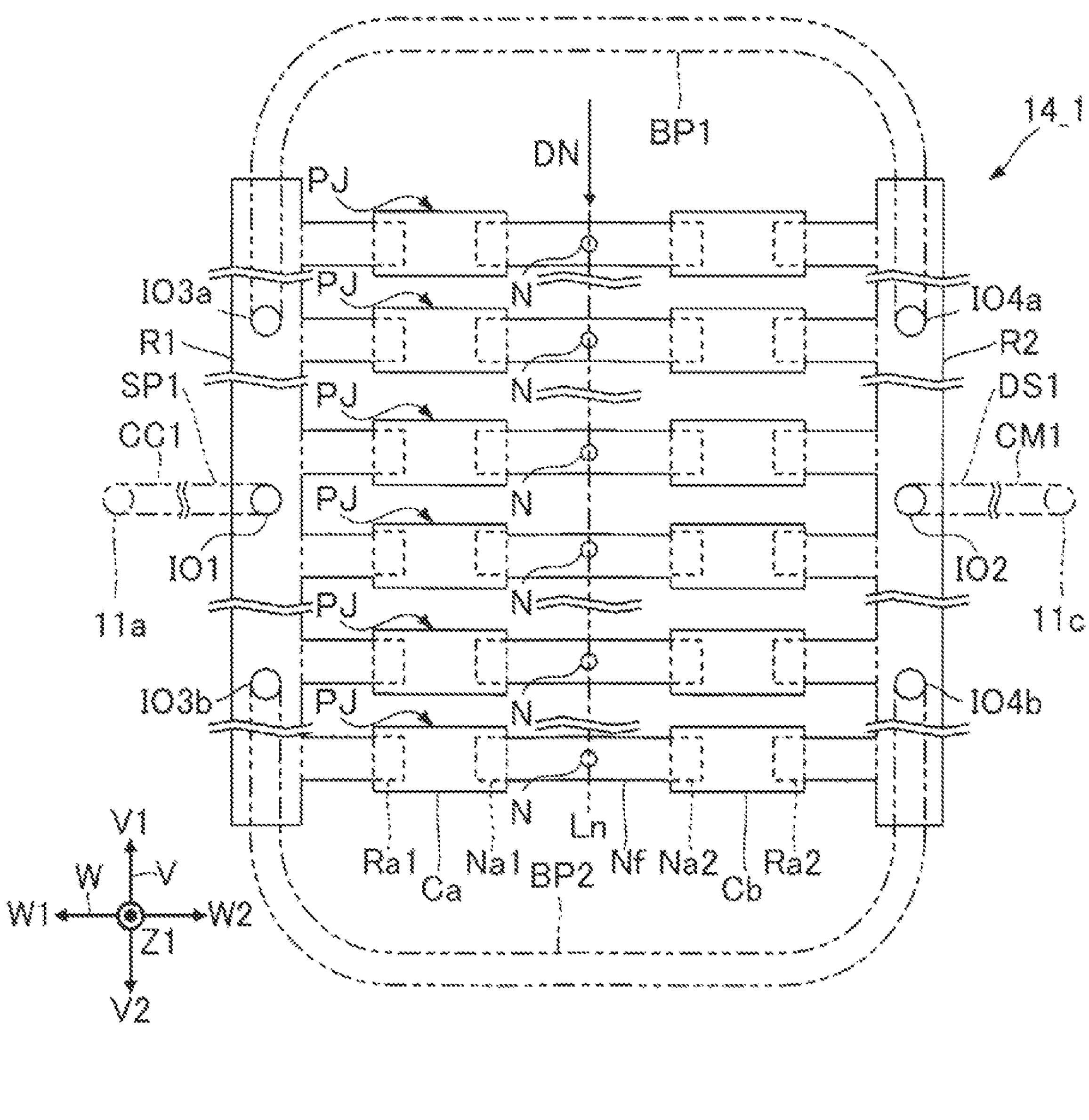
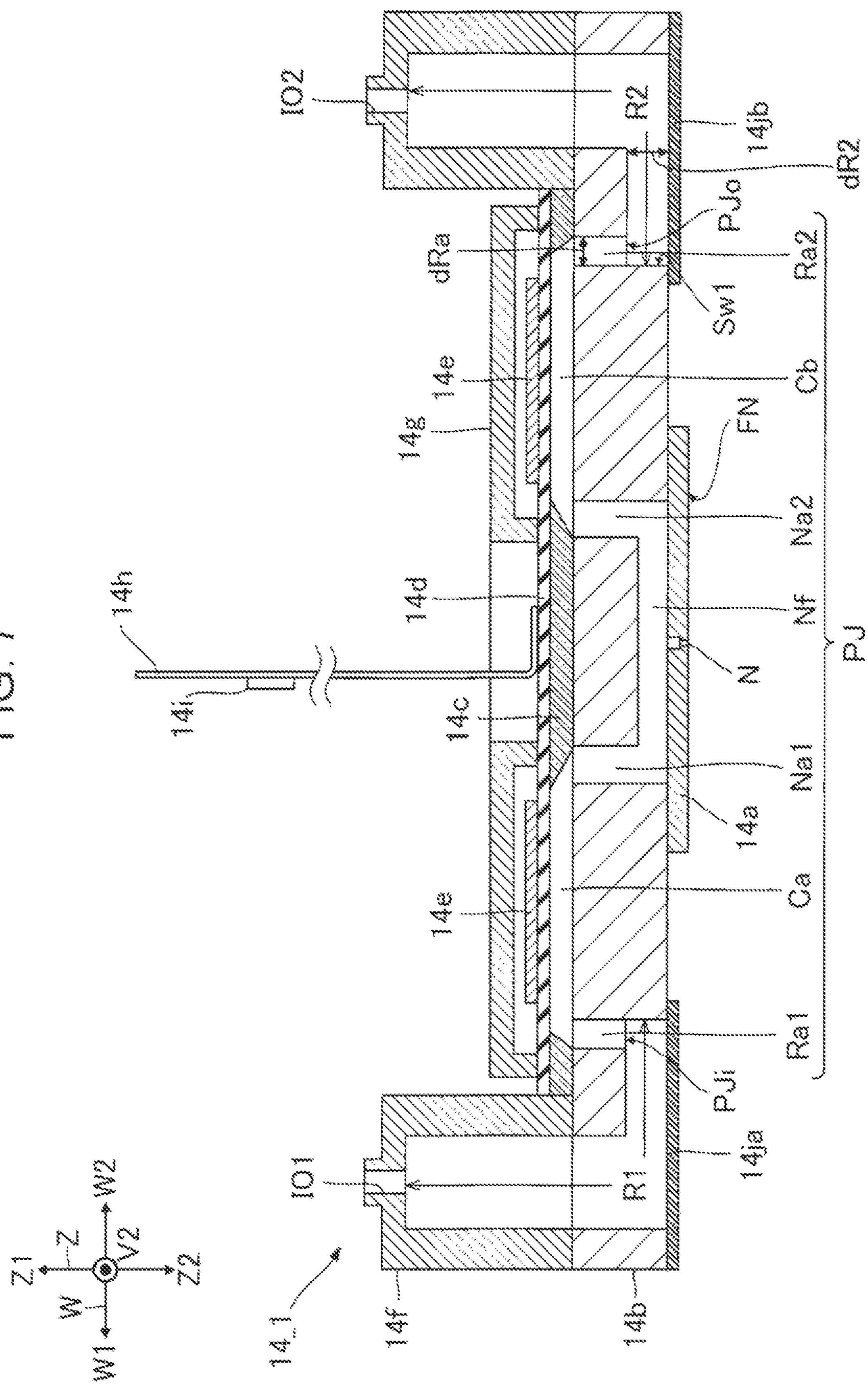

100
1514
P
151
LIQUID STORAGE PORTION
1512
1516
FIRST SUB TANK
SECOND SUB TANK
SF1
CF1
SJ1
CC1
SP1
R1
R2
DS1
CM1
CJ1
160
BP1
14_1
HEAD CHIP
FIRST COMMON LIQUID CHAMBER
SECOND COMMON LIQUID CHAMBER
PJ
N
25
Qin
Pin
FILTER
Qout
Pout
14_2
BP2
HEAD CHIP
14_3
HEAD CHIP
LIQUID EJECTING HEAD
10

FIG. 6



BP1
14_1
DN
PJ
N
IO3a
IO4a
R1
R2
SP1
DS1
CC1
CM1
IO1
IO2
11a
11c
IO3b
IO4b
V1
V
W
W1
W2
Z1
V2
Ra1
Ca
Na1
BP2
Ln
Nf
Na2
Cb
Ra2

FIG. 7


IO2
R2
14jb
dR2
PJo
Ra2
dRa
Sw1
14e
Cb
14g
FN
Na2
14h
14d
Nf
N
PJ
14i
14c
Na1
14a
Ca
14e
Ra1
PJi
IO1
R1
14ja
W2
Z
Z1
V2
W
Z2
W1
14_1
14f
14b

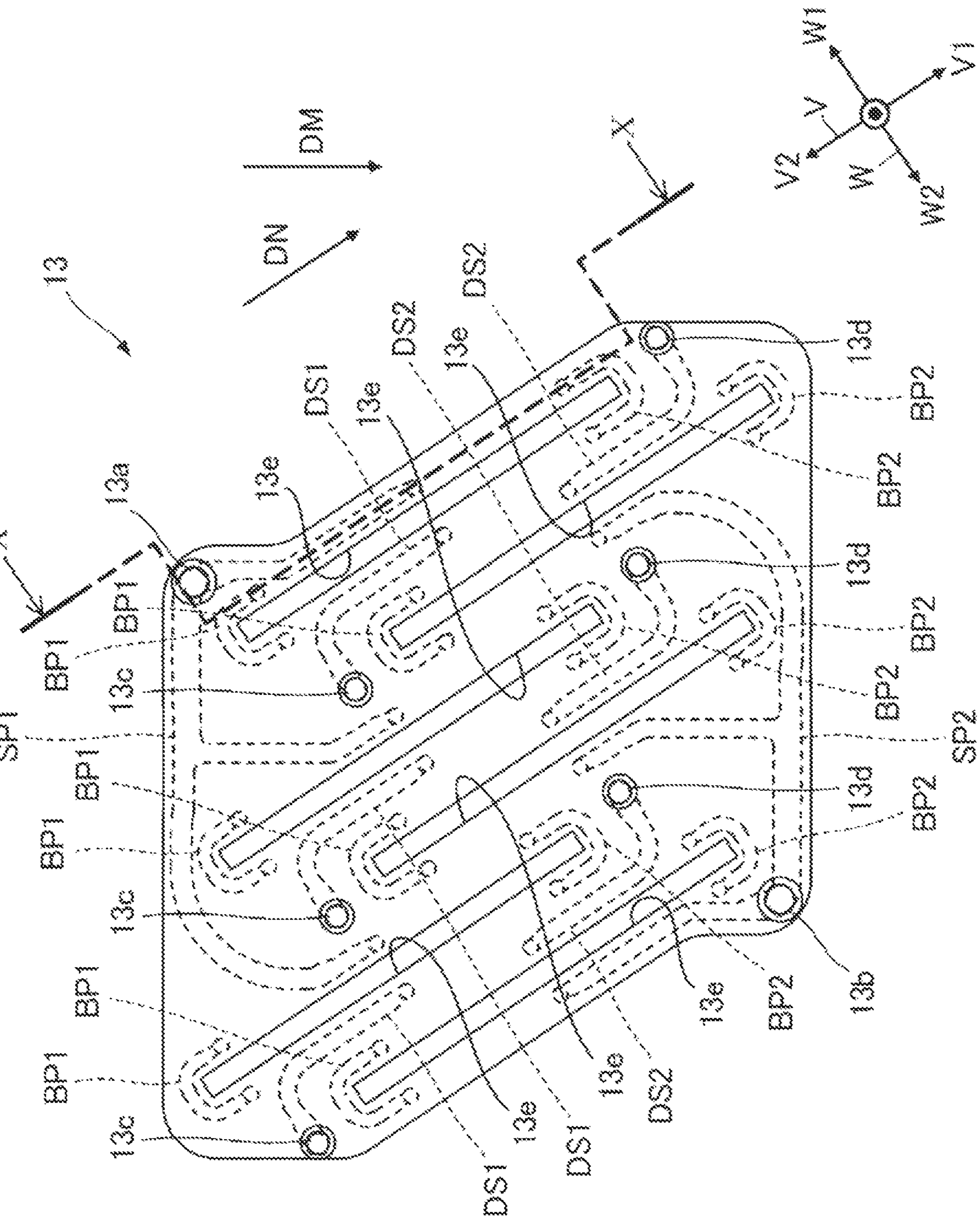
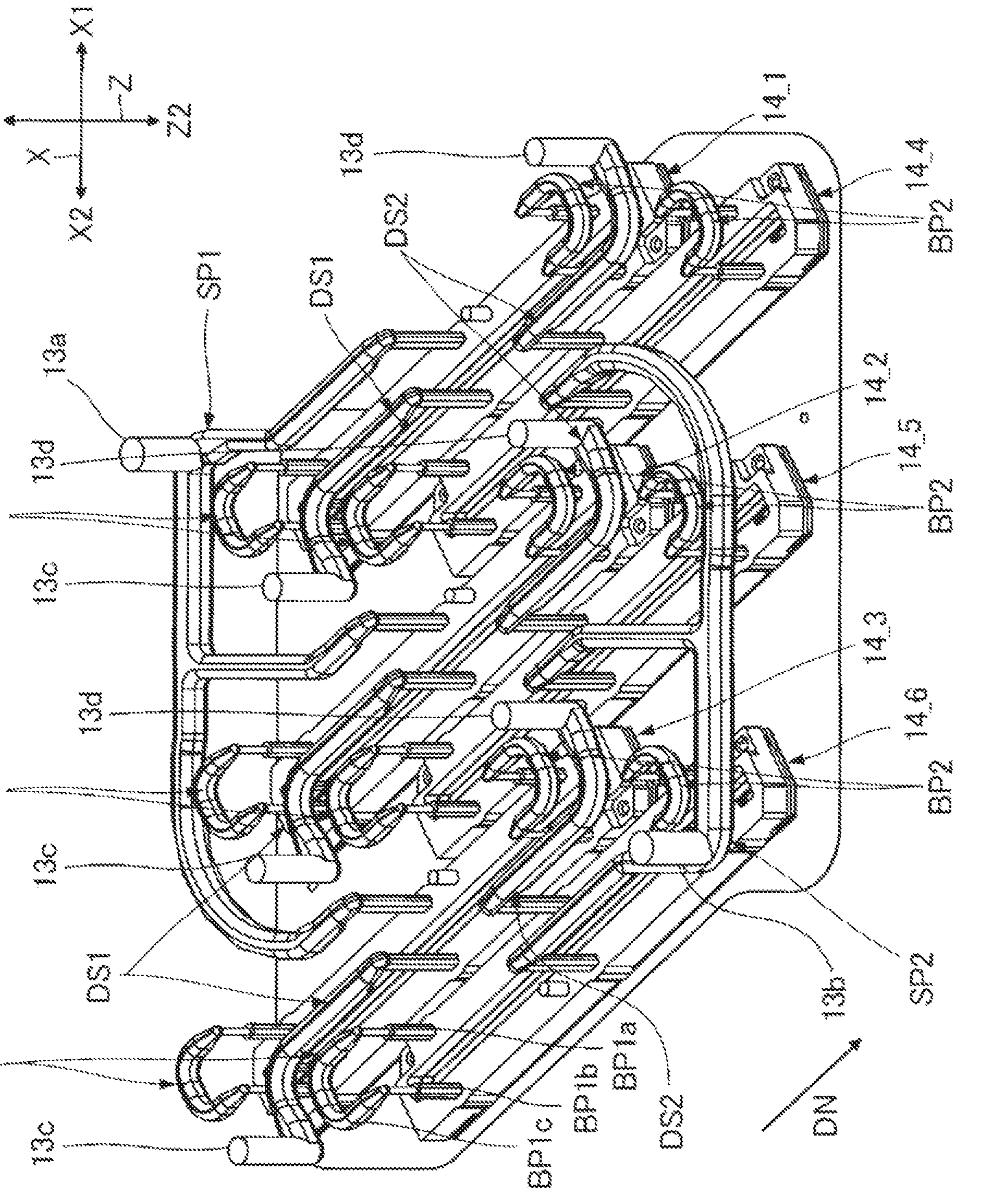

13
DN
DM
X
X
W1
V1
V
V2
W
W2
13a
13b
13c
13c
13c
13d
13d
13d
13e
13e
13e
13e
13e
13e
13e
DS1
DS1
DS1
DS2
DS2
DS2
BP1
BP1
BP1
BP1
BP1
BP1
BP1
BP2
BP2
BP2
BP2
BP2
BP2
BP2
SP1
SP2

FIG. 8



X1
X2
X
Z1
Z2
Z
13a
SP1
13d
DS1
DS2
14_1
14_4
BP2
BP1
13c
14_2
14_5
14_3
14_6
DS1
SP2
13b
BP1a
BP1b
BP1c
DS2
DN

FIG. 9

FIG. 10

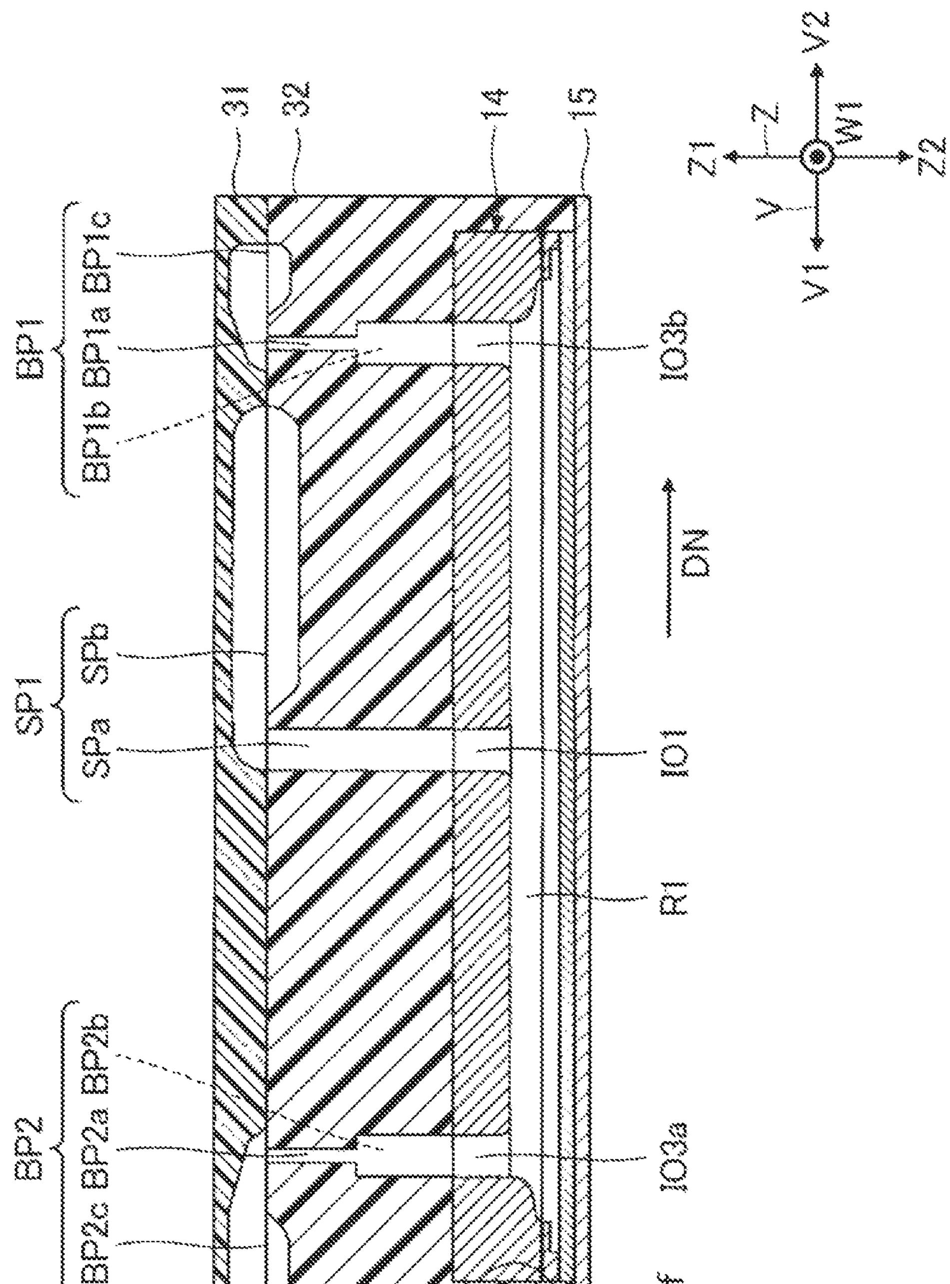
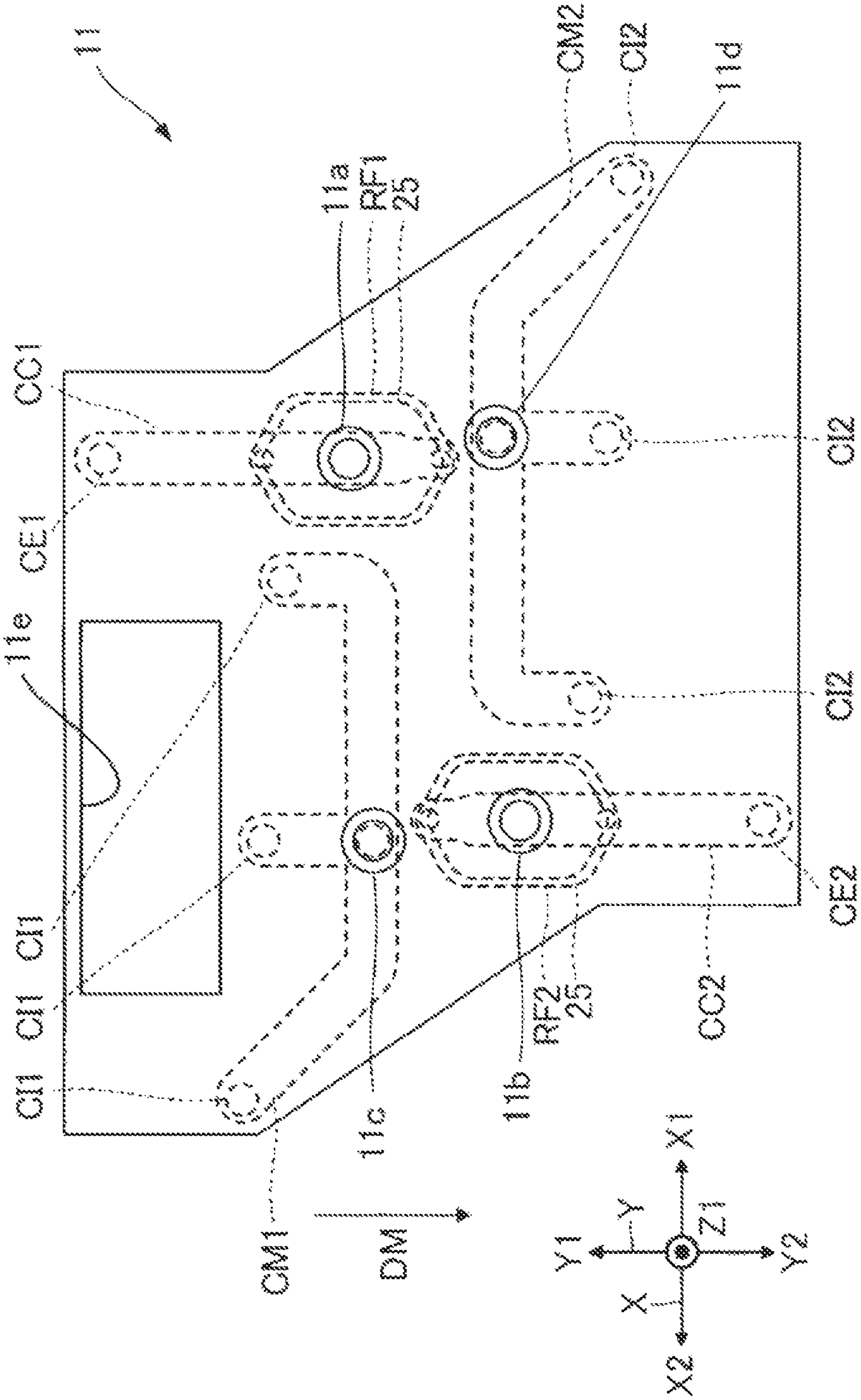

BP1
BP1b BP1a BP1c
SP1
SPa SPb
BP2
BP2c BP2a BP2b
31
32
14
15
IO3b
IO1
R1
IO3a
13f
DN
V1
V2
V
Z
Z1
Z2
W1

FIG. 11



11
11a
RF1
25
CC1
CE1
CM2
CI2
11d
CI2
CI2
11e
CI1
CI1
CI1
11c
11b
RF2
25
CC2
CE2
CM1
DM
X1
X
X2
Y
Y1
Y2
Z1

FIG. 12

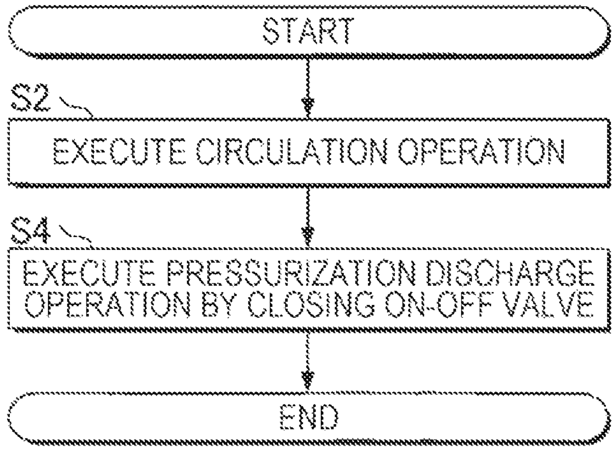

START
S2
EXECUTE CIRCULATION OPERATION
S4
EXECUTE PRESSURIZATION DISCHARGE OPERATION BY CLOSING ON-OFF VALVE
END

FIG. 13

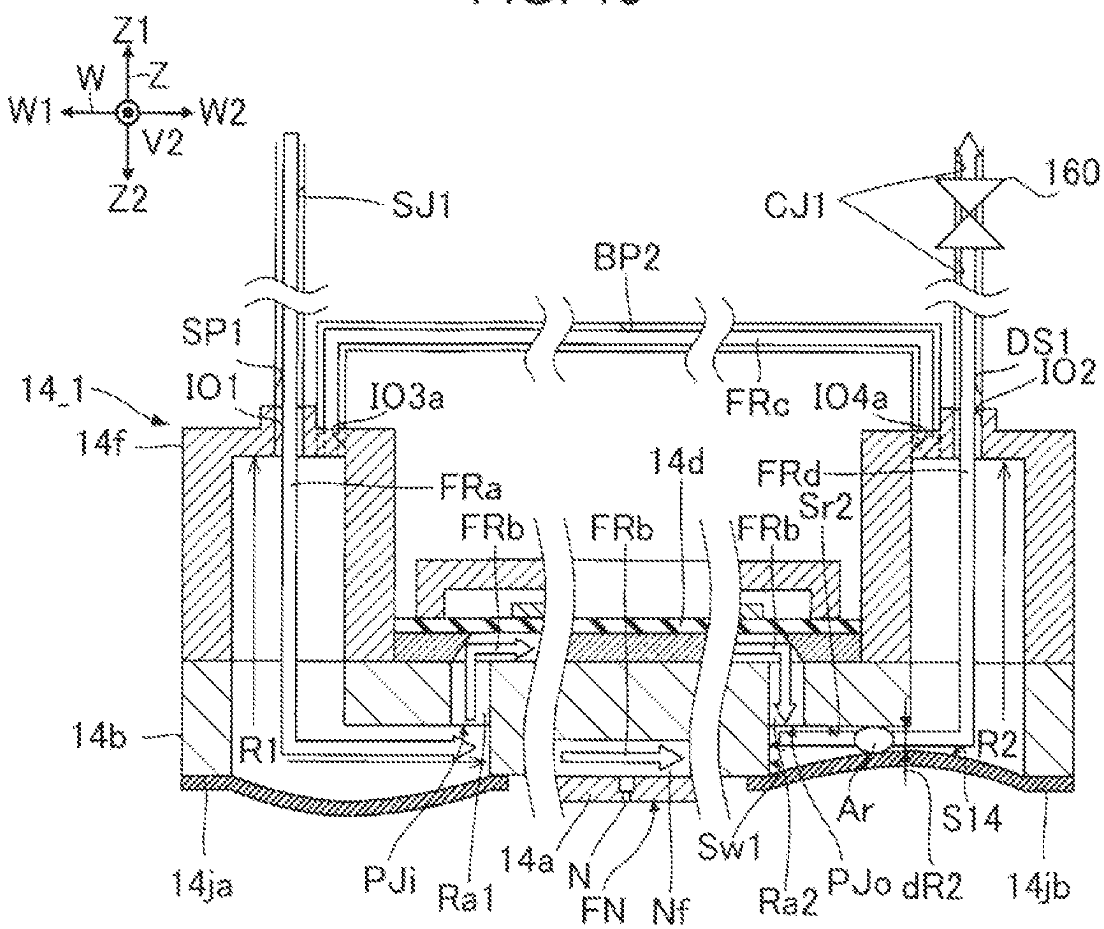
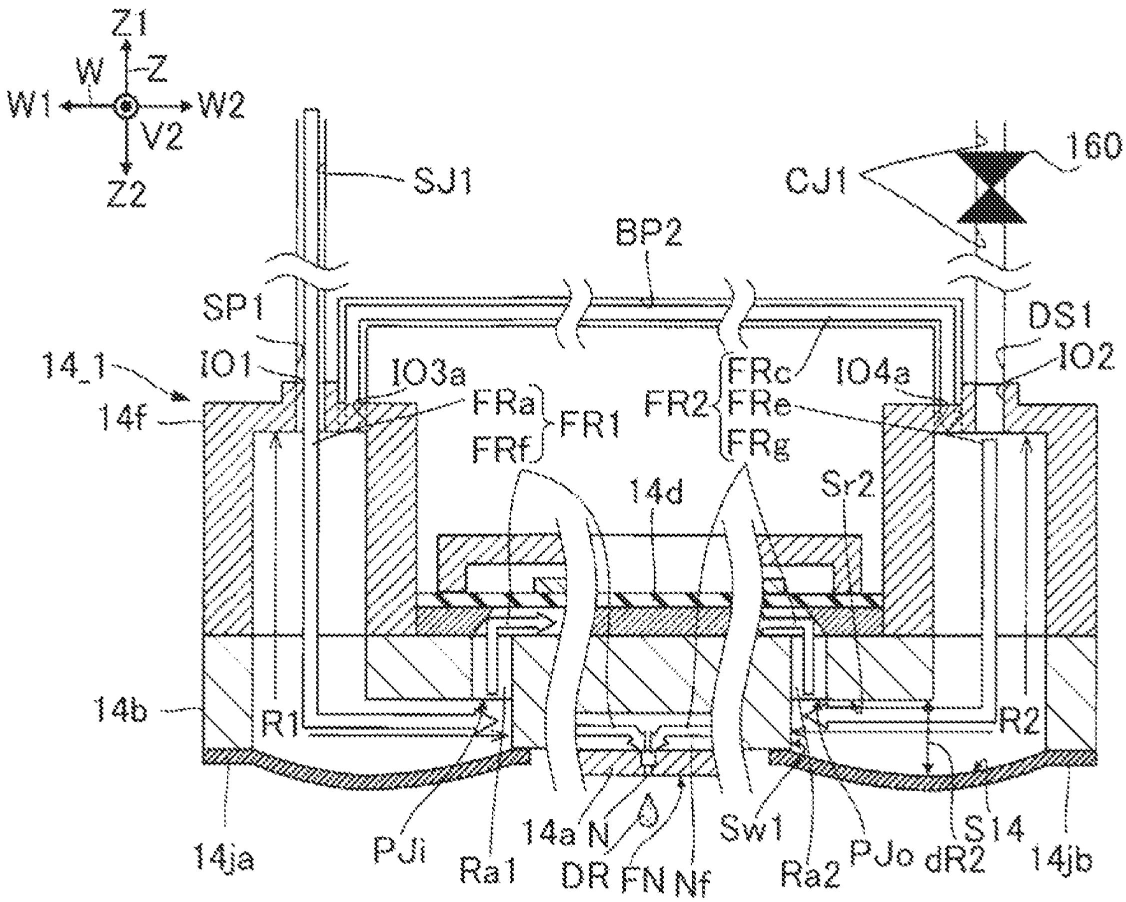
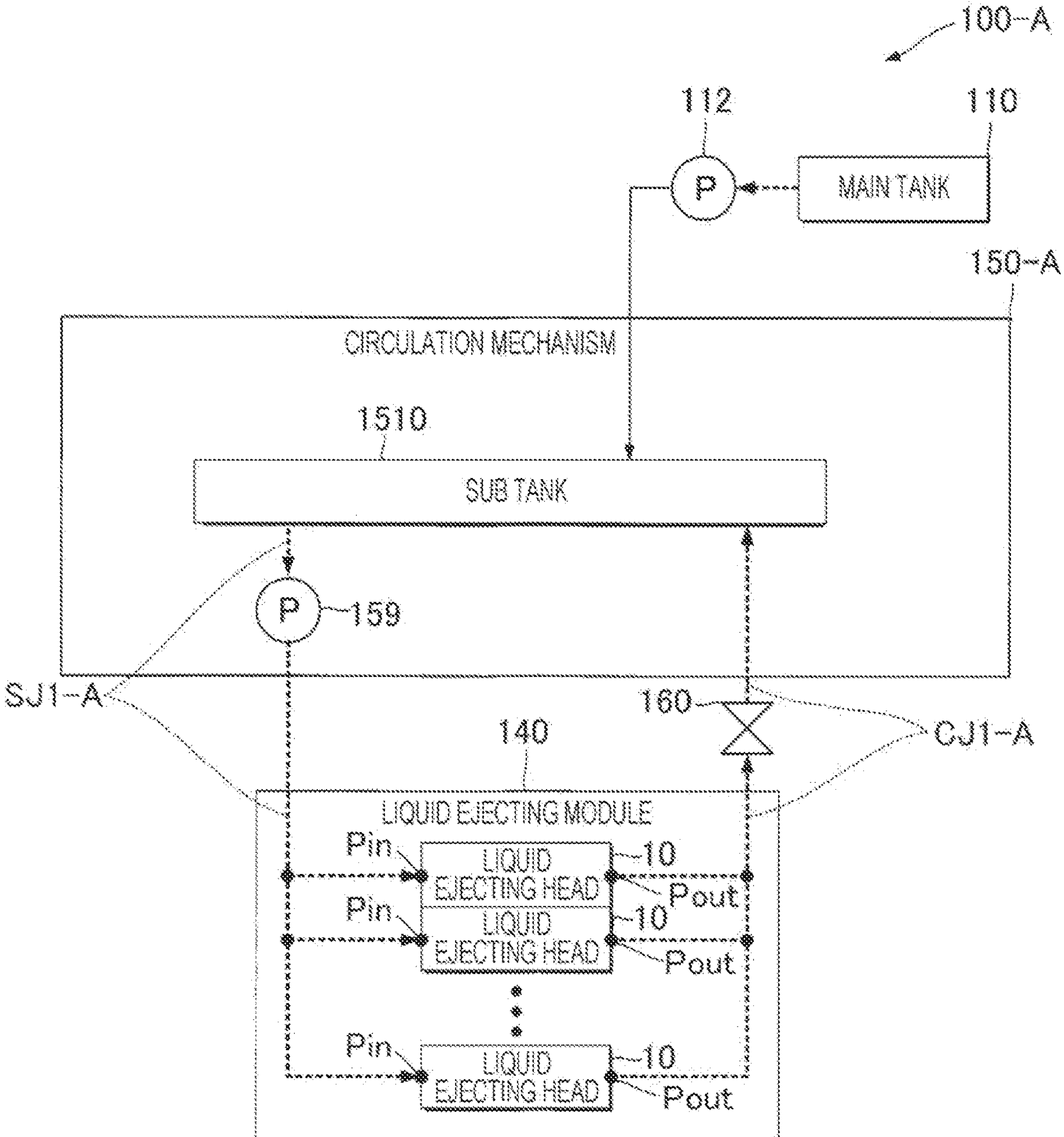

Z1
W
Z
W1
W2
V2
Z2
SJ1
CJ1
160
BP2
SP1
DS1
14_1
IO1
IO3a
FRc
IO4a
IO2
14f
FRa
14d
FRd
FRb
FRb
FRb
Sr2
14b
R1
R2
Ar
S14
14ja
PJi
Ra1
14a
N
FN
Nf
Sw1
Ra2
PJo
dR2
14jb

FIG. 14



Z1
W
Z
W1
W2
V2
Z2
SJ1
CJ1
160
BP2
SP1
DS1
14_1
IO1
IO3a
FRa
FRc
IO4a
IO2
14f
FR2
FRe
FR1
FRf
FRg
14d
Sr2
14b
R1
R2
14ja
PJi
Ra1
14a
N
DR
FN
Nf
Sw1
Ra2
PJo
dR2
S14
14jb

FIG. 15



100-A
112
110
P
MAIN TANK
150-A
CIRCULATION MECHANISM
1510
SUB TANK
P
159
SJ1-A
160
CJ1-A
140
LIQUID EJECTING MODULE
Pin
LIQUID EJECTING HEAD
10
Pout
Pin
LIQUID EJECTING HEAD
10
Pout
Pin
LIQUID EJECTING HEAD
10
Pout

FIG. 16

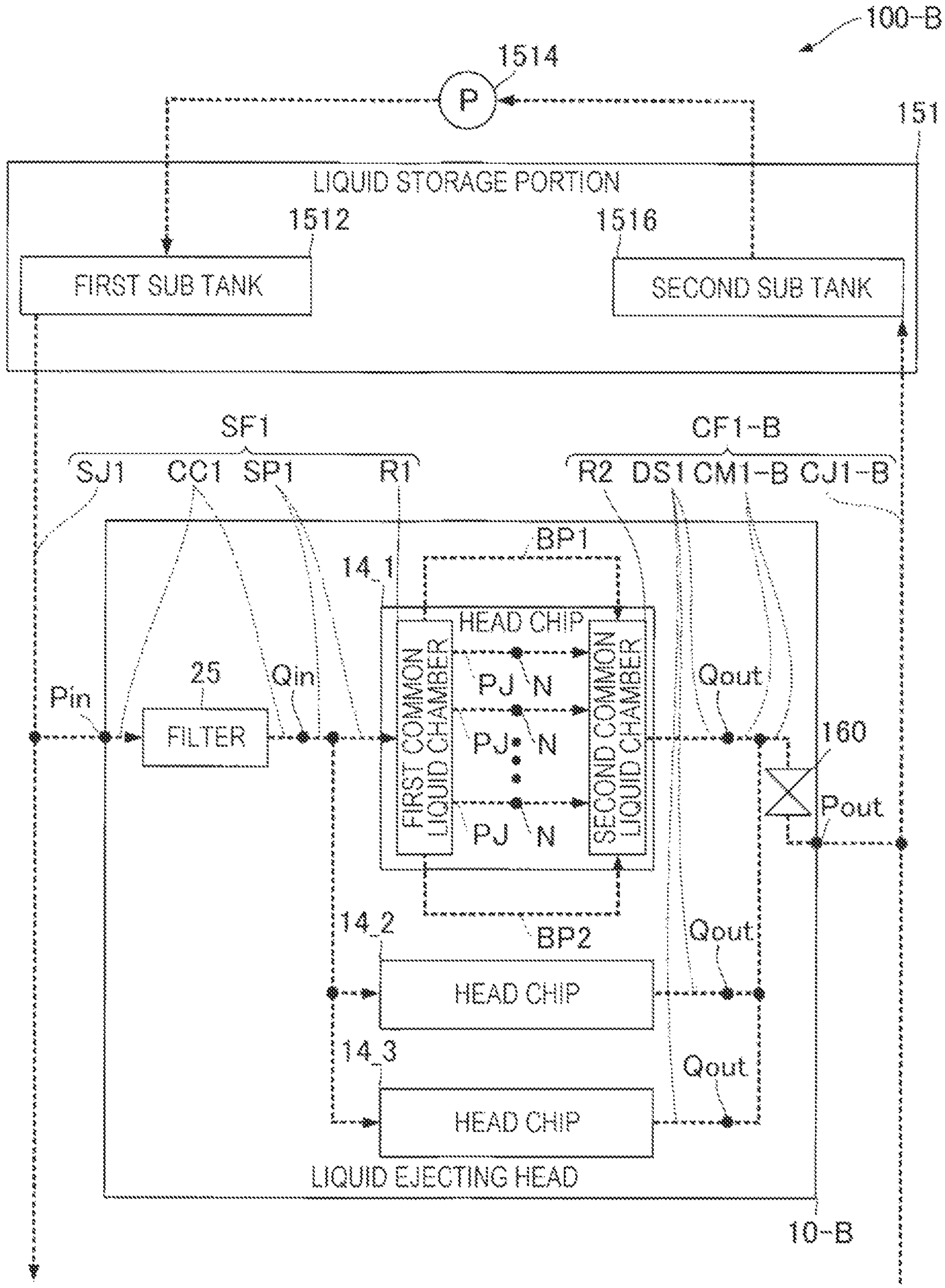
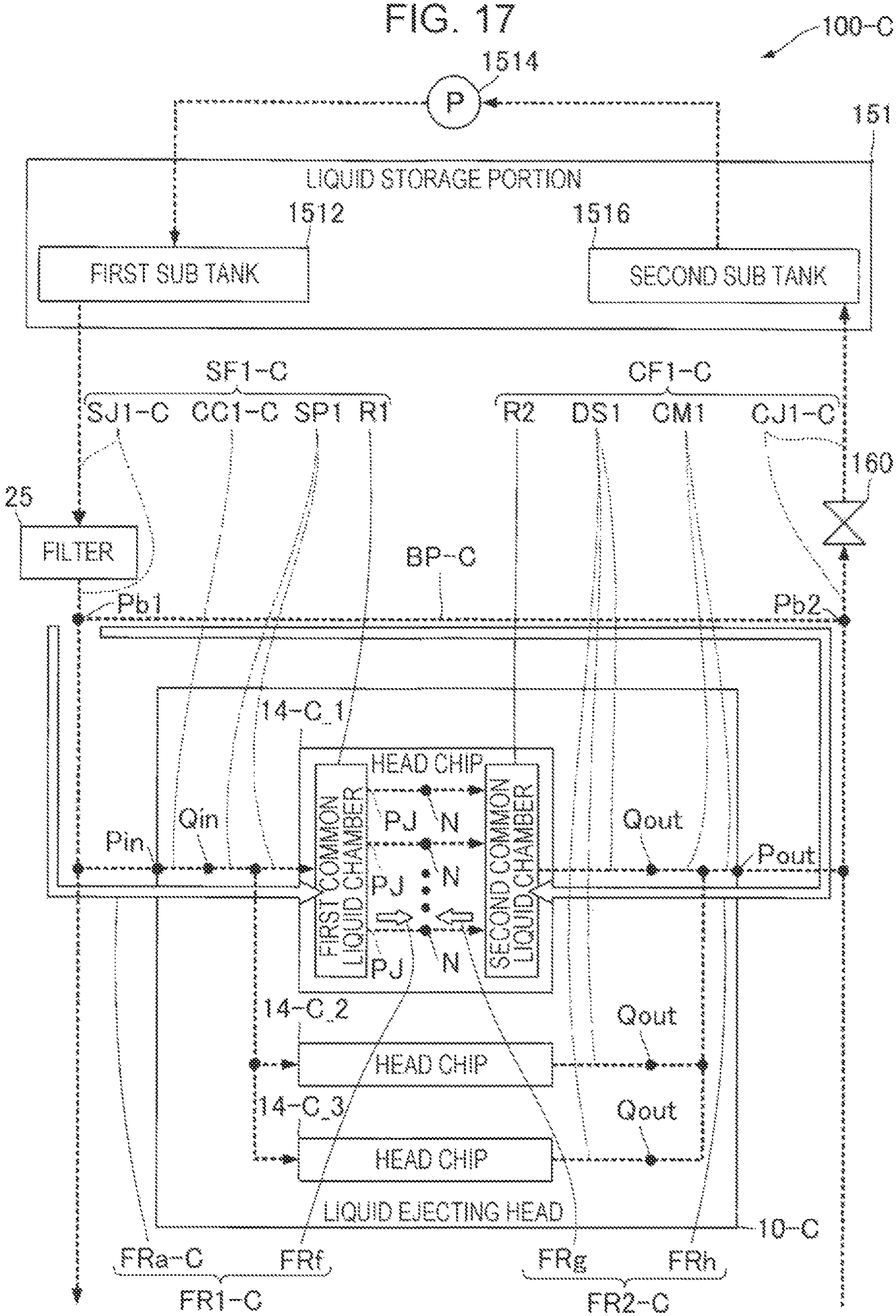

100-B
1514
P
151
LIQUID STORAGE PORTION
1512
1516
FIRST SUB TANK
SECOND SUB TANK
SF1
CF1-B
SJ1
CC1
SP1
R1
R2
DS1
CM1-B
CJ1-B
BP1
14_1
HEAD CHIP
25
Qin
Pin
FILTER
FIRST COMMON LIQUID CHAMBER
SECOND COMMON LIQUID CHAMBER
PJ
N
Qout
160
Pout
BP2
14_2
HEAD CHIP
14_3
HEAD CHIP
LIQUID EJECTING HEAD
10-B

FIG. 17



100-C
1514
P
151
LIQUID STORAGE PORTION
1512
1516
FIRST SUB TANK
SECOND SUB TANK
SF1-C
CF1-C
SJ1-C CC1-C SP1 R1
R2 DS1 CM1 CJ1-C
160
25
FILTER
BP-C
Pb1
Pb2
14-C_1
HEAD CHIP
FIRST COMMON LIQUID CHAMBER
SECOND COMMON LIQUID CHAMBER
PJ
N
Pin
Qin
Qout
Pout
14-C_2
HEAD CHIP
14-C_3
HEAD CHIP
LIQUID EJECTING HEAD
10-C
FRa-C
FRf
FRg
FRh
FR1-C
FR2-C

LIQUID EJECTING APPARATUS AND LIQUID DISCHARGING METHOD

The present application is based on, and claims priority from JP Application Serial Number 2022-085374, filed May 25, 2022, the disclosure of which is hereby incorporated by reference herein in its entirety.

BACKGROUND

1. Technical Field

The present disclosure relates to a liquid ejecting apparatus and a liquid discharging method.

2. Related Art

In the related art, a liquid ejecting apparatus that ejects liquid such as ink is known, as represented by an ink jet type printer. For example, in JP-A-2021-130258, a liquid ejecting apparatus having a plurality of individual flow paths that communicate with each of a plurality of nozzles for ejecting ink, a supply flow path that supplies liquid to each of the plurality of individual flow paths, and a recovery flow path that recovers the liquid from each of the plurality of individual flow paths is disclosed.

However, in the above-mentioned technique in the related art, even though the liquid flows in the order of the supply flow path, the individual flow path, and the recovery flow path, a bubble may stay in the recovery flow path.

SUMMARY

In order to solve the above problems, a liquid ejecting apparatus according to a preferred aspect of the present disclosure includes: a plurality of nozzles that eject liquid; a plurality of individual flow paths that communicate with each of the plurality of nozzles; a liquid storage portion that stores the liquid to be supplied to each of the plurality of nozzles; a supply flow path for supplying the liquid from the liquid storage portion to the plurality of individual flow paths; a recovery flow path for recovering the liquid from the plurality of individual flow paths to the liquid storage portion; a bypass flow path that couples the supply flow path and the recovery flow path without passing through any of the plurality of individual flow paths; and an on-off valve configured to close and open the recovery flow path, in which the on-off valve is disposed between the bypass flow path and the liquid storage portion in the recovery flow path, and a pressurization discharge operation of discharging the liquid from each of the plurality of nozzles by pressurizing the liquid in the supply flow path in a state in which the recovery flow path is closed by the on-off valve is executed.

A liquid discharging method of a liquid ejecting apparatus according to another preferred aspect of the present disclosure, the liquid ejecting apparatus including a plurality of nozzles that eject liquid, a plurality of individual flow paths that communicate with each of the plurality of nozzles, a liquid storage portion that stores the liquid to be supplied to each of the plurality of nozzles, a supply flow path for supplying the liquid from the liquid storage portion to the plurality of individual flow paths, a recovery flow path for recovering the liquid from the plurality of individual flow paths to the liquid storage portion, a bypass flow path that couples the supply flow path and the recovery flow path without passing through any of the plurality of individual flow paths, and an on-off valve configured to close and open the recovery flow path, the method includes: disposing the on-off valve between the bypass flow path and the liquid storage portion in the recovery flow path; and executing a pressurization discharge operation of discharging the liquid from each of the plurality of nozzles by pressurizing the liquid in the supply flow path in a state in which the recovery flow path is closed by the on-off valve, by the liquid ejecting apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view illustrating a configuration example of a liquid ejecting apparatus according to an embodiment.

FIG. **2** is a view illustrating a circulation mechanism and an on-off valve.

FIG. **3** is a perspective view of a liquid ejecting module.

FIG. **4** is an exploded perspective view of a liquid ejecting head illustrated in FIG. **3**.

FIG. **5** is a schematic view illustrating a flow path in the liquid ejecting apparatus.

FIG. **6** is a plan view schematically illustrating a flow path of a head chip.

FIG. **7** is a cross-sectional view of a head chip.

FIG. **8** is a plan view of a holder.

FIG. **9** is a perspective view illustrating a flow path provided in the holder and the head chip.

FIG. **10** is a cross-sectional view taken along the line X-X in FIG. **8**.

FIG. **11** is a plan view of a flow path structure.

FIG. **12** is a view illustrating a flowchart illustrating a series of processes at the time of filling ink.

FIG. **13** is a view illustrating a state of the head chip during a circulation operation.

FIG. **14** is a view illustrating a state of the head chip in a pressurization discharge operation.

FIG. **15** is a view illustrating a circulation mechanism in a first modification example.

FIG. **16** is a schematic view illustrating a flow path in a liquid ejecting apparatus in a second modification example.

FIG. **17** is a schematic view illustrating a flow path in a liquid ejecting apparatus in a third modification example.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

Hereinafter, embodiments for carrying out the present disclosure will be described with reference to the accompanying drawings. However, in each drawing, the size and scale of each portion are appropriately different from the actual ones. In addition, since the embodiments described below are preferred specific examples of the present disclosure, various technically preferable limitations are attached, but the scope of the present disclosure is not limited to the embodiments unless otherwise stated to specifically limit the present disclosure in the following description.

The following description will be given by appropriately using an X axis, a Y axis, and a Z axis which intersect with each other for convenience. In addition, one direction along the X axis is an X1 direction, and a direction opposite to the X1 direction is an X2 direction. Similarly, directions opposite to each other along the Y axis are a Y1 direction and a Y2 direction. In addition, directions opposite to each other along the Z axis are a Z1 direction and a Z2 direction.

Here, typically, the Z axis is a vertical axis, and the Z2 direction corresponds to a downward direction in the vertical direction. In other words, the Z2 direction is a gravity direction. However, the Z axis may not be a vertical axis and may be inclined with respect to the vertical axis. In addition, although the X axis, the Y axis, and the Z axis are typically orthogonal to each other, the axes are not limited thereto and may intersect at an angle within the range of, for example, 80 degrees or more and 100 degrees or less.

1. FIRST EMBODIMENT

1-1. Outline of Liquid Ejecting Apparatus **100**

FIG. **1** is a schematic view illustrating a configuration example of a liquid ejecting apparatus **100** according to an embodiment. The liquid ejecting apparatus **100** is an ink jet type printing apparatus that ejects ink which is an example of liquid onto a medium M as a droplet. The liquid ejecting apparatus **100** of the present embodiment is a so-called line type printing apparatus in which a plurality of nozzles N for ejecting the ink are distributed over the entire range in a width direction of the medium M. The medium M is typically printing paper. The medium M is not limited to the printing paper, and may be, for example, a printing target made of any material such as a resin film or cloth.

As illustrated in FIG. **1**, the liquid ejecting apparatus **100** includes a main tank **110**, a pump **112**, a control module **120**, a transport mechanism **130**, a liquid ejecting module **140** having a plurality of liquid ejecting heads **10**, a circulation mechanism **150**, and an on-off valve **160**.

The main tank **110** is a container that stores the ink. Examples of a specific aspect of the main tank **110** include a cartridge attachable to and detachable from the liquid ejecting apparatus **100**, a bag-shaped ink pack formed of a flexible film, and an ink tank replenishable with the ink. The type of ink stored in the main tank **110** is optional.

Although not illustrated in the drawing, the main tank **110** of the present embodiment includes a first liquid container and a second liquid container. The first liquid container stores a first ink. The second liquid container stores a second ink having a type different from that of the first ink. For example, the first ink and the second ink have different colors from each other. The first ink and the second ink may be the same type of ink. The pump **112** adjusts the amount of ink supplied from the main tank **110** to the circulation mechanism **150** under the control of the control module **120**. An apparatus other than the control module **120** may control the pump **112**. The pump **112** is provided for each container of the first liquid container and second liquid container described above.

The control module **120** controls an operation of each element of the liquid ejecting apparatus **100**. Specifically, the control module **120** receives image data Img indicating an image from a host computer such as a personal computer or a digital camera. Based on the received image data Img, the control module **120** supplies a drive signal Com for driving the liquid ejecting head **10** and a control signal SI for controlling the liquid ejecting head **10** to the liquid ejecting head **10**. Then, the liquid ejecting head **10** is driven by the drive signal Com under the control of the control signal SI, and ejects the ink in the Z2 direction from a part or all of the plurality of nozzles N provided in the liquid ejecting head **10**. That is, the liquid ejecting head **10** ejects the ink from a part or all of the plurality of nozzles N in conjunction with the transport of the medium M by the transport mechanism **130**, and causes the ejected ink to land on the surface of the medium M, thereby executing printing process for forming a desired image on the surface of the medium M. The nozzle N will be described later with reference to FIGS. **5**, **6**, and **7**.

The control module **120** includes, for example, one or a plurality of processing circuits such as a CPU or an FPGA, and one or a plurality of storage circuits such as a semiconductor memory. The CPU is an abbreviation of a central processing unit. The FPGA is an abbreviation of a field programmable gate array. Various programs and various data are stored in the storage circuit. The processing circuit realizes various controls by executing the programs and using the data as appropriate.

The transport mechanism **130** transports the medium M in a direction DM under control of the control module **120**. The direction DM of the present embodiment is the Y2 direction. In an example illustrated in FIG. **1**, the transport mechanism **130** includes a long transport roller along the X axis and a motor that rotates the transport roller. The transport mechanism **130** is not limited to the configuration using the transport roller, and may be configured to use, for example, a drum or an endless belt that transports the medium M in a state in which the medium M is attracted to an outer peripheral surface by electrostatic force or the like.

Under the control of the control module **120**, the liquid ejecting module **140** ejects the ink supplied from the main tank **110** via the pump **112** and the circulation mechanism **150** onto the medium M in the Z2 direction from each of the plurality of nozzles N. The liquid ejecting module **140** is a line head having a plurality of the liquid ejecting heads **10** disposed such that the plurality of nozzles N are distributed throughout the entire range of the medium M in a direction of the X axis. That is, the group of the plurality of liquid ejecting heads **10** constitutes a long line head extending in a direction along the X axis. By ejecting the ink from the plurality of liquid ejecting heads **10** in parallel with the transport of the medium M by the transport mechanism **130**, an image is formed on a surface of the medium M by the ink. The plurality of nozzles N included in one liquid ejecting head **10** may be disposed so as to be distributed throughout the entire range of the medium M in the direction along the X axis. In such a case, for example, the liquid ejecting module **140** is constituted of the one liquid ejecting head **10**.

The main tank **110** is coupled to the liquid ejecting module **140** via the circulation mechanism **150**. The circulation mechanism **150** is a mechanism that supplies the ink to each of the plurality of liquid ejecting heads **10** in the liquid ejecting module **140** under the control of the control module **120**, and that recovers the ink discharged from each of the plurality of liquid ejecting heads **10** in order to resupply the ink to the liquid ejecting head **10**. The circulation mechanism **150** and the on-off valve **160** are provided for each container of the first liquid container and second liquid container described above. By the operation of the circulation mechanism **150**, it is possible to suppress an increase in the viscosity of the ink and reduce the retention of the bubble in the ink. The circulation mechanism **150** and the on-off valve **160** will be described with reference to FIG. **2**.

1-2. Circulation Mechanism **150** and On-Off Valve **160**

FIG. **2** is a view illustrating the circulation mechanism **150** and the on-off valve **160**. Elements related to the first ink are displayed in FIG. **2**. Since the elements related to the second ink are the same as the elements related to the first ink, illustration and description thereof will be omitted.

As illustrated in FIG. **2**, the circulation mechanism **150** includes a liquid storage portion **151**, a compressor **152**, a regulator **153**, a vacuum pump **154**, a regulator **155**, a pressure sensor **156**, a pressure sensor **157**, and a pump **1514**.

The liquid storage portion **151** is coupled to a supply flow path SF**1** and a recovery flow path CF**1**, which will be described in detail later, and stores the first ink to be supplied to each of the plurality of liquid ejecting heads **10**. The liquid storage portion **151** of the present embodiment has a first sub tank **1512** coupled to the supply flow path SF**1** and a second sub tank **1516** coupled to the recovery flow path CF**1**. In the first sub tank **1512**, the first ink to be supplied to each of the plurality of liquid ejecting heads **10** is stored. In the second sub tank **1516**, the first ink recovered from each of the plurality of liquid ejecting heads **10** and the first ink replenished from the main tank **110** are stored.

The supply flow path SF**1** has an in-apparatus supply flow path SJ**1** that is coupled to the first sub tank **1512** and distributes and supplies the first ink to the plurality of liquid ejecting heads **10**, and a plurality of in-head supply flow paths which will be described in detail later. The in-apparatus supply flow path SJ**1** is a flow path provided outside the liquid ejecting head **10**, and includes a main flow portion coupled to the first sub tank **1512** and a plurality of tributary portions branched from the main flow portion for each of the plurality of in-head supply flow paths.

The recovery flow path CF**1** has an in-apparatus recovery flow path CJ**1** that is coupled to the second sub tank **1516** and recovering the first ink by merging the first ink from the plurality of liquid ejecting heads **10**, and a plurality of in-head recovery flow paths which will be described in detail later. The in-apparatus recovery flow path CJ**1** is a flow path provided outside the liquid ejecting head **10**, and includes a main flow portion coupled to the second sub tank **1516** and a plurality of tributary portions for coupling the main flow portion and each of the plurality of in-head recovery flow paths.

The on-off valve **160** is provided in the middle of the in-apparatus recovery flow path CJ**1**. The on-off valve **160** can close and open the in-apparatus recovery flow path CJ**1** under the control of the control module **120**. In the following description, closing the in-apparatus recovery flow path CJ**1** by the on-off valve **160** may be described as "closing the on-off valve **160**", and opening the in-apparatus recovery flow path CJ**1** by the on-off valve **160** may be described as "opening the on-off valve **160**". An apparatus other than the control module **120** may control the on-off valve **160**. The on-off valve **160** may be any valve as long as it can be controlled by an apparatus such as the control module **120**, and is, for example, a diaphragm valve, an electromagnetic valve, an electric valve, or the like.

In the present embodiment, the on-off valve **160** is provided in the middle of the main flow portion of the in-apparatus recovery flow path CJ**1**, but a plurality of the on-off valves **160** may be provided in the middle of each of the plurality of tributary portions of the in-apparatus recovery flow path CJ**1**.

The compressor **152** and the vacuum pump **154** generate differential pressure between the pressure in the first sub tank **1512** and the pressure in the second sub tank **1516**. In the present embodiment, the compressor **152** generates only pressure higher than pressure generated by the vacuum pump **154**. Specifically, the compressor **152** generates positive pressure higher than atmospheric pressure. The vacuum pump **154** generates negative pressure lower than the atmospheric pressure. The compressor **152** is an example of a "pressurizing mechanism". However, the pressurizing mechanism is not limited to the compressor, and may be a pump such as a tube pump, a syringe pump, or a diaphragm pump.

The regulator **153** is provided between the compressor **152** and the first sub tank **1512**. The regulator **153** adjusts the pressure generated in the compressor **152** to predetermined positive pressure under the control of the control module **120**, and supplies the predetermined positive pressure to the first sub tank **1512**. A value of the predetermined positive pressure is a value determined by a manufacturer of the liquid ejecting apparatus **100** or the like.

The regulator **155** is provided between the vacuum pump **154** and the second sub tank **1516**. The regulator **155** adjusts the pressure generated in the vacuum pump **154** to predetermined negative pressure under the control of the control module **120**, and supplies the predetermined negative pressure to the second sub tank **1516**. A value of the predetermined negative pressure is a value determined by the manufacturer of the liquid ejecting apparatus **100** or the like.

The pump **1514** is provided between the first sub tank **1512** and the second sub tank **1516**. The pump **1514** causes the first ink of the second sub tank **1516** to flow to the first sub tank **1512** under the control of the control module **120**.

The pressure sensor **156** is provided in the middle of the in-apparatus supply flow path SJ**1** between the first sub tank **1512** and the liquid supply port Pin of the liquid ejecting head **10**. The pressure sensor **156** measures the pressure of the in-apparatus supply flow path SJ**1**, and transmits the measurement information indicating the measured value which is the measurement result to the control module **120**.

The pressure sensor **157** is provided in the middle of the in-apparatus recovery flow path CJ**1** between the second sub tank **1516** and the liquid discharge port Pout of the liquid ejecting head **10**. More specifically, the pressure sensor **157** is provided between the on-off valve **160** and the second sub tank **1516**. The pressure sensor **157** measures the pressure of the in-apparatus recovery flow path CJ**1**, and transmits the measurement information indicating the measured value which is the measurement result to the control module **120**.

As described above, the first ink flows into the liquid ejecting head **10** from the first sub tank **1512** via the liquid supply port Pin, the first ink is recovered from the liquid discharge port Pout to the second sub tank **1516**, and the first ink flows into the first sub tank **1512** from the second sub tank **1516** by the pump **1514** to circulate the first ink.

The control module **120** controls the regulator **153** so that the measured value indicated by the measurement information received from the pressure sensor **156** approaches the predetermined positive pressure. Similarly, the control module **120** controls the regulator **155** so that the measured value indicated by the measurement information received from the pressure sensor **157** approaches the predetermined negative pressure.

By the control of the control module **120** described above, the control module **120** can keep the pressure of the meniscus, which is a liquid level of the nozzle N, constant while circulating the first ink via the inside of the liquid ejecting head **10**. An apparatus other than the control module **120** may control the circulation mechanism **150**.

When the first ink is ejected from the nozzle N, the sum of the first ink amount in the first sub tank **1512** and the second sub tank **1516** is reduced. Therefore, the pump **112** appropriately replenishes the first ink in the second sub tank **1516** by supplying the ink from the main tank **110** to the second sub tank **1516** under the control of the control module **120**. For example, the first ink in the second sub tank **1516** is replenished at the timing when the height of the first ink in the second sub tank **1516** is lower than a predetermined height.

1-3. Liquid Ejecting Module **140**

FIG. **3** is a perspective view of the liquid ejecting module **140**. As illustrated in FIG. **3**, the liquid ejecting module **140** has a support body **41** and the plurality of liquid ejecting heads **10**. The support body **41** is a member that supports the plurality of liquid ejecting heads **10**. In an example illustrated in FIG. **3**, the support body **41** is a plate-shaped member made of metal or the like, and is provided with mount holes **41***a* for mounting the plurality of liquid ejecting heads **10**. The plurality of liquid ejecting heads **10** are inserted into the mount holes **41***a* in a state of being lined up in a direction along the X axis. Each liquid ejecting head **10** is fixed to the support body **41** by screwing or the like. FIG. **3** illustrates two liquid ejecting heads as a representative. The number of liquid ejecting heads in the liquid ejecting module **140** is optional. In addition, the shape of the support body **41** and the like are not limited to the example illustrated in FIG. **3**, and are optional.

1-4. Liquid Ejecting Head **10**

FIG. **4** is an exploded perspective view of the liquid ejecting head **10** illustrated in FIG. **3**. As illustrated in FIG. **4**, the liquid ejecting head **10** has a flow path structure **11**, a wiring substrate **12**, a holder **13**, a plurality of head chips **14_1**, **14_2**, **14_3**, **14_4**, **14_5**, and **14_6**, a fixing plate **15**, and a base **16**. These are disposed in the order of the base **16**, the flow path structure **11**, the wiring substrate **12**, the holder **13**, the plurality of head chips **14_1**, **14_2**, **14_3**, **14_4**, **14_5**, and **14_6**, and the fixing plate **15** in the Z2 direction. Hereinafter, each portion of the liquid ejecting head **10** will be described in sequence. In the following, each of the head chips **14_1**, **14_2**, **14_3**, **14_4**, **14_5**, and **14_6** may be described as a head chip **14**.

The flow path structure **11** is a structure in which a flow path for flowing the ink between the circulation mechanism **150** and the plurality of head chips **14** are provided inside. As illustrated in FIG. **4**, the flow path structure **11** is provided with a coupling tube **11***a*, a coupling tube lib, a coupling tube **11***c*, a coupling tube **11***d*, and a hole **11***e*.

Here, although not illustrated in FIG. **4**, two in-structure supply flow paths CC**1** and CC**2** and two in-structure discharge flow paths CM**1** and CM**2** are provided inside the flow path structure **11**. Each of the in-structure supply flow paths CC**1** and CC**2** is a flow path for supplying the ink to the plurality of head chips **14**. A filter **25** for capturing foreign matter and the like is installed in the middle of each of the two in-structure supply flow paths CC**1** and CC**2**. The in-structure discharge flow paths CM**1** and CM**2** are flow paths through which the ink is discharged from the plurality of head chips **14**. The flow path of the flow path structure **11** will be described with reference to FIGS. **5** and **11** which will be described later.

The coupling tubes **11***a*, **11***b*, **11***c*, and **11***d* are tube bodies protruding in the Z1 direction. More specifically, the coupling tube **11***a* is a tube body that constitutes a flow path through which the first ink is supplied to the in-structure supply flow path CC**1**. In addition, the coupling tube **11***b* is a tube body that constitutes a flow path through which the second ink is supplied to the in-structure supply flow path CC**2**. Meanwhile, the coupling tube **11***c* is a tube body that constitutes a flow path through which the first ink is discharged from the in-structure discharge flow path CM**1**. In addition, the coupling tube **11***d* is a tube body that constitutes a flow path through which the second ink is discharged from the in-structure discharge flow path CM**2**. The hole **11***e* is a hole for inserting a connector **12***c* which will be described later. An opening of the coupling tube **11***a* is the liquid supply port Pin. An opening of the coupling tube **11***c* is the liquid discharge port Pout.

The wiring substrate **12** is a mount component that electrically couples the plurality of head chips **14** and an assembly substrate **16***b* which will be described later. The wiring substrate **12** is, for example, a rigid wiring substrate. The wiring substrate **12** is disposed between the flow path structure **11** and the holder **13**, and the connector **12***c* is installed on a surface of the wiring substrate **12** facing the flow path structure **11**. The connector **12***c* is a coupling component coupled to the assembly substrate **16***b* which will be described later. In addition, the wiring substrate **12** is provided with a plurality of holes **12***a* and a plurality of opening portions **12***b*. Each hole **12***a* is a hole for allowing coupling between the flow path structure **11** and the holder **13**. Each opening portion **12***b* is a hole through which the wiring substrate **14***h* coupling the head chip **14** and the wiring substrate **12** is passed. The wiring substrate **14***h* is coupled to a surface of the wiring substrate **12** facing the Z1 direction. The wiring substrate **14***h* is a member including wiring electrically coupled to a piezoelectric element **14***e* which will be described later, and is, for example, an FPC, a COF, or the like. The FPC is an abbreviation of flexible printed circuits. The COF is an abbreviation of a chip on film.

The holder **13** is a structure that accommodates and supports the plurality of head chips **14**. For example, the holder **13** is made of a resin material or a metal material. The holder **13** has a plate shape that extends in a direction perpendicular to the Z axis. In addition, the holder **13** is provided with a coupling tube **13***a*, a coupling tube **13***b*, a plurality of coupling tubes **13***c*, a plurality of coupling tubes **13***d*, and a plurality of wiring holes **13***e*. Although not illustrated in the drawing, a plurality of recessed portions that accommodate the plurality of head chips **14** are provided on the surface of the holder **13** facing the Z2 direction.

In the present embodiment, the holder **13** holds six head chips **14_1** to **14_6**. These head chips **14** are arranged in the X2 direction in the order of head chips **14_1**, **14_4**, **14_2**, **14_5**, **14_3**, and **14_6**. Here, the head chips **14_1** to **14_3** are disposed at positions shifted in the Y1 direction with respect to the head chips **14_4** to **14_6**. However, the head chips **14_1** to **14_6** have portions that overlap each other as viewed in the X1 direction or the X2 direction. The arrangement directions DN of the plurality of nozzles N which will be described later in the head chips **14_1** to **14_6** are parallel to each other. Furthermore, each of the head chips **14_1** to **14_6** is disposed such that the arrangement direction DN is inclined with respect to the direction DM which is the transport direction of the medium M.

Here, although not illustrated in FIG. **4**, inside the holder **13**, two in-holder supply flow paths SP**1** and SP**2**, in-holder discharge flow paths DS**1** and DS**2** for each head chip **14**, and a plurality of bypass flow paths BP**1** and BP**2** are provided. Each of the in-holder supply flow paths SP**1** and SP**2** is a flow path having a branch for supplying ink to the plurality of head chips **14**. The in-holder discharge flow paths DS**1** and DS**2** are flow paths for introducing the ink discharged from the head chip **14** into the in-structure discharge flow path CM**1** of the flow path structure **11**. The bypass flow paths BP**1** and BP**2** are provided for each head chip **14**, and are bypass flow paths through which a first common liquid chamber R**1** communicates with a second common liquid chamber R**2** which will be described later. The flow path of the holder **13** will be described with reference to FIGS. **6** to **8** which will be described later.

In the present embodiment, among the head chips **14_1** to **14_6**, the first ink is supplied to the head chips **14_1** to **14_3**, and the second ink is supplied to the head chips **14_4** to **14_6**.

The coupling tubes **13***a*, **13***b*, **13***c*, and **13***d* are tubular protrusions protruding in the Z1 direction. More specifically, the coupling tube **13***a* is a tube body that constitutes a flow path for supplying the first ink to the in-holder supply flow path SP**1**, and communicates with the in-structure supply flow path CC**1** of the flow path structure **11**. In addition, the coupling tube **13***b* is a tube body that constitutes a flow path for supplying the second ink to the in-holder supply flow path SP**2**, and communicates with the in-structure supply flow path CC**2** of the flow path structure **11**. Meanwhile, the coupling tube **13***c* is a tube body that constitutes a flow path for discharging the first ink to the in-holder discharge flow path DS**1**, and communicates with the in-structure discharge flow path CM**1** of the flow path structure **11**. In addition, the coupling tube **13***d* is a tube body that constitutes a flow path for discharging the second ink to the in-holder discharge flow path DS**2**, and communicates with the in-structure discharge flow path CM**2** of the flow path structure **11**. The wiring hole **13***e* is a hole through which the wiring substrate **14***h* coupling the head chip **14** and the wiring substrate **12** is passed.

Each head chip **14** ejects the ink. Specifically, although not illustrated in FIG. **4**, each head chip **14** has a plurality of nozzles N for ejecting the first ink and a plurality of nozzles N for ejecting the second ink. The nozzles N are provided on a nozzle surface FN, which is a surface of each head chip **14** facing the Z2 direction. Details of the head chip **14** will be described with reference to FIG. **7**, which will be described later.

The fixing plate **15** is a plate member which fixes the plurality of head chips **14** to the holder **13**. Specifically, the fixing plate **15** is disposed in a state in which the plurality of head chips **14** are sandwiched between the fixing plate **15** and the holder **13**, and is fixed to the holder **13** with an adhesive. The fixing plate **15** is made of, for example, a metal material. The fixing plate **15** is provided with a plurality of opening portions **15***a* for exposing the nozzles N of the plurality of head chips **14**. In an example illustrated in FIG. **4**, the plurality of opening portions **15***a* are individually provided for each head chip **14**.

The base **16** is a member which fixes the flow path structure **11**, the wiring substrate **12**, the holder **13**, the plurality of head chips **14**, and the fixing plate **15** to the above-mentioned support body **41**. The base **16** has a main body **16***a*, the assembly substrate **16***b*, and a cover **16***c*.

The main body **16***a* holds the flow path structure **11** and the wiring substrate **12** disposed between the base **16** and the holder **13** by being fixed to the holder **13** by screwing or the like. The main body **16***a* is made of, for example, a resin material or the like. The main body **16***a* has a plate-shaped portion facing the plate-shaped portion of the flow path structure **11** described above, and the plate-shaped portion is provided with a plurality of holes **16***d* into which the coupling tubes **11***a*, **11***b*, **11***c*, and **11***d* described above are inserted. The main body **16***a* has a portion extending in the Z2 direction from the plate-shaped portion, and a tip of the portion is provided with a flange **16***e* to be fixed to the support body **41** described above.

The assembly substrate **16***b* is a mount component for electrically coupling the control module **120** and the wiring substrate **12** described above. The assembly substrate **16***b* is, for example, a rigid wiring substrate. The cover **16***c* is a plate-shaped member which protects the assembly substrate **16***b* and fixes the assembly substrate **16***b* to the main body **16***a*. The cover **16***c* is made of, for example, a resin material or the like, and is fixed to the main body **16***a* by screwing or the like.

1-5. Flow Path in Liquid Ejecting Apparatus **100**

FIG. **5** is a schematic view illustrating the flow path in the liquid ejecting apparatus **100**. FIG. **5** illustrates the flow path through which the first ink flows. As described above, among the head chips **14_1** to **14_6**, the head chips **14** to which the first ink is supplied are the head chips **14_1** to **14_3**. Therefore, in FIG. **5**, the head chips **14_1** to **14_3** are displayed inside the liquid ejecting head **10**. Since the flow path through which the second ink flows is the same as the flow path through which the first ink flows, the illustration and description thereof will be omitted.

As illustrated in FIG. **5**, the liquid ejecting apparatus **100** has a plurality of individual flow paths PJ communicating with each of the plurality of nozzles N, a liquid storage portion **151**, a supply flow path SF**1** for supplying the first ink from the liquid storage portion **151** to the plurality of individual flow paths PJ, a recovery flow path CF**1** for recovering the first ink from the plurality of individual flow paths PJ to the liquid storage portion **151**, the bypass flow paths BP**1** and BP**2** that couple the supply flow path SF**1** and the recovery flow path CF**1** without passing through any of the plurality of individual flow paths PJ, and the on-off valve **160** that can close and open the recovery flow path CF**1**. In the following description, the bypass flow paths BP**1** and BP**2** may be collectively referred to as the bypass flow path BP. As illustrated in FIG. **5**, the on-off valve **160** is disposed between the bypass flow path BP and the liquid storage portion **151** in the recovery flow path CF**1**. The plurality of individual flow paths PJ and the plurality of nozzles N have a one-to-one correspondence with each other. The individual flow path PJ will be described with reference to FIG. **6**.

As described above, since the compressor **152** generates only pressure higher than the pressure generated by the vacuum pump **154**, the ink in the supply flow path SF**1** flows only in a direction in which the first ink flows from the liquid storage portion **151** to the plurality of individual flow paths PJ via the supply flow path SF**1**.

As illustrated in FIG. **5**, the supply flow path SF**1** for supplying the first ink includes the in-apparatus supply flow path SJ**1** illustrated in FIG. **2** and the in-head supply flow path described above. The in-head supply flow path includes the in-structure supply flow path CC**1**, the in-holder supply flow path SP**1**, and the first common liquid chamber R**1** of each of the head chips **14_1** to **14_3**. In addition, the recovery flow path CF**1** has the in-apparatus recovery flow path CJ**1** illustrated in FIG. **2** and the in-head discharge flow path described above. The in-head discharge flow path includes the second common liquid chamber R**2** of each of the head chips **14_1** to **14_3**, the in-holder discharge flow path DS**1**, and the in-structure discharge flow path CM**1**.

The in-structure supply flow path CC**1** is a flow path for supplying the first ink introduced from the liquid supply port Pin of the coupling tube **11***a* to the in-holder supply flow path SP**1**. As illustrated in FIG. **5**, a filter **25** is provided in the in-structure supply flow path CC**1**. As illustrated in FIG. **5**, the bypass flow path BP is provided downstream of the filter **25**.

The in-holder supply flow path SP**1** is a flow path for supplying the first ink introduced from the in-structure supply flow path CC**1** via a liquid supply port Qin of the coupling tube **13***a* to the head chips **14_1** to **14_3**. The liquid supply port Qin is an opening of the coupling tube **13***a* illustrated in FIG. **4**. The in-holder supply flow path SP**1** has three branched portions for supplying the first ink to the head chips **14_1** to **14_3**.

The first common liquid chamber R**1** stores the first ink to be supplied to each individual flow path PJ. The first common liquid chamber R**1** stores the first ink supplied from the in-holder supply flow path SP**1**. The second common liquid chamber R**2** stores the first ink discharged from each individual flow path PJ without being ejected. The first common liquid chamber R**1** and the second common liquid chamber R**2** communicate with each other via the plurality of individual flow paths PJ. In addition, the bypass flow paths BP**1** and BP**2** are coupled to the first common liquid chamber R**1** and the second common liquid chamber R**2**. The bypass flow paths BP**1** and BP**2** are flow paths that bypass the plurality of individual flow paths PJ and through which the first common liquid chamber R**1** communicates with the second common liquid chamber R**2**, and are provided in the holder **13**. The bypass flow path BP is not provided with the nozzle N. Details of the bypass flow paths BP**1** and BP**2** will be described with reference to FIGS. **6**, **8**, **9**, and **10** which will be described later.

The in-holder discharge flow path DS**1** is provided for each head chip **14** that uses the first ink, and is a flow path for discharging the first ink introduced from the head chip **14** from a liquid discharge port Qout of the coupling tube **13***c*. The liquid discharge port Qout is an opening of the coupling tube **13***c* illustrated in FIG. **4**.

The in-structure discharge flow path CM**1** is a flow path for supplying the first ink introduced from the in-holder discharge flow path DS**1** via the liquid discharge port Qout to the in-apparatus recovery flow path CJ**1**.

The circulation mechanism **150** executes a circulation operation of circulating the first ink in the order of the liquid storage portion **151**, the supply flow path SF**1**, the individual flow path PJ, the recovery flow path CF**1**, and the liquid storage portion **151**. That is, the liquid storage portion **151**, the supply flow path SF**1**, the individual flow path PJ, and the recovery flow path CF**1** constitute a circulation path through which the first ink circulates. The upstream in the present specification means an upstream portion of the circulation path in the circulation operation unless otherwise specified. The downstream in the present specification means a downstream of the circulation path in the circulation operation unless otherwise specified. That is, a coupling position between the liquid storage portion **151** (first sub tank **1512**) and the supply flow path SF**1** is the most upstream position in the circulation path, and a coupling position between the liquid storage portion **151** (second sub tank **1516**) and the recovery flow path CF**1** is the most downstream position. Therefore, in the first embodiment, when one element of the two elements is close to the first sub tank **1512** with respect to the other element, it means that one element is located upstream with respect to the other element. Similarly, when one element of the two elements is close to the second sub tank **1516** with respect to the other element, it means that one element is located downstream with respect to the other element.

1-6. Head Chip **14**

FIG. **6** is a plan view schematically illustrating the flow path of the head chip **14_1**. The following description will be given by appropriately using a V axis and a W axis in addition to the X axis, the Y axis, and the Z axis for convenience. In addition, one direction along the V axis is a V1 direction, and a direction opposite to the V1 direction is a V2 direction. Similarly, the directions opposite to each other along the W axis are a W1 direction and a W2 direction.

Here, the V axis is an axis along an arrangement direction of the plurality of nozzles N which will be described later, and is an axis that is obtained by rotating the Y axis around the Z axis at a predetermined angle. The W axis is an axis that is obtained by rotating the X axis around the Z axis at the predetermined angle. Therefore, the V axis and the W axis are typically orthogonal to each other, but are not limited to this, and may intersect at an angle within a range of, for example, 80 degrees or more and 100 degrees or less. In addition, the predetermined angle, that is, the angle which is formed by the V axis and the Y axis, or the angle which is formed by the W axis and the X axis is, for example, within a range of 40 degrees or more and 60 degrees or less.

In FIG. **6**, among the head chips **14_1** to **14_6**, the flow path of the head chip **14_1** is illustrated as a representative.

As illustrated in FIG. **6**, the head chip **14** is provided with the plurality of nozzles N, a plurality of individual flow paths PJ, the first common liquid chamber R**1**, and the second common liquid chamber R**2**. As illustrated by a chain double-dashed line in FIG. **6**, the bypass flow paths BP**1** and BP**2** are coupled to the first common liquid chamber R**1** and the second common liquid chamber R**2**.

The head chip **14** has a surface facing the medium M, and as illustrated in FIG. **6**, the plurality of nozzles N are provided on the surface. The plurality of nozzles N are arranged along the V axis. Each of the plurality of nozzles N ejects the ink in the Z2 direction.

Here, a set of the plurality of nozzles N constitutes a nozzle row Ln. In addition, the plurality of nozzles N are arranged at equal intervals at a predetermined pitch. The predetermined pitch is a distance between the centers of the plurality of nozzles N in the direction along the V axis.

The individual flow path PJ communicates with each of the plurality of nozzles N. Each of the plurality of individual flow paths PJ extends along the W axis and communicates with the nozzles N that are different from each other. The plurality of individual flow paths PJ are arranged along the V axis.

As illustrated in FIG. **6**, each individual flow path PJ has a pressure chamber Ca, a pressure chamber Cb, a nozzle flow path Nf, an individual supply flow path Ra**1**, an individual discharge flow path Ra**2**, a first communication flow path Na**1**, and a second communication flow path Na**2**.

Each of the pressure chamber Ca and the pressure chamber Cb in each individual flow path PJ extends along the W axis and is a space in which the ink ejected from the nozzle N communicating with the individual flow path PJ is stored. In an example illustrated in FIG. **6**, the plurality of pressure chambers Ca are arranged along the V axis. Similarly, a plurality of the pressure chambers Cb are arranged along the V axis. In each individual flow path PJ, positions of the pressure chamber Ca and the pressure chamber Cb in the direction along the V axis are the same in the example illustrated in FIG. **6**, but may be different from each other. In the following, when the pressure chamber Ca and the pressure chamber Cb are not particularly distinguished, each pressure chamber may be referred to as "pressure chamber C".

The nozzle flow path Nf is disposed between the pressure chamber Ca and the pressure chamber Cb in each individual flow path PJ. Here, the pressure chamber Ca communicates with the nozzle flow path Nf via the first communication flow path Na**1** which extends along the Z axis. The pressure chamber Cb communicates with the nozzle flow path Nf via the second communication flow path Na**2** which extends along the Z axis.

In each individual flow path PJ, the nozzle flow path Nf is a space which extends along the W axis. In addition, the plurality of nozzle flow paths Nf are arranged along the V axis at intervals from each other. The nozzle N is provided in each nozzle flow path Nf. In each nozzle flow path Nf, the ink is ejected from the nozzle N by changing the pressure in the pressure chamber Ca and the pressure chamber Cb described above.

Each of the first communication flow path Na**1** and the second communication flow path Na**2** is a space which extends along the Z axis. The first communication flow path Na**1** and the second communication flow path Na**2** may be provided as necessary, and may be removed.

The first common liquid chamber R**1** and the second common liquid chamber R**2** communicate with the plurality of individual flow paths PJ. Here, the pressure chamber Ca communicates with the first common liquid chamber R**1** via the individual supply flow path Ra**1** which extends along the Z axis. The pressure chamber Cb communicates with the second common liquid chamber R**2** via the individual discharge flow path Ra**2** which extends along the Z axis.

Each of the first common liquid chamber R**1** and the second common liquid chamber R**2** is a space which extends along the V axis throughout the entire range in which the plurality of nozzles N are distributed. Here, the first common liquid chamber R**1** is coupled to an end of each individual flow path PJ in the W2 direction. The first common liquid chamber R**1** stores the ink for supplying to each individual flow path PJ. Meanwhile, the second common liquid chamber R**2** is coupled to an end of each individual flow path PJ in the W1 direction. The second common liquid chamber R**2** stores the ink discharged from each individual flow path PJ without being ejected.

The first common liquid chamber R**1** is provided with a supply port IO**1**, a discharge port IO**3***a*, and a discharge port IO**3***b*. The supply port IO**1** is a tube path for introducing the ink from the in-holder supply flow path SP**1** of the holder **13** into the first common liquid chamber R**1**. The discharge port IO**3***a* is a tube path for discharging the ink from the first common liquid chamber R**1** to the bypass flow path BP**1**. The discharge port IO**3***b* is a tube path for discharging the ink from the first common liquid chamber R**1** to the bypass flow path BP**2**.

Here, the in-holder supply flow path SP**1** is coupled to the circulation mechanism **150** via the in-structure supply flow path CC**1** of the flow path structure **11**.

The second common liquid chamber R**2** is provided with a discharge port **102**, an introduction port IO**4***a*, and an introduction port IO**4***b*. The discharge port **102** is a tube path for discharging the ink from the second common liquid chamber R**2** to the in-holder discharge flow path DS**1** of the holder **13**. The introduction port IO**4***a* is a tube path for introducing the ink from the bypass flow path BP**1** to the second common liquid chamber R**2**. The introduction port IO**4***b* is a tube path for introducing the ink from the bypass flow path BP**2** into the second common liquid chamber R**2**.

Here, the in-holder discharge flow path DS**1** is coupled to the circulation mechanism **150** via the in-structure discharge flow path CM**1** of the flow path structure **11**.

FIG. **7** is a cross-sectional view of the head chip **14**. FIG. **7** illustrates a cross section of the head chip **14** which is cut in a plane including the W axis and the Z axis. As illustrated in FIG. **7**, the head chip **14** has a nozzle substrate **14***a*, a flow path substrate **14***b*, a pressure chamber substrate **14***c*, a vibration plate **14***d*, a plurality of piezoelectric elements **14***e*, a case **14***f*, a protective plate **14***g*, a wiring substrate **14***h*, a flexible member **14***ja*, and a flexible member **14***jb*.

The nozzle substrate **14***a*, the flow path substrate **14***b*, the pressure chamber substrate **14***c*, and the vibration plate **14***d* are laminated in this order in the Z1 direction. Each of the members extends along the V axis and is manufactured, for example, by processing a silicon single crystal substrate using a semiconductor processing technique. The members are bonded to each other by an adhesive or the like. It should be noted that another layer such as an adhesive layer or a substrate may be appropriately interposed between two adjacent members among the members.

The plurality of nozzles N are provided on the nozzle substrate **14***a*. Each of the plurality of nozzles N penetrates the nozzle substrate **14***a* and is a through hole through which the ink passes. The plurality of nozzles N are arranged in the direction along the V axis.

The flow path substrate **14***b* is provided with a part of each of the first common liquid chamber R**1** and the second common liquid chamber R**2** and a portion of the plurality of individual flow paths PJ excluding the pressure chamber Ca and the pressure chamber Cb. That is, the flow path substrate **14***b* is provided with the nozzle flow path Nf, the first communication flow path Na**1**, the second communication flow path Na**2**, the individual supply flow path Ra**1**, and the individual discharge flow path Ra**2**.

A part of each of the first common liquid chamber R**1** and the second common liquid chamber R**2** is a space for penetrating the flow path substrate **14***b*. The flexible members **14***ja* and **14***jb* that blocks the opening by the space are installed on the surface of the flow path substrate **14***b* facing the Z2 direction. In the following description, the flexible members **14***ja* and **14***jb* may be collectively referred to as the flexible member **14***j*.

The flexible member **14***j* is a layered member made of an elastic material. One surface of the flexible member **14***ja* defines a part of the first common liquid chamber R**1** and the other surface of the flexible member **14***ja* faces a space open to the atmosphere, so that the flexible member **14***ja* absorbs the pressure fluctuation in the first common liquid chamber R**1**. A surface S**14** which is one surface of the flexible member **14***jb* defines a part of the second common liquid chamber R**2** and the other surface of the flexible member **14***jb* faces a space open to the atmosphere, so that the flexible member **14***jb* absorbs the pressure fluctuation in the second common liquid chamber R**2**. Since the flexible member **14***j* absorbs the pressure fluctuations of the first common liquid chamber R**1** and the second common liquid chamber R**2**, these pressure fluctuations are less likely to reach the pressure chamber C. By making it difficult for the pressure fluctuations to reach the pressure chamber C, it is possible to improve the quality of the image formed on the medium M.

A width dR**2** from a wall surface of the second common liquid chamber R**2** in the Z1 direction in the flow path substrate **14***b* to the flexible member **14***jb* along the Z axis is, for example, about 200 μm in a state in which the flexible member **14***jb* is not deformed. "μm" indicates micrometer.

The nozzle flow path Nf is a space in a groove provided on a surface of the flow path substrate **14***b* facing the Z2 direction. Here, the nozzle substrate **14***a* constitutes a part of the wall surface of the nozzle flow path Nf.

Each of the first communication flow path Na**1** and the second communication flow path Na**2** is a space for penetrating the flow path substrate **14***b*.

Each of the individual supply flow path Ra**1** and the individual discharge flow path Ra**2** is a space for penetrating the flow path substrate **14***b*. The individual supply flow path Ra**1** causes the first common liquid chamber R**1** to communicate with the pressure chamber Ca so as to supply the ink from the first common liquid chamber R**1** to the pressure chamber Ca. Here, one end of the individual supply flow path Ra**1** is opened on a surface of the flow path substrate **14***b* facing the Z1 direction. On the other hand, the other end of the individual supply flow path Ra**1** is an upstream end of the individual flow path PJ and is an opening PJi on the wall surface of the first common liquid chamber R**1** in the flow path substrate **14***b*. On the other hand, the individual discharge flow path Ra**2** causes the second common liquid chamber R**2** to communicate with the pressure chamber Cb so as to discharge the ink from the pressure chamber Cb to the second common liquid chamber R**2**. Here, one end of the individual discharge flow path Ra**2** is opened on the surface of the flow path substrate **14***b* facing the Z1 direction. On the other hand, the other end of the individual discharge flow path Ra**2** is a downstream end of the individual flow path PJ, and is an opening PJo of the wall surface of the second common liquid chamber R**2** in the flow path substrate **14***b*. The width dRa of the individual discharge flow path Ra**2** along the W axis is, for example, from 120 μm to 130 μm.

The pressure chamber substrate **14***c* is provided with the pressure chambers Ca and the pressure chambers Cb of the plurality of individual flow paths PJ. Each of the pressure chamber Ca and the pressure chamber Cb penetrates the pressure chamber substrate **14***c* and is a gap between the flow path substrate **14***b* and the vibration plate **14***d*.

The vibration plate **14***d* is a plate-shaped member which can elastically vibrate. The vibration plate **14***d* is a laminate including, for example, a first layer made of silicon oxide (SiO_2) and a second layer made of zirconium oxide (ZrO_2). Here, another layer such as a metal oxide may be interposed between the first layer and the second layer. A part or all of the vibration plate **14***d* may be integrally made of the same material as the pressure chamber substrate **14***c*. For example, the vibration plate **14***d* and the pressure chamber substrate **14***c* can be integrally formed by selectively removing a part in a thickness direction of the region corresponding to the pressure chamber C in the plate-shaped member having a predetermined thickness. In addition, the vibration plate **14***d* may be constituted of a layer of a single material.

The plurality of piezoelectric elements **14***e* corresponding to the pressure chambers C different from each other are installed on a surface of the vibration plate **14***d* facing the Z1 direction. Each piezoelectric element **14***e* is configured by, for example, laminating a first electrode and a second electrode facing each other and a piezoelectric layer disposed between the two electrodes. Each piezoelectric element **14***e* fluctuates the pressure of the ink in the pressure chamber C to eject the ink in the pressure chamber C from the nozzle N. When the drive signal Com is supplied, the piezoelectric element **14***e* vibrates the vibration plate **14***d* with its own deformation. With the vibration, the pressure chamber C expands and contracts such that the pressure of the ink in the pressure chamber C fluctuates. The piezoelectric element **14***e* is an example of a drive element. However, the head chip **14** may have a heat generating element instead of the piezoelectric element **14***e*.

The case **14***f* is a case that stores the ink. The case **14***f* is provided with a space constituting a remaining portion other than a part provided on the flow path substrate **14***b* for each of the first common liquid chamber R**1** and the second common liquid chamber R**2**.

The protective plate **14***g* is a plate-shaped member installed on the surface of the vibration plate **14***d* facing the Z1 direction, protects the plurality of piezoelectric elements **14***e*, and reinforces the mechanical strength of the vibration plate **14***d*. Here, a space for accommodating the plurality of piezoelectric elements **14***e* is formed between the protective plate **14***g* and the vibration plate **14***d*.

The wiring substrate **14***h* is mounted on the surface of the vibration plate **14***d* facing the Z1 direction, and is a mount component that electrically couples the control module **120** and the head chip **14**. For example, a flexible wiring substrate **14***h* such as a flexible printed circuit (FPC) and a flexible flat cable (FFC) is preferably used. The drive circuit **14***i* described above is mounted on the wiring substrate **14***h*.

In the head chip **14** having the above-described configuration, the ink flows to the first common liquid chamber R**1**, the individual supply flow path Ra**1**, the pressure chamber Ca, the nozzle flow path Nf, the pressure chamber Cb, and the individual discharge flow path Ra**2** and the second common liquid chamber R**2**, in this order, by the operation of the circulation mechanism **150** described above.

The pressure of the pressure chamber Ca and the pressure chamber Cb is caused to fluctuate by simultaneously driving the piezoelectric element **14***e* corresponding to both the pressure chamber Ca and the pressure chamber Cb by the drive signal Com from the drive circuit **14***i*. Thereby, the ink is ejected from the nozzle N in accordance with the pressure fluctuation thereof.

1-7. Holder **13**

FIG. **8** is a plan view of the holder **13**. FIG. **9** is a perspective view illustrating the flow path provided in the holder **13** and the head chip **14**. In FIG. **8**, an example of the structure inside the holder **13** as viewed in the Z2 direction is illustrated by a broken line. In FIG. **9**, in addition to the flow path of the holder **13** and the plurality of head chips **14**, the fixing plate **15** is illustrated.

As illustrated in FIGS. **8** and **9**, inside the holder **13**, the in-holder supply flow path SP**1**, the in-holder supply flow path SP**2**, three in-holder discharge flow paths DS**1**, three in-holder discharge flow paths DS**2**, six bypass flow paths BP**1**, and six bypass flow paths BP**2** are provided.

The in-holder supply flow path SP**1** is a flow path having three branched portions for supplying the first ink introduced into the coupling tube **13***a* to the three head chips **14**. The in-holder supply flow path SP**2** is a flow path having three branched portions for supplying the second ink introduced into the coupling tube **13***b* to the three head chips **14**.

The in-holder discharge flow path DS**1** is provided for each head chip **14** that uses the first ink, and is a flow path for discharging the first ink introduced from the head chip **14** from the coupling tube **13***c*. The in-holder discharge flow path DS**2** is provided for each head chip **14** that uses the second ink, and is a flow path for discharging the second ink introduced from the head chip **14** from the coupling tube **13***d*.

Each of the bypass flow path BP**1** and bypass flow path BP**2** is provided for each head chip **14**, and are flow paths through which the above-described first common liquid chamber R**1** communicates with the and the above-described second common liquid chamber R**2**. Here, the bypass flow path BP**1** and the bypass flow path BP**2** are located opposite each other with respect to the center of the first common liquid chamber R**1** or the second common liquid chamber R**2** in the direction along the X axis. In an example illustrated in FIG. **8**, the bypass flow path BP**1** is located in the V2 direction with respect to the bypass flow path BP**2**. In addition, each of the bypass flow path BP**1** and the bypass flow path BP**2** has a U shape as viewed in the direction along the Z axis.

FIG. **10** is a cross-sectional view taken along the line X-X in FIG. **8**. In FIG. **10**, in addition to the holder **13**, the head chip **14** and the fixing plate **15** are illustrated. As illustrated in FIG. **10**, the holder **13** has a plate shape that extends in a direction perpendicular to the Z axis. The holder **13** has a layer **31** and a layer **32**, which are laminated in this order in the Z2 direction. Each of the layer **31** and the layer **32** is made of, for example, a resin material and is formed by injection molding. The layer **31** and the layer **32** are bonded to each other, for example, with an adhesive.

Each of the above-described flow paths included in the holder **13** is provided in a laminate constituted of the layer **31** and the layer **32**, and a recessed portion **13***f* that accommodates the head chip **14** is provided on the surface of the layer **32** facing the Z2 direction. In an example illustrated in FIG. **10**, a thickness of the layer **32** is thicker than a thickness of the layer **31**. Therefore, the thickness of the layer **32** required for forming the recessed portion **13***f* can be easily secured.

Here, the in-holder supply flow path SP**1** has a vertical flow path SPa and a horizontal flow path SPb. The vertical flow path Spa extends in the direction along the Z axis, and is constituted of holes penetrating the layer **32**. The horizontal flow path SPb extends in a direction orthogonal to the Z axis, and is provided between the layer **31** and the layer **32**. In the example illustrated in FIG. **10**, the horizontal flow path SPb is constituted of a groove provided on the surface of the layer **31** facing the Z2 direction and a groove provided on the surface of the layer **32** facing the Z1 direction. Although not illustrated in FIG. **10**, the in-holder supply flow path SP**2** is configured in the same manner as the in-holder supply flow path SP**1**.

The bypass flow path BP**1** has a first portion BP**1***a*, a second portion BP**1***b*, and a third portion BP**1***c*. Each of the first portion BP**1***a* and the second portion BP**1***b* extends in the direction along the Z axis and is constituted of holes penetrating the layer **32**. The third portion BP**1***c* extends in the direction orthogonal to the Z axis, and is provided between the layer **31** and the layer **32**. In the example illustrated in FIG. **10**, the third portion BP**1***c* is constituted of a groove provided on the surface of the layer **31** facing the Z2 direction and a groove provided on the surface of the layer **32** facing the Z1 direction.

Similarly, the bypass flow path BP**2** has a first portion BP**2***a*, a second portion BP**2***b*, and a third portion BP**2***c*. Each of the first portion BP**2***a* and the second portion BP**2***b* extends in the direction along the Z axis and is constituted of holes penetrating the layer **32**. The third portion BP**2***c* extends in a direction orthogonal to the Z axis, and is provided between the layer **31** and the layer **32**. In the example illustrated in FIG. **10**, the third portion BP**2***c* is constituted of a groove provided on the surface of the layer **31** facing the Z2 direction and a groove provided on the surface of the layer **32** facing the Z1 direction.

In one head chip **14**, the sum of flow path resistances of the bypass flow path BP is smaller than the sum of flow path resistances of the plurality of individual flow paths PJ. That is, in one head chip **14**, the combined resistance of the bypass flow path BP**1** and the bypass flow path BP**2** is smaller than the combined resistance of the plurality of individual flow paths PJ.

1-8. Flow Path Structure **11**

FIG. **11** is a plan view of the flow path structure **11**. In FIG. **11**, an example of the structure in the flow path structure **11** as viewed in the Z2 direction is illustrated by a broken line. As illustrated in FIG. **11**, inside the flow path structure **11**, the in-structure supply flow path CC**1**, the in-structure supply flow path CC**2**, the in-structure discharge flow path CM**1**, the in-structure discharge flow path CM**2**, a first filter chamber RF**1**, and a second filter chamber RF**2** are provided. The filter **25** is provided inside each of the first filter chamber RF**1** and the second filter chamber RF**2**.

The filter **25** is a plate-shaped or sheet-shaped member that captures foreign matter and the like mixed in the ink while allowing the ink to pass therethrough. The filter **25** is made of, for example, a metal fiber such as a twilled dutch weave or a plain dutch weave. The filter **25** is not limited to the configuration using the metal fiber, and may be made of a resin fiber such as non-woven fabric, for example. The filter **25** is typically disposed so as to be parallel to the nozzle surface FN. Here, the filter **25** may be provided so as to be inclined in a range of 0 degrees or more and 45 degrees or less with respect to the nozzle surface FN.

The in-structure supply flow path CC**1** is a flow path for supplying the first ink introduced into the coupling tube **11***a* to the holder **13** described above. Here, the in-structure supply flow path CC**1** communicates with an internal space of the coupling tube **11***a* via the first filter chamber RF**1**. A discharge port CE**1** coupled to the coupling tube **13***a* described above communicates with the in-structure supply flow path CC**1**.

The in-structure supply flow path CC**2** is a flow path for supplying the second ink introduced into the coupling tube **11***b* to the holder **13** described above. Here, the in-structure supply flow path CC**2** communicates with an internal space of the coupling tube **11***b* via the second filter chamber RF**2**. A discharge port CE**2** coupled to the coupling tube **13***b* described above communicates with the in-structure supply flow path CC**2**.

The in-structure discharge flow path CM**1** is a flow path for discharging the first ink from the holder **13** described above from the coupling tube **11***c*. An introduction port CI' coupled to the three coupling tubes **13***c* described above communicates with the in-structure discharge flow path CM**1**.

The in-structure discharge flow path CM**2** is a flow path for discharging the second ink from the holder **13** described above from the coupling tube **11***d*. An introduction port CI**2** coupled to the three coupling tubes **13***d* described above communicates with the in-structure discharge flow path CM**2**.

1-9. Operation at the Time of Filling Ink

A series of processes when the liquid ejecting head **10** is filled with the first ink will be described with reference to FIGS. **12**, **13**, and **14**. With respect to the second ink, the liquid ejecting apparatus **100** executes a series of processes similar to those for the first ink. Hereinafter, a series of processes related to the first ink will be described.

FIG. **12** is a flowchart illustrating a series of processes at the time of filling ink. In step S**2**, the liquid ejecting apparatus **100** controls the circulation mechanism **150** in a state in which the on-off valve **160** is open, and executes a circulation operation of circulating the first ink in the order of the liquid storage portion **151**, the supply flow path SF**1**, the individual flow path PJ, the recovery flow path CF**1**, and the liquid storage portion **151**. In the circulation operation, the control module **120** opens the on-off valve **160**, sets the in-apparatus supply flow path SJ**1** to have predetermined positive pressure, sets the in-apparatus recovery flow path CJ**1** to have predetermined negative pressure, and supplies the first ink to each of the plurality of head chips **14**. The flow rate increases as a difference between the upstream pressure and the downstream pressure increases. Therefore, a period required for filling the nozzle N, the individual flow path PJ, the supply flow path SF**1**, and the recovery flow path CF**1** with the first ink in accordance with an increase in the difference between the upstream pressure and the downstream pressure can be shortened.

When the circulation operation is executed when the first ink is not filled in the plurality of nozzles N, the supply flow path SF**1**, the individual flow path PJ, and the recovery flow path CF**1**, the plurality of nozzles N, the supply flow path SF**1**, the individual flow path PJ, and the recovery flow path CF**1** are filled with the first ink, and after the first ink is filled, the first ink circulates in the order of the liquid storage portion **151**, the supply flow path SF**1**, the individual flow path PJ, the recovery flow path CF**1**, and the liquid storage portion **151**. By executing the circulation operation, the bubble staying in the supply flow path SF**1**, the individual flow path PJ, and the recovery flow path CF**1** can be discharged, but the bubble may not be completely discharged and may stay. A state of the head chip **14_1** during the circulation operation will be described with reference to FIG. **13**.

FIG. **13** is a view illustrating the state of the head chip **14_1** during the circulation operation. In FIG. **13** and FIG. **14**, which will be described later, a view of a cross section of the head chip **14_1** which is parallel to the Z axis and the W axis and passes through the supply port IO**1** and the discharge port **102** as viewed from the V2 direction to the V1 direction is illustrated. In addition, in FIGS. **13** and **14**, in order to prevent the drawing from becoming complicated, the wiring substrate **14***h* and the drive circuit **14***i* are not illustrated, and the in-holder supply flow path SP**1**, the in-apparatus supply flow path SJ**1**, the bypass flow path BP**2**, the in-holder discharge flow path DS**1**, and the in-apparatus recovery flow path CJ**1** are schematically illustrated. Furthermore, in FIGS. **13** and **14**, in order to make it easier to understand the flow of the first ink in the bypass flow path BP**2**, as a display for convenience, the discharge port IO**3***a* is displayed by being shifted in the W2 direction from the original, and the introduction port IO**4***a* is displayed by being shifted in the W1 direction from the original. In addition, in FIGS. **13** and **14**, for easy understanding, the on-off valve **160** is illustrated as a white figure in a state in which the on-off valve **160** is open, and the on-off valve **160** is illustrated as a black figure in a state in which the on-off valve **160** is closed. In FIG. **13**, the on-off valve **160** is open.

As illustrated in FIG. **13**, the flow FRa of the first ink in the supply flow path SF**1**, the flow FRb of the first ink in the individual flow path PJ, the flow FRc of the first ink in the bypass flow path BP, and the flow FRd of the first ink in the recovery flow path CF**1** are formed by the circulation operation. The flow FRa is a flow of the first ink from the liquid storage portion **151** to an opening PJi of each of the plurality of individual flow paths PJ or the discharge port IO**3***b* via the supply flow path SF**1**. The flow FRb is a flow of the first ink from the opening PJi to the opening PJo. The flow FRc is a flow of the first ink from the discharge port IO**3***b* to the introduction port IO**4***b* via the bypass flow path BP**2**. Although not illustrated in FIG. **13**, a flow of the first ink from the discharge port IO**3***a* to the introduction port IO**4***a* via the bypass flow path BP**1** is also formed by the circulation operation. The flow FRd is a flow of the first ink from an opening PJo of each of the plurality of individual flow paths PJ to the liquid storage portion **151** via the recovery flow path CF**1**.

Since the pressure of the first common liquid chamber R**1** also becomes the positive pressure when the in-apparatus supply flow path SJ**1** has the predetermined positive pressure, as illustrated in FIG. **13**, the flexible member **14***ja* is bent in the Z2 direction. On the other hand, since the pressure of the second common liquid chamber R**2** also becomes the negative pressure when the in-apparatus recovery flow path CJ**1** has the predetermined negative pressure, as illustrated in FIG. **13**, the flexible member **14***jb* is bent in the Z1 direction. As the flexible member **14***jb* is bent in the Z1 direction, the width dR**2** from the wall surface of the second common liquid chamber R**2** in the Z1 direction to the flexible member **14***jb* along the Z axis becomes narrower compared to a state in which the flexible member **14***jb* is not deformed. For example, in a state in which the flexible member **14***jb* is bent in the Z1 direction, the width dR**2** is about 100 μm.

As the width dR**2** becomes narrower, there is a concern that the bubble is likely to stay in the second common liquid chamber R**2**. When the bubble is generated in the second common liquid chamber R**2**, the ink supply amount is insufficient or an ejection abnormality occurs. The ejection abnormality is a state in which the ink cannot be ejected according to an aspect specified by the drive signal Com even though an attempt is made to eject the ink from the nozzle N by the drive signal Com. This is because since the pressure in the individual flow path PJ becomes the negative pressure when the ink is ejected from the nozzle N, when the ink is drawn from the second common liquid chamber R**2**, the bubble staying in the second common liquid chamber R**2** is also drawn into the individual flow path PJ together with the ink in the second common liquid chamber R**2**, so the nozzle N is blocked by the bubble. FIG. **13** illustrates a bubble Ar staying in the second common liquid chamber R**2**.

The bubble has a property that the smaller the volume of the bubble, the less likely the shape of the bubble is to be deformed. Therefore, when the bubble is sandwiched between a surface Sr**2** of the second common liquid chamber R**2** facing the Z2 direction and the surface S**14** of the flexible member **14***jb* facing the Z1 direction as the width dR**2** is narrowed, it may be difficult for the bubble to pass through the second common liquid chamber R**2** because the bubble is difficult to deform.

Furthermore, it can be said that the bubble is likely to stay in the second common liquid chamber R**2** having a width dR**2** narrower than that of the individual flow path PJ. When the bubble exists in the individual flow path PJ, the individual flow path PJ may be blocked by the bubble. When the individual flow path PJ is blocked, the pressure applied to an upstream surface of the bubble staying in the individual flow path PJ increases due to the flow FRb of the first ink in the individual flow path PJ, and a difference in pressure between an upstream portion and a downstream portion of the bubble increases, and a force for moving the bubble is generated by this difference in pressure. Therefore, even though the bubble exists in the individual flow path PJ, the bubble moves to the recovery flow path CF**1** downstream due to the difference in pressure in which the bubble receives, so that the bubble is less likely to stay in the individual flow path PJ. On the other hand, even though the bubble exists in the second common liquid chamber R**2** having a narrow width dR**2**, it can be said that the possibility that the second common liquid chamber R**2** is blocked by the bubble is lower than the possibility that the individual flow path PJ is blocked. This is because, since the second common liquid chamber R**2** extends along the V axis, even though the size of the bubble is substantially equal to the width of the second common liquid chamber R2 along the Z axis, the first ink flows in a portion of the second common liquid chamber R2 where the bubble Ar does not exist, that is, the portion in the V1 direction or the V2 direction with respect to the bubble Ar, so that the first ink can flow while avoiding the bubble Ar. Since the first ink collides with the bubble, a difference in pressure is generated between the upstream portion and the downstream portion of the bubble Ar, but it is difficult to generate enough force to deform the bubble Ar and pass through the width dR2. As described above, as the width dR2 is narrowed, the bubble Ar is less likely to be discharged from the second common liquid chamber R2.

In addition, in FIG. **13**, the bubble Ar is displayed at a position sandwiched between the surface Sr2 and the surface S**14**, but a position where the bubble is likely to stay in a state in which the flexible member **14***jb* is bent in the Z1 direction is not limited to the position illustrated in FIG. **13**. When the flexible member **14***jb* is not deformed, as understood from FIG. **7**, an angle formed by the surface Sw**1** and the surface S**14** defining an end of the second common liquid chamber R2 in the W1 direction is approximately 90 degrees. However, when the flexible member **14***jb* is bent in the Z1 direction, the angle formed by the surface Sw**1** and the surface S**14** becomes an acute angle. Therefore, the bubble is sandwiched between the surface Sw**1** and the surface S**14**, and the bubble is likely to stay. A similar phenomenon occurs between a surface defining an end of the second common liquid chamber R**2** in the W2 direction and the surface S**14**.

The description returns to FIG. **12**. In step S**4**, when a predetermined flow rate is circulated by the circulation operation, the control module **120** executes the pressurization discharge operation of discharging the first ink from each of the plurality of nozzles N by closing the on-off valve **160**. In the pressurization discharge operation, the control module **120** pressurizes the first ink in the supply flow path SF**1** by setting the in-apparatus supply flow path SJ**1** to have the predetermined positive pressure by the control of the circulation mechanism **150**. However, the pressure of the in-apparatus supply flow path SJ**1** during the circulation operation and the pressure of the in-apparatus supply flow path SJ**1** during the pressurization discharge operation may be the same value or different values. By closing the on-off valve **160**, a place where the first ink is discharged is limited to the nozzle N only. A state of the head chip **14_1** during the pressurization discharge operation will be described with reference to FIG. **14**.

FIG. **14** is a view illustrating the state of the head chip **14_1** in the pressurization discharge operation. In the pressurization discharge operation, a flow toward the nozzle N is formed because the nozzle N is the only place where the first ink is discharged. Specifically, as illustrated in FIG. **14**, by the pressurization discharge operation, the flow FR**1** of the first ink from the supply flow path SF**1** to the nozzle N via a part of the individual flow path PJ and the flow FR**2** of the first ink from the supply flow path SF**1** to the nozzle N via the bypass flow path BP, a part of the recovery flow path CF**1**, and a part of the individual flow path PJ in this order, are formed. The flow FR**1** includes a flow FRa of the first ink in the supply flow path SF**1** and a flow FRf of the first ink in a flow path of a part of the individual flow path PJ. The flow FR**2** includes a flow FRc of the first ink in the bypass flow path BP**2**, a flow FRe of the first ink in the second common liquid chamber R**2** which is a part of the recovery flow path CF**1**, and a flow FRg of the first ink in the flow path of the part of the individual flow path PJ. By closing the on-off valve **160**, the recovery flow path CF**1** is divided into two flow paths, an upstream flow path and a downstream flow path, with the on-off valve **160** interposed therebetween. The second common liquid chamber R**2** is included in the upstream flow path of the two flow paths, that is, a flow path close to the individual flow path PJ. Similar to FIG. **13**, the flow FR**2** also includes a flow of the first ink in the bypass flow path BP**1**.

The flow FRe is a flow of the first ink from the introduction port IO**4***b* to the opening PJo of each of the plurality of individual flow paths PJ through the second common liquid chamber R**2**. The flow FRf is a flow of the first ink from the opening PJi to the nozzle N through the flow path of the part of the individual flow path PJ. Therefore, the flow path of the part of the individual flow path PJ in the flow FRf is the individual supply flow path Ra**1**, the pressure chamber Ca, the first communication flow path Na**1**, and a flow path from an end of the nozzle flow path Nf in the W1 direction to a point where it communicates with nozzle N. The flow FRg is the flow of the first ink from the opening PJo to the nozzle N through the flow path of the part of the individual flow path PJ. Therefore, the flow path of the part of the individual flow path PJ in the flow FRg is the individual discharge flow path Ra**2**, the pressure chamber Cb, the second communication flow path Na**2**, and a flow path from an end of the nozzle flow path Nf in the W2 direction to a point where it communicates with nozzle N. The first ink is discharged from the nozzle N by the flow FRf and the flow FRg. In FIG. **14**, the first ink being discharged from the nozzle N is illustrated by displaying a droplet DR.

In the pressurization discharge operation, the pressure of the second common liquid chamber R**2** is likely to be a positive pressure via the bypass flow path BP. In FIG. **14**, it is assumed that the pressure of the second common liquid chamber R**2** is the positive pressure. When the pressure of the second common liquid chamber R**2** is a positive pressure, the flexible member **14***jb* is bent in the Z2 direction as illustrated in FIG. **14**. That is, since the width dR**2** becomes wide, the bubble Ar is released from being sandwiched between the surface Sr**2** and the surface S**14**. Therefore, the bubble Ar moves in the second common liquid chamber R**2** along the flow FRe, moves in the flow path of the part of the individual flow path PJ along the flow FRg, and is discharged together with the droplet DR. Even when the bubble is sandwiched between the surface Sw**1** and the surface S**14** in the circulation operation, an angle formed by the surface Sw**1** and the surface S**14** becomes an obtuse angle, as understood from FIG. **14**. Therefore, the bubble sandwiched between the surface Sw**1** and the surface S**14** also easily moves and is discharged together with the droplet DR. The bubble sandwiched between the surface S**14** and the surface defining an end of the second common liquid chamber R**2** in the W2 direction in the circulation operation is also discharged together with the droplet DR in the same manner as the bubble sandwiched between the surface Sw**1** and the surface S**14**.

In addition, as understood from FIGS. **13** and **14**, in the circulation operation and the pressurization discharge operation, the flows of the first ink in the second common liquid chamber R**2** are opposite to each other. It may be difficult for the bubble to move in one direction, but it may be easy for the bubble to move in the opposite direction. For example, the surface Sr**2** may be inclined in the Z2 direction as it is directed in the W2 direction. When the Z axis is a vertical axis, buoyancy in the Z1 direction is generated in the bubble. Therefore, in the circulation operation, the bubble in contact with the surface Sr**2** needs to move against the buoyancy in order to move in the W2 direction. On the other hand, in the pressurization discharge operation, the bubble in contact with the surface Sr**2** may move in the W1 direction. When the surface Sr**2** is inclined in the Z2 direction as it is directed in the W2 direction, it is easier for the bubble in contact with the surface Sr**2** to move in the W1 direction compared to moving in the W2 direction.

By the pressurization discharge operation, the bubble staying in any of the bypass flow paths BP**1** and BP**2**, the second common liquid chamber R**2**, and the flow path from the opening PJo to the nozzle N among each of the plurality of individual flow paths PJ is discharged from the nozzle N. Therefore, it is preferable that the control module **120** ends the pressurization discharge operation after at least from the start of the pressurization discharge operation, flowing the first ink of a volume obtained by multiplying the sum of the volumes of the bypass flow paths BP**1** and BP**2**, the second common liquid chamber R**2**, and the flow path from the opening PJo to the nozzle N among each of the plurality of individual flow paths PJ by the number of the liquid ejecting heads **10** included in the liquid ejecting apparatus **100**, in the flow FR**2**. After the end of the pressurization discharge operation, the liquid ejecting apparatus **100** ends a series of processes illustrated in FIG. **12**.

In the above description, the liquid ejecting apparatus **100** executes the series of processes illustrated in FIG. **12** in a state in which the plurality of nozzles N, the supply flow path SF**1**, the individual flow path PJ, and the recovery flow path CF**1** are not filled with the first ink, but it is not limited to this. For example, the liquid ejecting apparatus **100** may execute the series of processes illustrated in FIG. **12** as one of the maintenance processes to restore the ink ejection state to normal in a state in which the plurality of nozzles N, the supply flow path SF**1**, the individual flow path PJ, and the recovery flow path CF**1** are filled with the first ink, for example, before and/or after the printing process.

1-10. Summary of First Embodiment

Hereinafter, the features of the liquid ejecting apparatus **100** will be described using the flow path related to the first ink.

As described above, the liquid ejecting apparatus **100** according to the first embodiment includes the plurality of nozzles N that eject the first ink, the plurality of individual flow paths PJ that communicate with each of the plurality of nozzles N, and a liquid storage portion **151** that stores the first ink to be supplied to each of the plurality of nozzles N, the supply flow path SF**1** for supplying the first ink from the liquid storage portion **151** to the plurality of individual flow paths PJ, the recovery flow path CF**1** for recovering the first ink from the plurality of individual flow paths PJ to the liquid storage portion **151**, the bypass flow path BP that couples the supply flow path SF**1** and the recovery flow path CF**1** without passing through any of the plurality of individual flow paths PJ, and the on-off valve **160** that can close and open the recovery flow path CF**1**. The on-off valve **160** is disposed between the bypass flow path BP and the liquid storage portion **151** in the recovery flow path CF**1**, and the liquid ejecting apparatus **100** executes the pressurization discharge operation of discharging the first ink from each of the plurality of nozzles N by pressurizing the first ink in the supply flow path SF**1** in a state in which the recovery flow path CF**1** is closed by the on-off valve **160**.

By pressurizing the first ink in a state in which the recovery flow path CF**1** is closed by the on-off valve **160**, a flow FR**2** of the first ink flowing toward the nozzle N via the bypass flow paths BP**1** and BP**2** is formed because the nozzle N is the only place where the first ink is discharged. In the second common liquid chamber R**2** which is a part of the recovery flow path CF**1**, the direction of the flow FRe of the first ink formed by the pressurization discharge operation is opposite to the direction of the flow FRd of the first ink formed by the circulation operation. Therefore, the liquid ejecting apparatus **100** according to the first embodiment can discharge the bubble in the recovery flow path CF**1** that cannot be discharged in the circulation operation. That is, the liquid ejecting apparatus **100** according to the first embodiment can easily discharge the bubble staying in the recovery flow path CF**1**.

In addition, as an aspect for generating a flow in the recovery flow path CF**1** in a direction opposite to the direction of the flow FRd, an aspect in which the on-off valve **160** is not provided, the first ink is supplied from the recovery flow path CF**1**, and the first ink is recovered from the supply flow path SF**1** is also conceivable. Hereinafter, this aspect will be referred to as a "comparative aspect". However, in the comparative aspect, since the ink that does not pass through the filter **25** is supplied to the individual flow path PJ, there is a possibility that the ejection abnormality due to the foreign matter may occur. In the first embodiment, the bypass flow path BP is provided downstream of the filter **25**. Therefore, in the liquid ejecting apparatus **100** according to the first embodiment, the first ink from which the foreign matter is removed by the filter **25** can form the flow FR**2** flowing toward the nozzle N via the bypass flow path BP. As described above, the liquid ejecting apparatus **100** according to the first embodiment can suppress the occurrence of the ejection abnormality due to the foreign matter as compared with the comparative aspect, while suppressing the occurrence of the ejection abnormality due to the bubble.

In addition, the liquid ejecting apparatus **100** according to the first embodiment further includes the flexible member **14***jb* that defines a portion of the recovery flow path CF**1** coupled to the bypass flow path BP, and has flexibility. The portion of the recovery flow path CF**1** coupled to the bypass flow path BP is the second common liquid chamber R**2**.

As described above, the flexible member **14***jb* is bent in the Z1 direction, so that bubble is likely to stay in the second common liquid chamber R**2**. In the liquid ejecting apparatus **100** according to the first embodiment, since the flexible member **14***jb* can be bent in the Z2 direction in the pressurization discharge operation, the bubble staying in the second common liquid chamber R**2** can be discharged.

In addition, instead of the flexible member **14***jb*, an aspect having a member having no flexibility is also conceivable. However, in this aspect, since the pressure fluctuation of the second common liquid chamber R**2** easily reaches the pressure chamber C, the ejection abnormality is likely to occur. Therefore, the liquid ejecting apparatus **100** according to the first embodiment can suppress the occurrence of the ejection abnormality due to the bubble while improving the quality of the image formed on the medium M by having the flexible member **14***jb*.

In addition, during the execution of the pressurization discharge operation, the pressure of the first ink flowing upstream from the on-off valve **160** in the recovery flow path CF**1** is the positive pressure with respect to the atmospheric pressure. The first ink flowing upstream of the on-off valve **160** in the recovery flow path CF**1** means the first ink flowing upstream of the on-off valve **160** in the circulation operation, and typically, is the first ink in the second common liquid chamber R**2**. In other words, it can be said that the first ink in the second common liquid chamber R**2** flows a downstream portion of the bypass flow path BP in the recovery flow path CF**1** in the pressurization discharge operation, as illustrated by the flow FR**2** in FIG. **14**.

When the pressure of the first ink is the positive pressure, in the liquid ejecting apparatus **100** according to the first embodiment, the flexible member **14***jb* can be bent in the Z2 direction during the pressurization discharge operation.

In addition, by the pressurization discharge operation, the flow FR**1** of the first ink from the supply flow path SF**1** to the nozzle N via a part of the individual flow path PJ and the flow FR**2** of the first ink from the supply flow path SF**1** to the nozzle N via the bypass flow path BP, the second common liquid chamber R**2**, which is a part of the recovery flow path CF**1**, and a part of the individual flow path PJ in this order, are formed.

By forming the flow FR**2**, the liquid ejecting apparatus **100** according to the first embodiment can generate a flow in the second common liquid chamber R**2** in the direction opposite to the direction of the flow FRd.

In addition, the liquid ejecting apparatus **100** according to the first embodiment executes the circulation operation of circulating the first ink in the order of the liquid storage portion **151**, the supply flow path SF**1**, the individual flow path PJ, the recovery flow path CF**1**, and the liquid storage portion **151**.

In addition, the liquid ejecting apparatus **100** according to the first embodiment starts the pressurization discharge operation by closing the recovery flow path CF**1** by the on-off valve **160** while the circulation operation is being executed.

By closing the on-off valve **160** while the circulation operation is being executed, it is possible to instantaneously generate pressure for the first ink in the recovery flow path CF**1** toward the nozzle N. Therefore, in the liquid ejecting apparatus **100** according to the first embodiment, a period required for discharging the bubble can be shortened as compared with an aspect in which the on-off valve **160** is closed after the circulation operation is temporarily stopped by the circulation mechanism **150**, and the first ink in the supply flow path SF**1** is pressurized by the circulation mechanism **150** after the on-off valve **160** is closed. Since the period required for discharging the bubble is shortened, in the liquid ejecting apparatus **100** according to the first embodiment, the amount of the ink discharged from the nozzle N during the pressurization discharge operation can be reduced because the period required for the pressurization discharge operation is shortened.

In addition, the liquid ejecting apparatus **100** according to the first embodiment includes a compressor **152** that pressurizes the ink in the supply flow path SF**1** so as to flow the ink in the supply flow path SF**1** only in a direction in which the first ink flows from the liquid storage portion **151** to the plurality of individual flow paths PJ via the supply flow path SF**1** by the circulation operation.

In the liquid ejecting apparatus **100** according to the first embodiment, since it is not necessary to change the flow direction of the first ink in the recovery flow path CF**1** to the opposite direction by the compressor **152**, the configuration of the liquid ejecting apparatus **100** can be simplified as compared with an aspect in which the flow direction of the first ink in the recovery flow path CF**1** can be changed in the opposite direction by the compressor **152**. In addition, in the above-described comparative aspect, the flow directions are changed in the opposite directions in the supply flow path SF**1**, the individual flow path PJ, the bypass flow path BP, and the recovery flow path CF**1**. On the other hand, in the liquid ejecting apparatus **100** according to the first embodiment, the flow direction is changed only in the second common liquid chamber R**2** and a part of the individual flow path PJ. Therefore, in the liquid ejecting apparatus **100** according to the first embodiment, as compared with the comparative aspect, a range of changing the flow direction among the supply flow path SF**1**, the individual flow path PJ, the bypass flow path BP, and the recovery flow path CF**1** can be narrowed, so that the period required for discharging the bubble can be shortened.

In addition, the supply flow path SF**1** has the first common liquid chamber R**1** coupled to the plurality of individual flow paths PJ, the recovery flow path CF**1** has a second common liquid chamber R**2** coupled to the plurality of individual flow paths PJ. The bypass flow path BP causes the first common liquid chamber R**1** to communicate with the second common liquid chamber R**2**. In other words, the bypass flow path BP is coupled to the second common liquid chamber R**2** in the recovery flow path CF**1**.

In the liquid ejecting apparatus **100** according to the first embodiment, a range of changing the flow direction in the recovery flow path CF**1** can be narrowed as compared with an aspect in which the bypass flow path BP is coupled to any of the in-holder discharge flow path DS**1** and the in-structure discharge flow path CM**1** other than the second common liquid chamber R**2** in the recovery flow path CF**1**. In the liquid ejecting apparatus **100** according to the first embodiment, by shortening a range of changing the flow direction in the recovery flow path CF**1**, a period required for discharging the bubble can be shortened, and an ink consumption amount can also be reduced. That is, it is preferable that a flow path length from a coupling position between the bypass flow path BP and the recovery flow path CF**1** to the on-off valve **160** is shorter than a flow path length from the coupling position to the opening PJo which is one end of the individual flow path PJ.

The flow path resistance of the bypass flow path BP is smaller than the sum of flow path resistances of the plurality of individual flow paths PJ.

In the liquid ejecting apparatus **100** according to the first embodiment, the pressure of the second common liquid chamber R**2** can be easily set to the positive pressure as compared with an aspect in which the flow path resistance of the bypass flow path BP is larger than the sum of flow path resistances of the plurality of individual flow paths PJ.

According to the above description, the liquid ejecting apparatus **100** according to the first embodiment can also be specified as a liquid discharging method for executing the pressurization discharge operation of discharging the first ink from each of the plurality of nozzles N by pressurizing the first ink in the supply flow path SF**1** in a state in which the recovery flow path CF**1** is closed by the on-off valve **160**.

2. MODIFICATION EXAMPLE

Each form exemplified above can be variously modified. Specific modification aspects are exemplified below. Two or more aspects optionally selected from the following examples can be appropriately combined within a scope where the aspects do not contradict each other.

2.1. First Modification Example

The liquid storage portion **151** according to the first embodiment includes the first sub tank **1512** that stores ink to be supplied to each of the plurality of liquid ejecting heads **10**, and the second sub tank **1516** that recovers the ink from each of the plurality of liquid ejecting heads **10**, but the present disclosure is not limited to this. Specifically, the sub tank that stores the ink to be supplied to each of the plurality of liquid ejecting heads **10** and the sub tank that recovers the ink from each of the plurality of liquid ejecting heads **10** may be the same.

FIG. **15** is a view illustrating a circulation mechanism **150**-A in a first modification example. A liquid ejecting apparatus **100**-A according to the first modification example differs from the liquid ejecting apparatus **100** in that it has a circulation mechanism **150**-A instead of the circulation mechanism **150**, an in-apparatus supply flow path SJ**1**-A instead of the in-apparatus supply flow path SJ**1**, and an in-apparatus recovery flow path CJ**1**-A instead of the in-apparatus recovery flow path CJ**1**.

The circulation mechanism **150**-A differs from the circulation mechanism **150** in that it has a sub tank **1510** instead of the liquid storage portion **151**, does not have the compressor **152**, the regulator **153**, the vacuum pump **154**, the regulator **155**, the pressure sensor **156**, and the pressure sensor **157**, and uses the pump **159**. In the first modification example, the sub tank **1510** is an example of the "liquid storage portion", and the pump **159** is an example of the "pressurizing mechanism".

The sub tank **1510** stores the first ink to be supplied to each of the plurality of liquid ejecting heads **10**. In the sub tank **1510**, the first ink replenished from the main tank **110** and the first ink recovered from each of the plurality of liquid ejecting heads **10** are stored.

The in-apparatus supply flow path SJ**1**-A differs from the in-apparatus supply flow path SJ**1** in that a pump **159** is provided instead of the pressure sensor **156**. The pump **159** pressurizes the first ink in the in-apparatus supply flow path SJ**1**-A. The in-apparatus recovery flow path CJ**1**-A differs from the in-apparatus recovery flow path CJ**1** in that it does not have the pressure sensor **157**.

2-2. Second Modification Example

In the first embodiment and the first modification example, the on-off valve **160** is provided outside the liquid ejecting head **10**, but may be provided inside the liquid ejecting head **10**.

FIG. **16** is a schematic view illustrating a flow path in a liquid ejecting apparatus **100**-B in a second modification example. FIG. **16** illustrates the flow path through which the first ink flows. In the second modification example, since the flow path through which the second ink flows is the same as the flow path through which the first ink flows, the description thereof will be omitted.

The liquid ejecting apparatus **100**-B differs from the liquid ejecting apparatus **100** in that it has a recovery flow path CF**1**-B instead of the recovery flow path CF**1**. The recovery flow path CF**1**-B differs from the recovery flow path CF**1** in that it has an in-structure discharge flow path CM**1**-B instead of the in-structure discharge flow path CM**1**, and has an in-apparatus recovery flow path CJ**1**-B instead of the in-apparatus recovery flow path CJ**1**. The in-structure discharge flow path CM**1**-B is provided in the liquid ejecting head **10**-B in the second modification example. Therefore, the liquid ejecting head **10**-B differs from the liquid ejecting head **10** in that the in-structure discharge flow path CM**1**-B is provided instead of the in-structure discharge flow path CM**1**.

The in-structure discharge flow path CM**1**-B differs from the in-structure discharge flow path CM**1** in that an on-off valve **160** is provided. In the second modification example, the on-off valve **160** is provided for each of the liquid ejecting heads **10**-B.

The in-apparatus recovery flow path CJ**1**-B differs from the in-apparatus recovery flow path CJ**1** in that the on-off valve **160** is not provided.

As understood from the first embodiment and the second modification example, since the flow of the ink is reversed via the bypass flow path BP in the pressurization discharge operation, the on-off valve **160** may be located downstream of the bypass flow path BP in the circulation operation. One on-off valve **160** may be provided in the liquid ejecting apparatus **100** as in the first embodiment, may be provided for each of the liquid ejecting heads **10**-B as illustrated in FIG. **16**, or may be provided for each head chip **14**. As an example in which the on-off valve **160** is provided for each head chip **14**, in FIG. **16**, the on-off valve **160** is provided in the in-structure discharge flow path CM**1**-B, but the on-off valve **160** may be provided in each of the three in-holder discharge flow paths DS**1**.

2-3. Third Modification Example

In the first embodiment, the first modification example, and the second modification example, the bypass flow path BP is provided inside the liquid ejecting head **10**, **10**-B, **10**-C, but as it is located upstream of the on-off valve **160**, the bypass flow path BP may be provided outside the liquid ejecting head **10**, **10**-B, **10**-C.

FIG. **17** is a schematic view illustrating a flow path in a liquid ejecting apparatus **100**-C in a third modification example. FIG. **17** illustrates the flow path through which the first ink flows. In the third modification example, since the flow path through which the second ink flows is the same as the flow path through which the first ink flows, the description thereof will be omitted.

The liquid ejecting apparatus **100**-C differs from the liquid ejecting apparatus **100** in that it has a supply flow path SF**1**-C instead of the supply flow path SF**1** and has a recovery flow path CF**1**-C instead of the recovery flow path CF**1**.

The supply flow path SF**1**-C differs from the supply flow path SF**1** in that it has an in-apparatus supply flow path SJ**1**-C instead of the in-apparatus supply flow path SJ**1** and has an in-structure supply flow path CC**1**-C instead of the in-structure supply flow path CC**1**. The recovery flow path CF**1**-C differs from the recovery flow path CF**1** in that the in-apparatus recovery flow path CJ**1**-C is provided instead of the in-apparatus recovery flow path CJ**1**. The in-structure supply flow path CC**1**-C is provided in the liquid ejecting head **10**-C in the third modification example. Therefore, the liquid ejecting head **10**-C differs from the liquid ejecting head **10** in that the in-structure supply flow path CC**1**-C is provided instead of the in-structure supply flow path CC**1**. Furthermore, the liquid ejecting head **10**-C differs from the liquid ejecting head **10** in that it has a plurality of head chips **14**-C instead of the plurality of head chips **14**.

The in-apparatus supply flow path SJ**1**-C differs from the in-apparatus supply flow path SJ**1** in that a filter is provided and is further coupled by a bypass flow path BP-C. The in-apparatus recovery flow path CJ**1**-C differs from the in-apparatus recovery flow path CJ**1** in that it is coupled by the bypass flow path BP-C. The in-structure supply flow path CC**1**-C differs from the in-structure supply flow path CC**1** in that the filter **25** is not provided.

As illustrated in FIG. **17**, a first coupling position Pb**1** between the bypass flow path BP-C and the in-apparatus supply flow path SJ**1**-C is located upstream of the first common liquid chamber R**1**. Furthermore, the first coupling position Pb**1** is located downstream of the filter **25**.

As illustrated in FIG. **17**, a second coupling position Pb**2** between the bypass flow path BP-C and the in-apparatus recovery flow path CJ**1**-C is located downstream of the second common liquid chamber R**2**. Furthermore, the second coupling position Pb**2** is located upstream of the on-off valve **160**.

The flow path resistance from the second coupling position Pb**2** to the nozzle N is smaller than the flow path resistance from the first coupling position Pb**1** to the nozzle N. In the following, for the easy description, the flow path resistance from the first coupling position Pb**1** to the nozzle N may be described as "first flow path resistance", and the flow path resistance from the second coupling position Pb**2** to the nozzle N may be described as "second flow path resistance".

FIG. **17** illustrates a flow FR**1**-C and a flow FR**2**-C formed by the pressurization discharge operation when the on-off valve **160** is closed. The flow FR**1**-C is a flow of the first ink from the supply flow path SF**1**-C to the nozzle N via a part of the individual flow path PJ. The flow FR**2**-C is a flow of the first ink from the first coupling position Pb**1** of the supply flow path SF**1**-C to the nozzle N via the bypass flow path BP-C, a part of the recovery flow path CF**1**-C, and a part of the individual flow path PJ in this order.

The flow FR**1**-C has a flow FRa-C and a flow FRf. The flow FRa-C is a flow of the first ink reaching the first common liquid chamber R**1** via the flow path from the first coupling position Pb**1** in the in-apparatus supply flow path SJ**1**-C to the liquid supply port Pin of the liquid ejecting head **10**-C, the in-structure supply flow path CC**1**-C, and the in-holder supply flow path SP**1** in this order. The flow FRf is the same as in the first embodiment.

The flow FR**2**-C has a flow FRh and a flow FRg. The flow FRh is a flow of the first ink reaching the second common liquid chamber R**2** via the bypass flow path BP-C, a flow path from the second coupling position Pb**2** in the in-apparatus recovery flow path CJ**1**-C to the liquid discharge port Pout of the liquid ejecting head **10**-C, the in-structure discharge flow path CM**1**, and the in-holder discharge flow path DS**1** in this order. The flow FRg is the same as in the first embodiment.

In the pressurization discharge operation, as indicated by the flow FR**2**-C, the second coupling position Pb**2** is located upstream of the second common liquid chamber R**2**.

As understood from FIG. **17**, the flexible member **14*jb*** in the third modification example defines the second common liquid chamber R**2** which is a part of the recovery flow path CF**1**-C located upstream of the second coupling position Pb**2** between the bypass flow path BP-C and the recovery flow path CF**1**-C.

As understood from the first embodiment and the third modification example, in order to prevent the ink not passing through the filter **25** from being supplied to the individual flow path PJ, the filter **25** may be located upstream of the bypass flow path BP, BP-C in the circulation operation. As illustrated in FIG. **17**, one filter **25** may be provided in the liquid ejecting apparatus **100**, may be provided for each of the liquid ejecting heads **10** as in the first embodiment, or may be provided for each head chip **14**. However, the liquid ejecting apparatus **100**-C may not have the filter **25**. Similarly, one bypass flow path BP may be provided in the liquid ejecting apparatus **100**-C as illustrated in FIG. **17**, may be provided for each of the liquid ejecting heads **10**-C as in the first embodiment, or may be provided for each head chip **14**.

As described above, in the liquid ejecting apparatus **100**-C according to the third modification example, the supply flow path SF**1**-C has the first common liquid chamber R**1** coupled to the plurality of individual flow paths PJ, the recovery flow path CF**1**-C has the second common liquid chamber R**2** coupled to the plurality of individual flow paths PJ, the first coupling position Pb**1** between the bypass flow path BP-C and the supply flow path SF**1**-C is located upstream of the first common liquid chamber R**1**, the second coupling position Pb**2** between the bypass flow path BP-C and the recovery flow path CF**1**-C is located downstream of the second common liquid chamber R**2**, and the second flow path resistance from the second coupling position Pb**2** to the nozzle N is smaller than the first flow path resistance from the first coupling position Pb**1** to the nozzle N.

The nozzle N discharges the first ink that flows according to the flow FR**1**-C and the first ink that flows according to the flow FR**2**-C. In the pressurization discharge operation, since the bubble contained in the flow FR**2**-C is discharged, the amount of the first ink discharged by the flow FR**2**-C is preferably larger than the amount of the ink discharged by the flow FR**1**-C. Since the second flow path resistance is smaller than the first flow path resistance, the ink discharged by the flow FR**2**-C is larger than the ink discharged by the flow FR**1**-C as compared with the aspect in which the second flow path resistance is larger than the first flow path resistance. As described above, in the liquid ejecting apparatus **100**-C according to the third modification example, the bubble contained in the flow FR**2**-C can be easily discharged as compared with the aspect in which the second flow path resistance is larger than the first flow path resistance.

2-4. Fourth Modification Example

The second common liquid chamber R**2** of the head chip **14** in each of the above-described aspects is partitioned by the flexible member **14*jb*** having flexibility, but may be partitioned by a member having no flexibility. As described above, it may be difficult for the bubble to move in one direction, but it may be easy for the bubble to move in the opposite direction. The liquid ejecting apparatus **100** according to the fourth modification example can discharge the bubble, which is difficult to be discharged in the circulation operation, by the pressurization discharge operation.

2-5. Fifth Modification Example

In each of the above-described aspects, the pressurization discharge operation is started by closing the recovery flow path CF**1** by the on-off valve **160** during execution of the circulation operation, but the on-off valve **160** may be closed after the circulation operation by the circulation mechanism **150** is temporarily stopped, and then the first ink in the supply flow path SF**1** may be pressurized by the circulation mechanism **150**.

2-6. Sixth Modification Example

In each of the above-described aspects, the flow path resistance of the bypass flow path BP is smaller than the sum of the flow path resistances of the plurality of individual flow paths PJ, but the flow path resistance of the bypass flow path BP may be larger than the sum of the flow path resistances of the plurality of individual flow paths PJ.

2-7. Seventh Modification Example

In each of the above-described aspects, the two pressure chambers C communicate with one nozzle N, but the present disclosure is not limited thereto. For example, the number of pressure chambers C communicating with one nozzle N may be one or three or more, for example, four.

2-8. Eighth Modification Example

As illustrated in FIG. **1**, the liquid ejecting apparatus **100** in each of the above-described aspects is a so-called line type liquid ejecting apparatus in which the plurality of liquid ejecting heads **10** are fixed to the support body **41** and printing is performed simply by transporting the medium M, but the configuration of the liquid ejecting apparatus is not limited to that described above. For example, the present disclosure can also be applied to a so-called serial type liquid ejecting apparatus in which the plurality of liquid ejecting heads **10** are mounted on a carriage, the plurality of the liquid ejecting heads **10** are reciprocated along the X axis direction, and printing is performed by transporting the medium M.

2-9. Other Modification Examples

The above-described liquid ejecting apparatus can be adopted in various apparatuses such as a facsimile machine and a copier, in addition to an apparatus dedicated to printing. However, the application of the liquid ejecting apparatus of the present disclosure is not limited to printing. For example, the liquid ejecting apparatus that ejects a solution of a coloring material is used as a manufacturing apparatus for forming a color filter of a liquid crystal display device. In addition, a liquid ejecting apparatus that ejects a solution of a conductive material is used as a manufacturing apparatus for forming wiring and electrodes of a wiring substrate.

3. APPENDIX

From the above-exemplified embodiment, for example, the following configuration can be grasped.

A liquid ejecting apparatus according to Aspect 1, which is a preferred aspect, includes: a plurality of nozzles that eject liquid; a plurality of individual flow paths that communicate with each of the plurality of nozzles; a liquid storage portion that stores the liquid to be supplied to each of the plurality of nozzles; a supply flow path for supplying the liquid from the liquid storage portion to the plurality of individual flow paths; a recovery flow path for recovering the liquid from the plurality of individual flow paths to the liquid storage portion; a bypass flow path that couples the supply flow path and the recovery flow path without passing through any of the plurality of individual flow paths; and an on-off valve configured to close and open the recovery flow path, in which the on-off valve is disposed between the bypass flow path and the liquid storage portion in the recovery flow path, and a pressurization discharge operation of discharging the liquid from each of the plurality of nozzles by pressurizing the liquid in the supply flow path in a state in which the recovery flow path is closed by the on-off valve is executed.

By pressurizing the liquid in a state in which the recovery flow path is closed by the on-off valve, a flow of the liquid flowing toward the nozzle via the bypass flow path and a part of the recovery flow path is formed because the nozzle is the only place where the liquid is discharged. In the part of the recovery flow path, the direction of the flow of the liquid formed by the pressurization discharge operation is opposite to the direction of the flow of the liquid formed in a state in which the recovery flow path is opened by the on-off valve. Therefore, according to the Aspect 1, the bubble in the recovery flow path that cannot be discharged in the state the recovery flow path is opened by the on-off valve can be discharged. That is, according to the Aspect 1, the bubble staying in the recovery flow path can be easily discharged.

In Aspect 2 which is a specific example of the Aspect 1, the liquid ejecting apparatus further includes a flexible member that defines a part of the recovery flow path upstream from a coupling position between the bypass flow path and the recovery flow path or a portion of the recovery flow path coupled to the bypass flow path and that has flexibility.

In the Aspect 2, the flexible member is bent in a direction of narrowing a width of a flow path of the part of the recovery flow path, so that the bubble is likely to stay in the recovery flow path. In the Aspect 2, since the flexible member can be bent in the direction of widening the width of the flow path of the part of the recovery flow path in the pressurization discharge operation, the bubble staying in the recovery flow path can be discharged.

In Aspect 3 which is a specific example of the Aspect 2, during the execution of the pressurization discharge operation, pressure of the liquid flowing upstream of the on-off valve in the recovery flow path is positive pressure with respect to atmospheric pressure.

According to the Aspect 3, since the pressure of the liquid is the positive pressure, the flexible member can be bent in a direction of widening the width of the flow path of the part of the recovery flow path during the pressurization discharge operation.

In Aspect 4 which is a specific example of the Aspect 1, a flow of the liquid from the supply flow path to the nozzle via a part of the individual flow path and a flow of the liquid from the supply flow path to the nozzle via the bypass flow path, a part of the recovery flow path, and a part of the individual flow path in this order are formed by the pressurization discharge operation.

According to the Aspect 4, the flow of the liquid from the supply flow path to the nozzle via the bypass flow path, the part of the recovery flow path, and the part of the individual flow path in this order is formed, so that it is possible to generate a flow in a direction opposite to a direction from the recovery flow path to the liquid storage portion in the part of the recovery flow path.

In Aspect 5 which is a specific example of the Aspect 1, a circulation operation of circulating the liquid in an order of the liquid storage portion, the supply flow path, the individual flow path, the recovery flow path, and the liquid storage portion is executed.

In Aspect 6 which is a specific example of the Aspect 5, during the execution of the circulation operation, the pressurization discharge operation is started by closing the recovery flow path by the on-off valve.

By closing the recovery circuit with the on-off valve while the circulation operation is being executed, it is possible to instantaneously generate the pressure for the liquid in the recovery flow path toward the nozzle. Therefore, according to the Aspect 6, a period required for discharging the bubble can be shortened as compared with an aspect in which the recovery flow path is closed by the on-off valve after the circulation operation is temporarily stopped, and the liquid in the supply flow path is pressurized after the recovery flow path is closed.

In Aspect 7 which is a specific example of the Aspect 5, the liquid ejecting apparatus further includes a pressurizing mechanism that pressurizes the liquid in the supply flow path such that the liquid in the supply flow path flows only in a direction in which the liquid flows from the liquid storage portion to the plurality of individual flow paths via the supply flow path by the circulation operation.

According to the Aspect 7, since it is not necessary to change the direction of the liquid flow in the recovery flow path to the opposite direction by the pressurizing mechanism, the configuration of the liquid ejecting apparatus can be simplified as compared with an aspect in which the direction of the liquid flow in the recovery flow path can be changed in the opposite direction by the pressurizing mechanism.

In Aspect 8 which is a specific example of the Aspect 1, the supply flow path has a first common liquid chamber coupled to the plurality of individual flow paths, the recovery flow path has a second common liquid chamber coupled to the plurality of individual flow paths, and the bypass flow path causes the first common liquid chamber to communicate with the second common liquid chamber.

In the liquid ejecting apparatus according to the Aspect 8, as compared with an aspect in which the bypass flow path is coupled to the flow path other than the second common liquid chamber in the recovery flow path, a range of changing the flow direction in the recovery flow path can be shortened. Therefore, according to the Aspect 8, by shortening the range of changing the flow direction in the recovery flow path, the period required for discharging the bubble can be shortened, and a liquid consumption amount can also be reduced.

In Aspect 9 which is a specific example of the Aspect 1, a flow path resistance of the bypass flow path is smaller than a sum of flow path resistances of the plurality of individual flow paths.

According to the Aspect 9, pressure of the second common liquid chamber can be easily set to positive pressure as compared with an aspect in which the flow path resistance of the bypass flow path is larger than the sum of the flow path resistances of the plurality of individual flow paths.

In Aspect 10 which is a specific example of the Aspect 1, the supply flow path has a first common liquid chamber coupled to the plurality of individual flow paths, the recovery flow path has a second common liquid chamber coupled to the plurality of individual flow paths, a first coupling position between the bypass flow path and the supply flow path is located upstream of the first common liquid chamber, a second coupling position between the bypass flow path and the recovery flow path is located downstream of the second common liquid chamber, and a flow path resistance from the second coupling position to the nozzle is smaller than a flow path resistance from the first coupling position to the nozzle.

According to the Aspect 10, the bubble included in the recovery flow path is easily discharged as compared with an aspect in which the flow path resistance from the second coupling position to the nozzle is larger than the flow path resistance from the first coupling position to the nozzle.

A liquid discharging method of a liquid ejecting apparatus according to Aspect 11, which is another preferred aspect, is a liquid discharging method of a liquid ejecting apparatus including a plurality of nozzles that eject liquid, a plurality of individual flow paths that communicate with each of the plurality of nozzles, a liquid storage portion that stores the liquid to be supplied to each of the plurality of nozzles, a supply flow path for supplying the liquid from the liquid storage portion to the plurality of individual flow paths, a recovery flow path for recovering the liquid from the plurality of individual flow paths to the liquid storage portion, a bypass flow path that couples the supply flow path and the recovery flow path without passing through any of the plurality of individual flow paths, and an on-off valve configured to close and open the recovery flow path, the method includes disposing the on-off valve between the bypass flow path and the liquid storage portion in the recovery flow path, and executing a pressurization discharge operation of discharging the liquid from each of the plurality of nozzles by pressurizing the liquid in the supply flow path in a state in which the recovery flow path is closed by the on-off valve, by the liquid ejecting apparatus.

According to the Aspect 11, the same effect as that of the Aspect 1 can be obtained.

In Aspect 12 which is a specific example of the Aspect 11, the liquid ejecting apparatus further includes a flexible member that defines a part of the recovery flow path upstream from a coupling position between the bypass flow path and the recovery flow path or a portion of the recovery flow path coupled to the bypass flow path and that has flexibility.

According to the Aspect 12, the same effect as that of the Aspect 2 can be obtained.

In Aspect 13 which is a specific example of the Aspect 11, during the execution of the pressurization discharge operation, pressure of the liquid flowing upstream of the on-off valve in the recovery flow path is positive pressure with respect to atmospheric pressure.

According to the Aspect 13, the same effect as that of the Aspect 3 can be obtained.

In Aspect 14 which is a specific example of the Aspect 11, a flow of the liquid from the supply flow path to the nozzle via a part of the individual flow path and a flow of the liquid from the supply flow path to the nozzle via the bypass flow path, a part of the recovery flow path, and a part of the individual flow path in this order are formed by the pressurization discharge operation.

According to the Aspect 14, the same effect as that of the Aspect 4 can be obtained.

In Aspect 15 which is a specific example of the Aspect 11, the liquid ejecting apparatus executes a circulation operation of circulating the liquid in an order of the liquid storage portion, the supply flow path, the individual flow path, the recovery flow path, and the liquid storage portion.

According to the Aspect 15, the same effect as that of the Aspect 5 can be obtained.

In Aspect 16 which is a specific example of the Aspect 15, the liquid ejecting apparatus starts the pressurization discharge operation by closing the recovery flow path by the on-off valve during the execution of the circulation operation.

According to the Aspect 16, the same effect as that of the Aspect 6 can be obtained.

In Aspect 17 which is a specific example of the Aspect 15, the liquid ejecting apparatus further includes a pressurizing mechanism that pressurizes the liquid in the supply flow path such that the liquid in the supply flow path flows only in a direction in which the liquid flows from the liquid storage portion to the plurality of individual flow paths via the supply flow path by the circulation operation.

According to the Aspect 17, the same effect as that of the Aspect 7 can be obtained.

In Aspect 18 which is a specific example of the Aspect 11, the supply flow path has a first common liquid chamber coupled to the plurality of individual flow paths, the recovery flow path has a second common liquid chamber coupled to the plurality of individual flow paths, and the bypass flow path causes the first common liquid chamber to communicate with the second common liquid chamber.

According to the Aspect 18, the same effect as that of the Aspect 8 can be obtained.

In Aspect 19 which is a specific example of the Aspect 11, a flow path resistance of the bypass flow path is smaller than a sum of flow path resistances of the plurality of individual flow paths.

According to the Aspect 19, the same effect as that of the Aspect 9 can be obtained.

In Aspect 20 which is a specific example of the Aspect 11, the supply flow path has a first common liquid chamber coupled to the plurality of individual flow paths, the recovery flow path has a second common liquid chamber coupled to the plurality of individual flow paths, a first coupling position between the bypass flow path and the supply flow path is located upstream of the first common liquid chamber, a second coupling position between the bypass flow path and the recovery flow path is located downstream of the second common liquid chamber, and a flow path resistance from the second coupling position to the nozzle is smaller than a flow path resistance from the first coupling position to the nozzle.

According to the Aspect 20, the same effect as that of the Aspect 10 can be obtained.

What is claimed is:

1. A liquid ejecting apparatus comprising:
- nozzles configured to eject liquid;
- individual flow paths communicating with each of the nozzles;
- a liquid storage portion storing the liquid to be supplied to each of the nozzles;
- a supply flow path for supplying the liquid from the liquid storage portion to the individual flow paths;
- a recovery flow path for recovering the liquid from the individual flow paths to the liquid storage portion;
- a bypass flow path that couples the supply flow path and the recovery flow path without passing through any of the individual flow paths; and
- an on-off valve configured to close and open the recovery flow path, wherein
- the on-off valve is disposed between the bypass flow path and the liquid storage portion in the recovery flow path, and
- a pressurization discharge operation of discharging the liquid from each of the nozzles by pressurizing the liquid in the supply flow path in a state in which the recovery flow path is closed by the on-off valve is executed.

2. The liquid ejecting apparatus according to claim **1**, further comprising:
- a flexible member that defines a part of the recovery flow path upstream from a coupling position between the bypass flow path and the recovery flow path or a portion of the recovery flow path coupled to the bypass flow path and that has flexibility.

3. The liquid ejecting apparatus according to claim **2**, wherein
- during the execution of the pressurization discharge operation, pressure of the liquid flowing upstream of the on-off valve in the recovery flow path is positive pressure with respect to atmospheric pressure.

4. The liquid ejecting apparatus according to claim **1**, wherein
- a flow of the liquid from the supply flow path to the nozzle via a part of the individual flow path and a flow of the liquid from the supply flow path to the nozzle via the bypass flow path, a part of the recovery flow path, and a part of the individual flow path in this order are formed by the pressurization discharge operation.

5. The liquid ejecting apparatus according to claim **1**, wherein
- a circulation operation of circulating the liquid in an order of the liquid storage portion, the supply flow path, the individual flow path, the recovery flow path, and the liquid storage portion is executed.

6. The liquid ejecting apparatus according to claim **5**, wherein
- during the execution of the circulation operation, the pressurization discharge operation is started by closing the recovery flow path by the on-off valve.

7. The liquid ejecting apparatus according to claim **5**, further comprising:
- a pressurizing mechanism that pressurizes the liquid in the supply flow path such that the liquid in the supply flow path flows only in a direction in which the liquid flows from the liquid storage portion to the individual flow paths via the supply flow path by the circulation operation.

8. The liquid ejecting apparatus according to claim **1**, wherein
- the supply flow path has a first common liquid chamber coupled to the individual flow paths,
- the recovery flow path has a second common liquid chamber coupled to the individual flow paths, and
- the bypass flow path makes the first common liquid chamber communicate with the second common liquid chamber.

9. The liquid ejecting apparatus according to claim **1**, wherein
- a flow path resistance of the bypass flow path is smaller than a sum of flow path resistances of the individual flow paths.

10. The liquid ejecting apparatus according to claim **1**, wherein
- the supply flow path has a first common liquid chamber coupled to the individual flow paths,
- the recovery flow path has a second common liquid chamber coupled to the individual flow paths,
- a first coupling position between the bypass flow path and the supply flow path is located upstream of the first common liquid chamber,
- a second coupling position between the bypass flow path and the recovery flow path is located downstream of the second common liquid chamber, and
- a flow path resistance from the second coupling position to the nozzle is smaller than a flow path resistance from the first coupling position to the nozzle.

11. A liquid discharging method of a liquid ejecting apparatus including
- nozzles configured to eject liquid,
- individual flow paths communicating with each of the nozzles,
- a liquid storage portion storing the liquid to be supplied to each of the nozzles,
- a supply flow path for supplying the liquid from the liquid storage portion to the individual flow paths,
- a recovery flow path for recovering the liquid from the individual flow paths to the liquid storage portion,
- a bypass flow path that couples the supply flow path and the recovery flow path without passing through any of the individual flow paths, and
- an on-off valve configured to close and open the recovery flow path, the method comprising:
- disposing the on-off valve between the bypass flow path and the liquid storage portion in the recovery flow path; and

executing a pressurization discharge operation of discharging the liquid from each of the nozzles by pressurizing the liquid in the supply flow path in a state in which the recovery flow path is closed by the on-off valve, by the liquid ejecting apparatus.

12. The liquid discharging method according to claim **11**, wherein

the liquid ejecting apparatus further includes a flexible member that defines a part of the recovery flow path upstream from a coupling position between the bypass flow path and the recovery flow path or a portion of the recovery flow path coupled to the bypass flow path and that has flexibility.

13. The liquid discharging method according to claim **12**, wherein

during the execution of the pressurization discharge operation, pressure of the liquid flowing upstream of the on-off valve in the recovery flow path is positive pressure with respect to atmospheric pressure.

14. The liquid discharging method according to claim **11**, wherein

a flow of the liquid from the supply flow path to the nozzle via a part of the individual flow path and a flow of the liquid from the supply flow path to the nozzle via the bypass flow path, a part of the recovery flow path, and a part of the individual flow path in this order are formed by the pressurization discharge operation.

15. The liquid discharging method according to claim **11**, wherein

the liquid ejecting apparatus executes a circulation operation of circulating the liquid in an order of the liquid storage portion, the supply flow path, the individual flow path, the recovery flow path, and the liquid storage portion.

16. The liquid discharging method according to claim **15**, wherein

the liquid ejecting apparatus starts the pressurization discharge operation by closing the recovery flow path by the on-off valve during the execution of the circulation operation.

17. The liquid discharging method according to claim **15**, wherein

the liquid ejecting apparatus includes a pressurizing mechanism that pressurizes the liquid in the supply flow path such that the liquid in the supply flow path flows only in a direction in which the liquid flows from the liquid storage portion to the individual flow paths via the supply flow path by the circulation operation.

18. The liquid discharging method according to claim **11**, wherein

the supply flow path has a first common liquid chamber coupled to the individual flow paths,

the recovery flow path has a second common liquid chamber coupled to the individual flow paths, and

the bypass flow path makes the first common liquid chamber communicate with the second common liquid chamber.

19. The liquid discharging method according to claim **11**, wherein

a flow path resistance of the bypass flow path is smaller than a sum of flow path resistances of the individual flow paths.

20. The liquid discharging method according to claim **11**, wherein

the supply flow path has a first common liquid chamber coupled to the individual flow paths,

the recovery flow path has a second common liquid chamber coupled to the individual flow paths,

a first coupling position between the bypass flow path and the supply flow path is located upstream of the first common liquid chamber,

a second coupling position between the bypass flow path and the recovery flow path is located downstream of the second common liquid chamber, and

a flow path resistance from the second coupling position to the nozzle is smaller than a flow path resistance from the first coupling position to the nozzle.

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