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(54) **MANUFACTURING METHOD OF LIQUID EJECTING HEAD**

(71) Applicant: **SEIKO EPSON CORPORATION**, Tokyo (JP)

(72) Inventors: **Hiroaki OKUI**, Azumino (JP); **Shun KATSUIE**, Matsumoto (JP); **Hirokazu YANAGIHARA**, Chino (JP); **Ayumi YOKOO**, Matsumoto (JP); **Yu HASEGAWA**, Shiojiri (JP)

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(57) **ABSTRACT**

In a method of manufacturing a liquid ejecting head including a plurality of head modules each having a chip including at least a nozzle plate in which a plurality of nozzles is formed and a flow path opening forming member, and a holder holding the plurality of head modules, the method includes a first positioning step of optically positioning the nozzle plate and the flow path opening forming member with reference to the nozzles, and a second positioning step of positioning the head module and the holder by press fitting one of a first positioning portion of the flow path opening forming member and a second positioning portion of the holder into the other of first positioning portion and the second positioning portion.

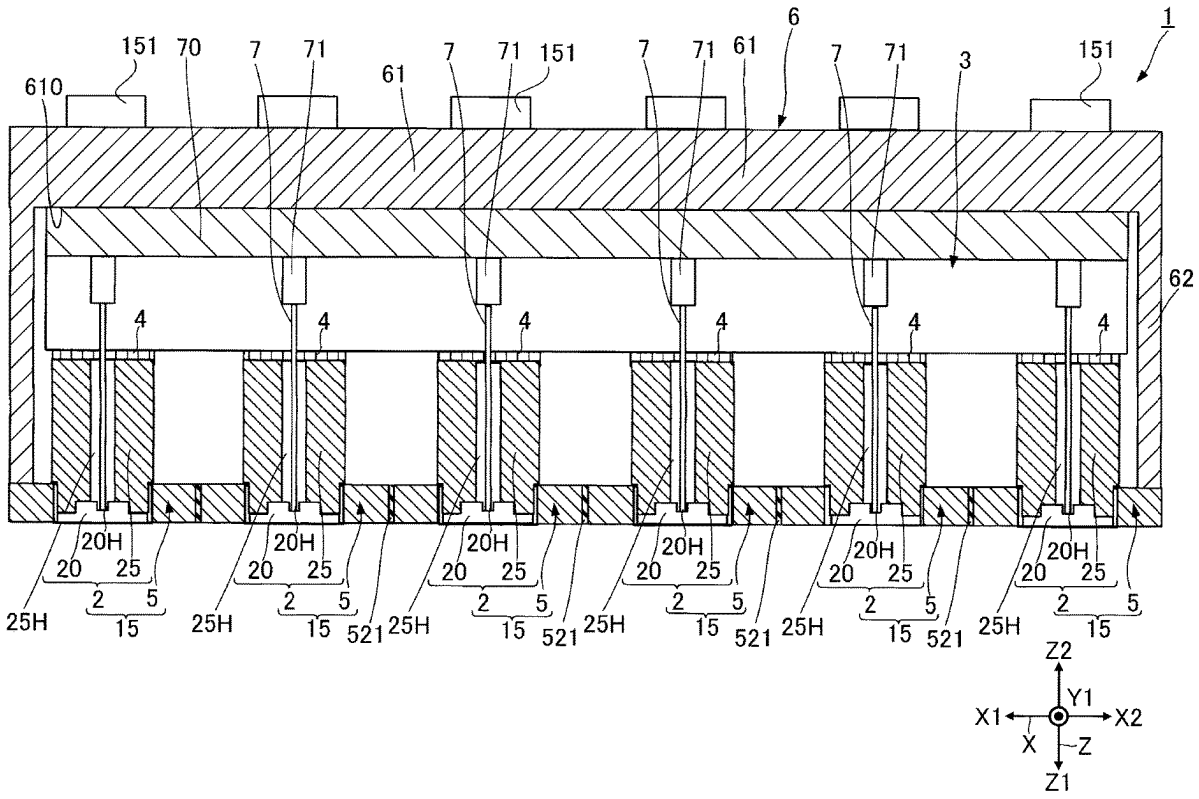


FIG. 1

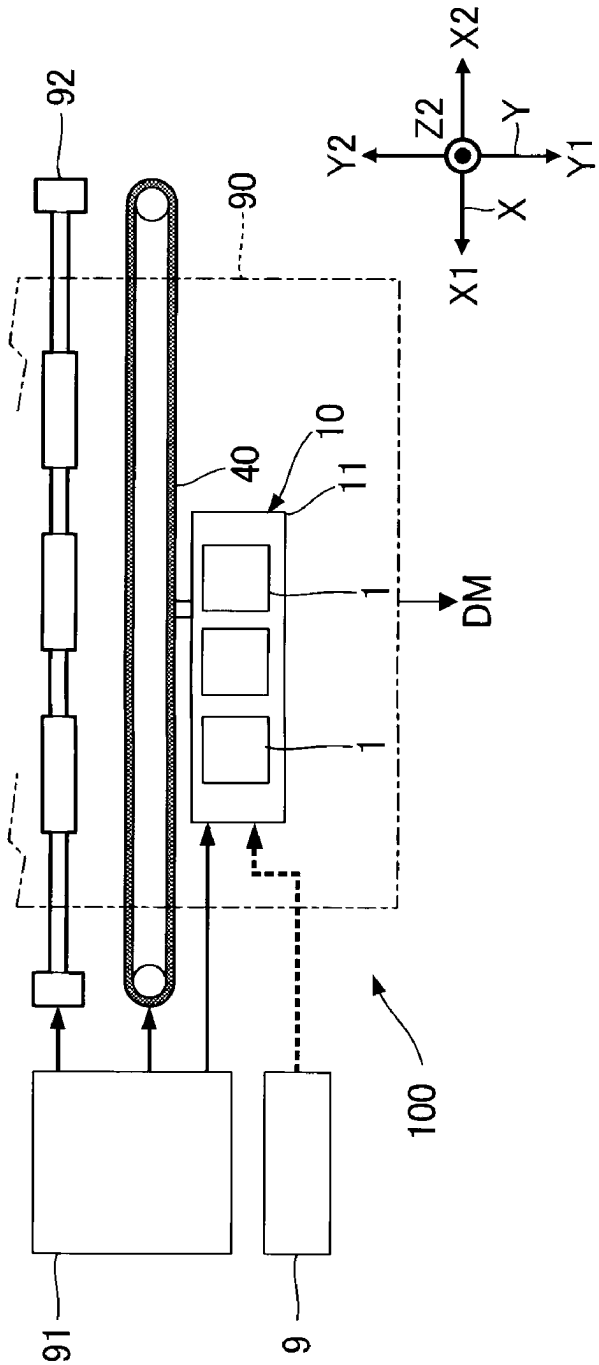


FIG. 2

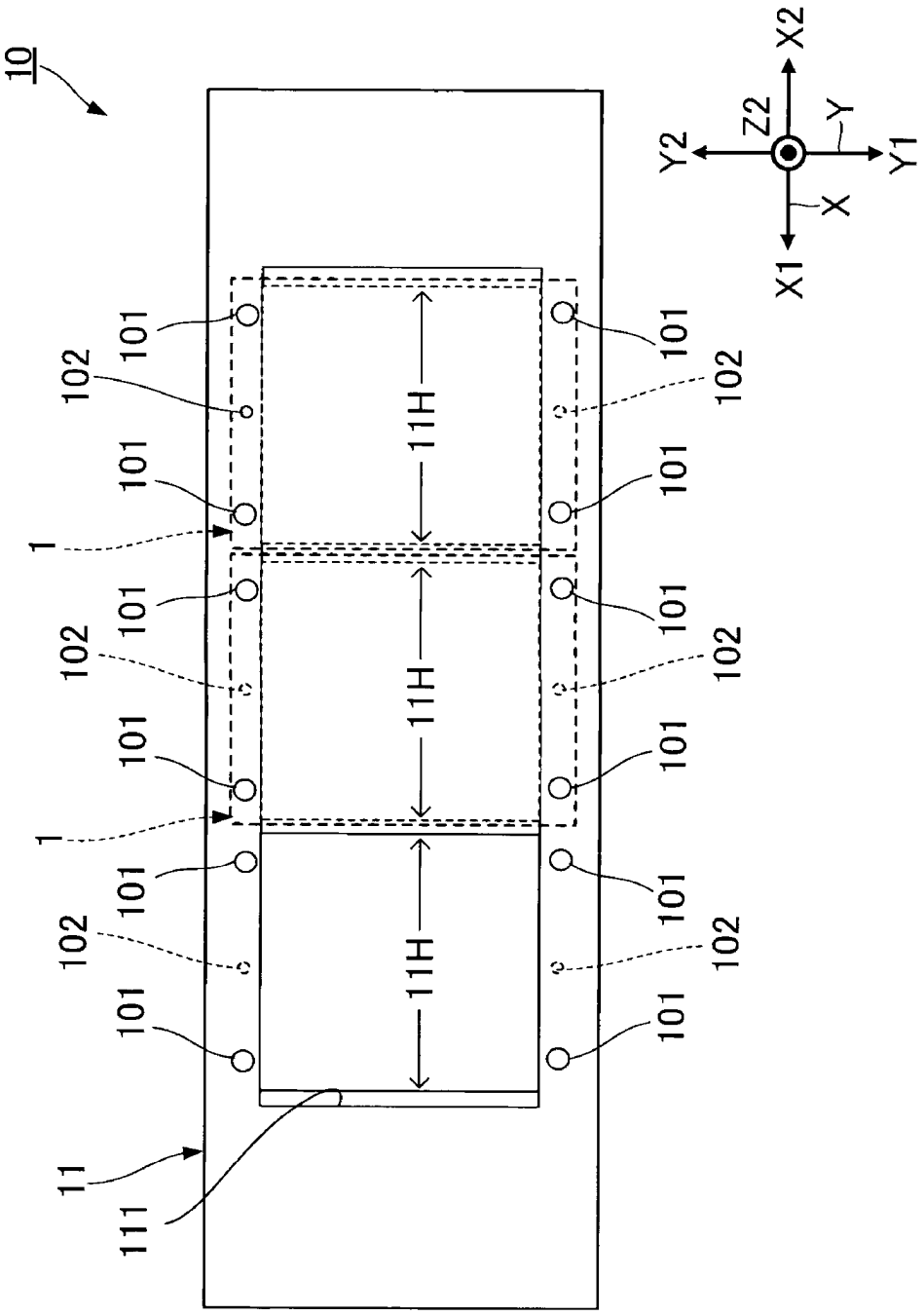
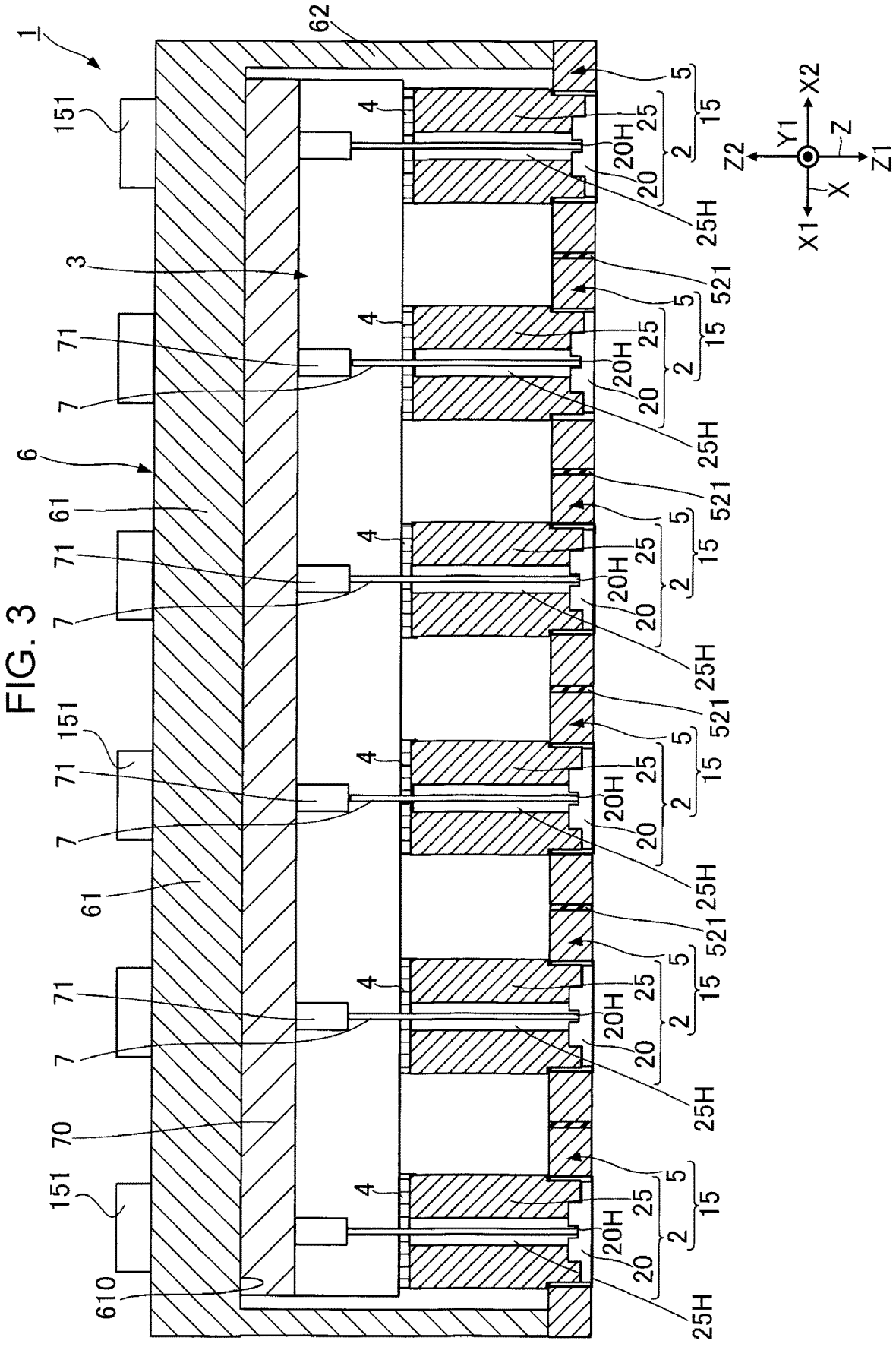


FIG. 3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62
151
3
71
7
6
61
71
7
151
71
7
61
71
7
70
151
610
4
5
15
2
25
20H
20
25H
521
X1
X2
Y1
Y2
Z
Z1
Z2
X

FIG. 4

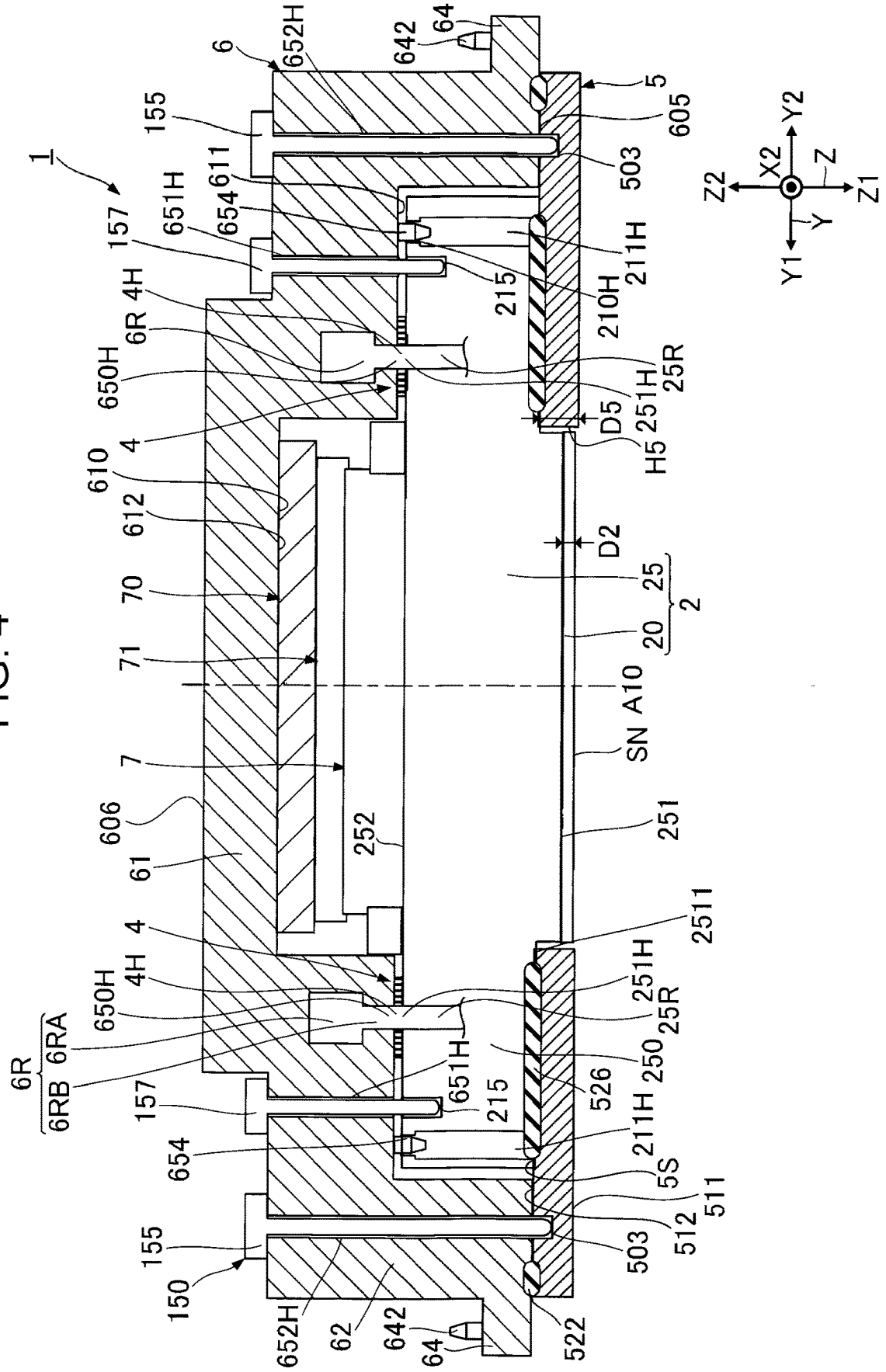

1
6
652H
642
64
5
605
155
611
503
654
651H
157
211H
215
210H
6R
4H
650H
25R
251H
D5
H5
4
610
612
D2
25
2
70
20
71
A10
SN
7
606
252
251
61
2511
6RA
6RB
526
250
5S
511
512
150
62
522
X2
Y2
Z
Z2
Z1
Y
Y1

FIG. 5

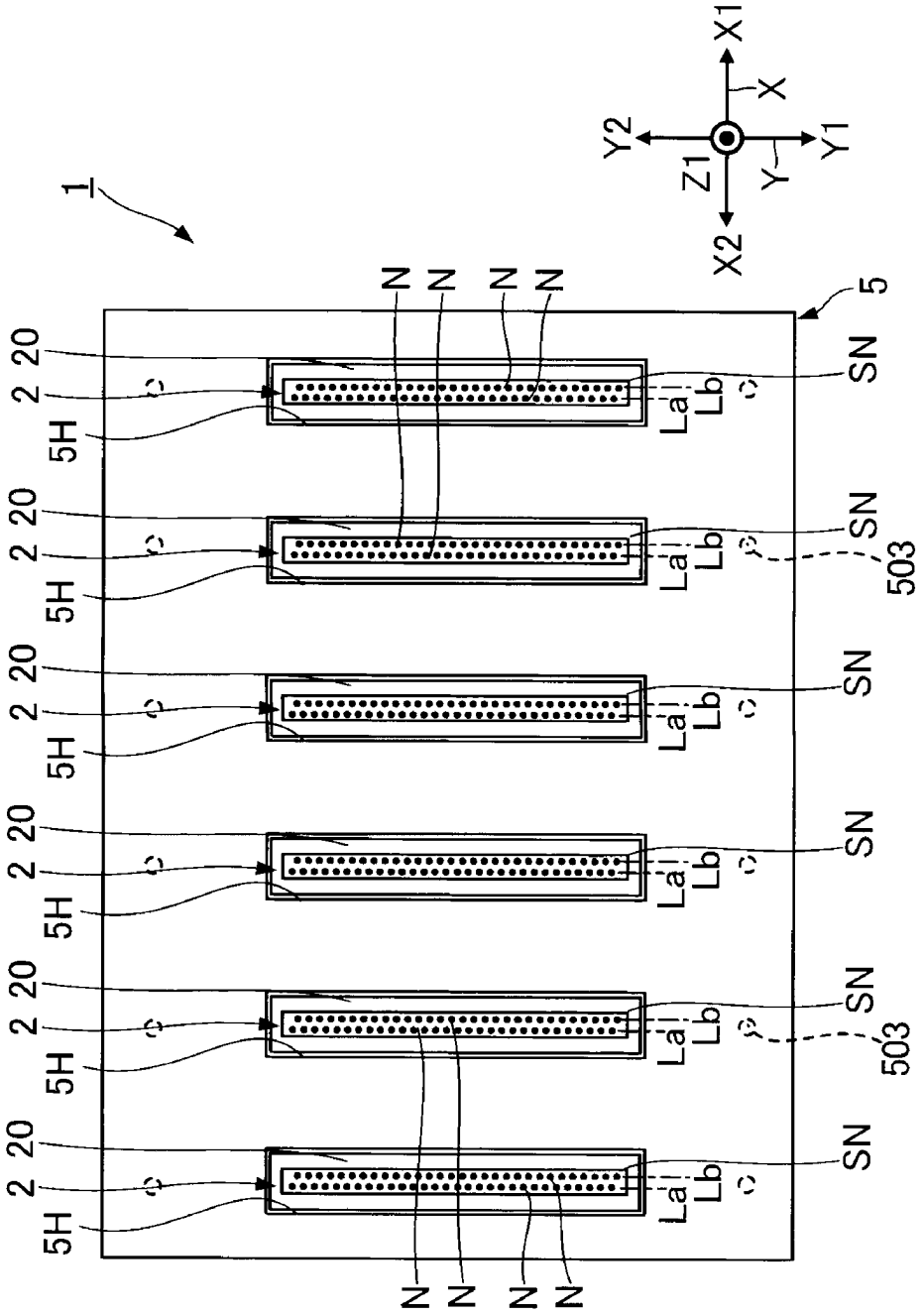


FIG 6

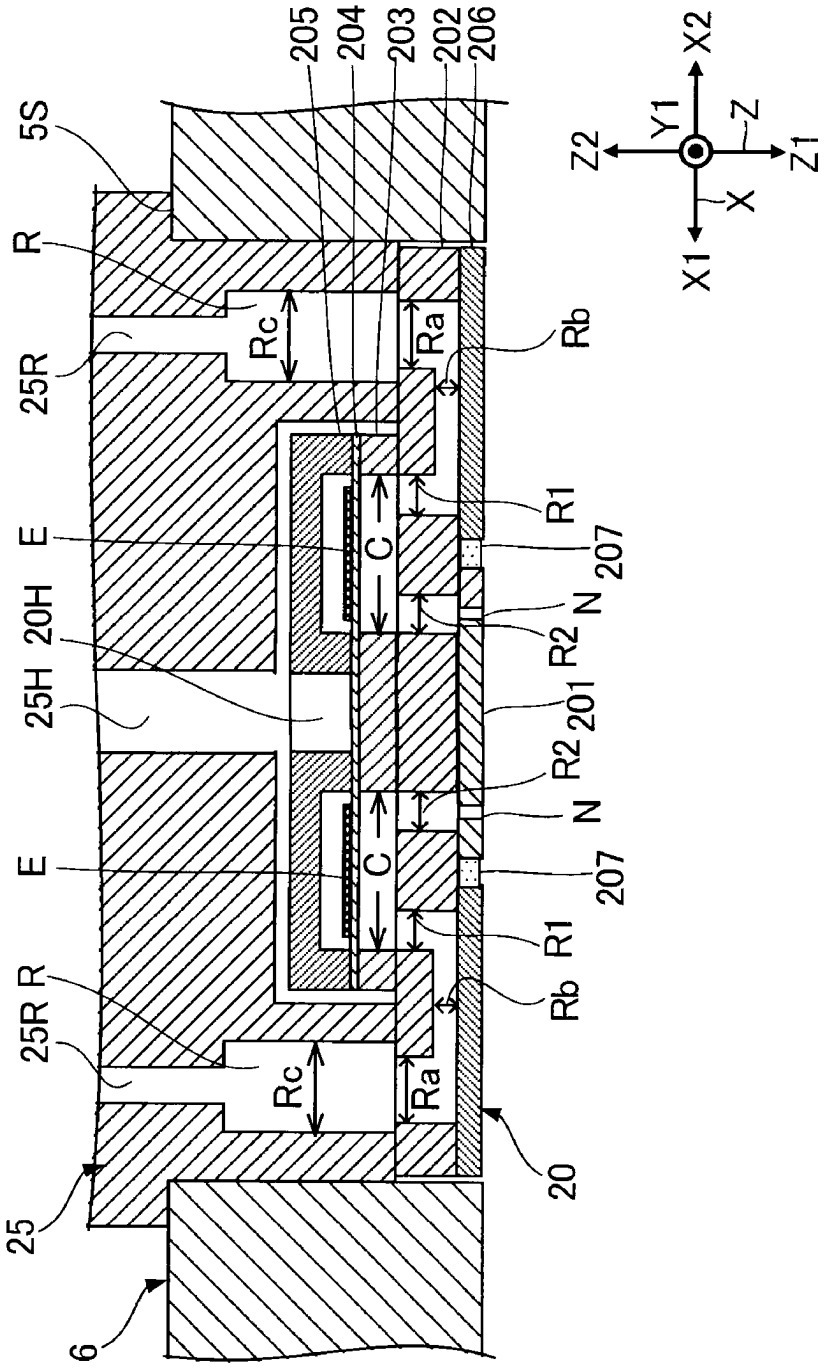

205
204
203
202
206
5S
R
25R
Rc
Ra
Rb
E
C
R1
207
N
20H
25H
R2
201
25
6
20
X2
Y1
Z
Z2
Z1
X
X1

FIG. 7

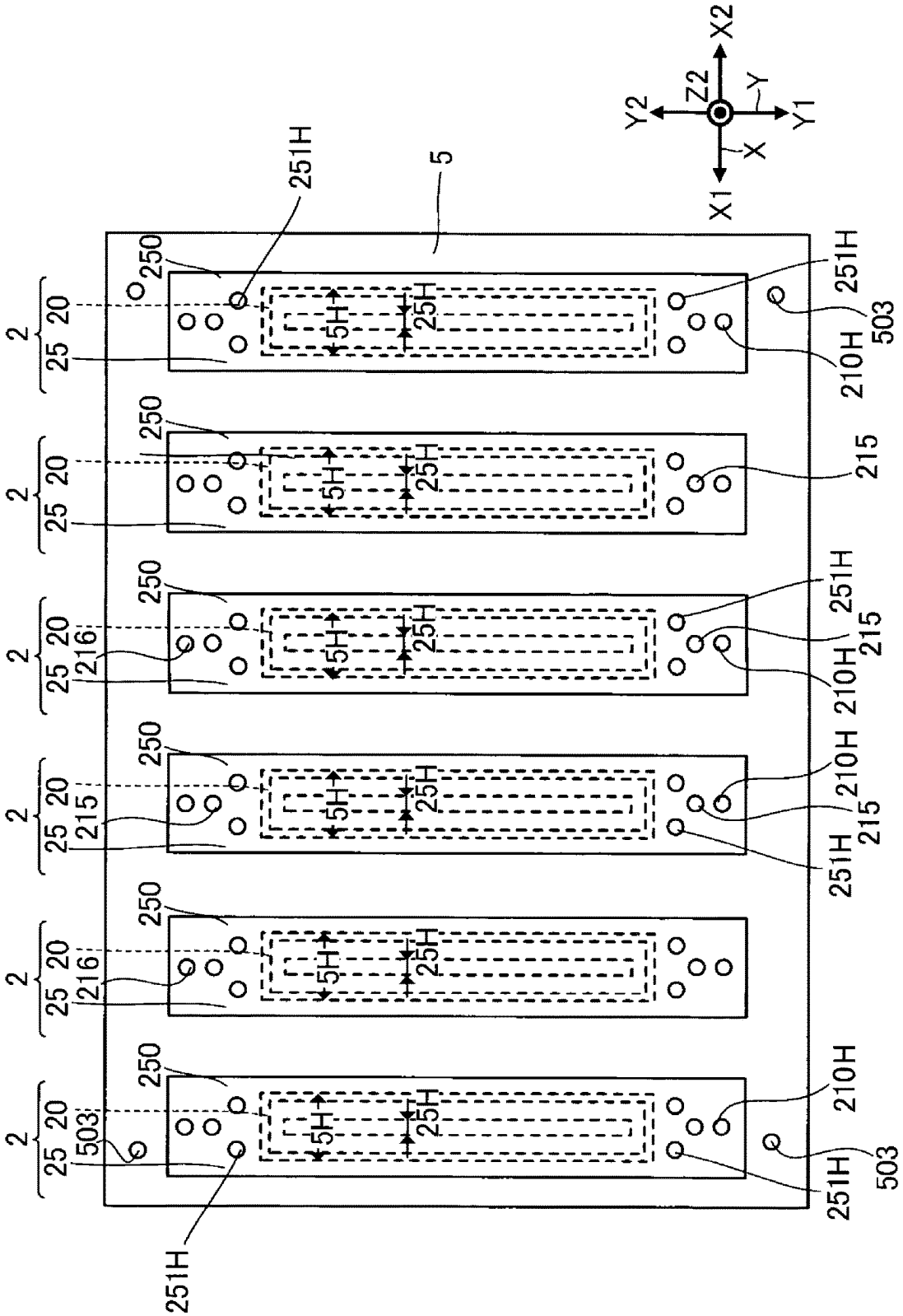


FIG. 8

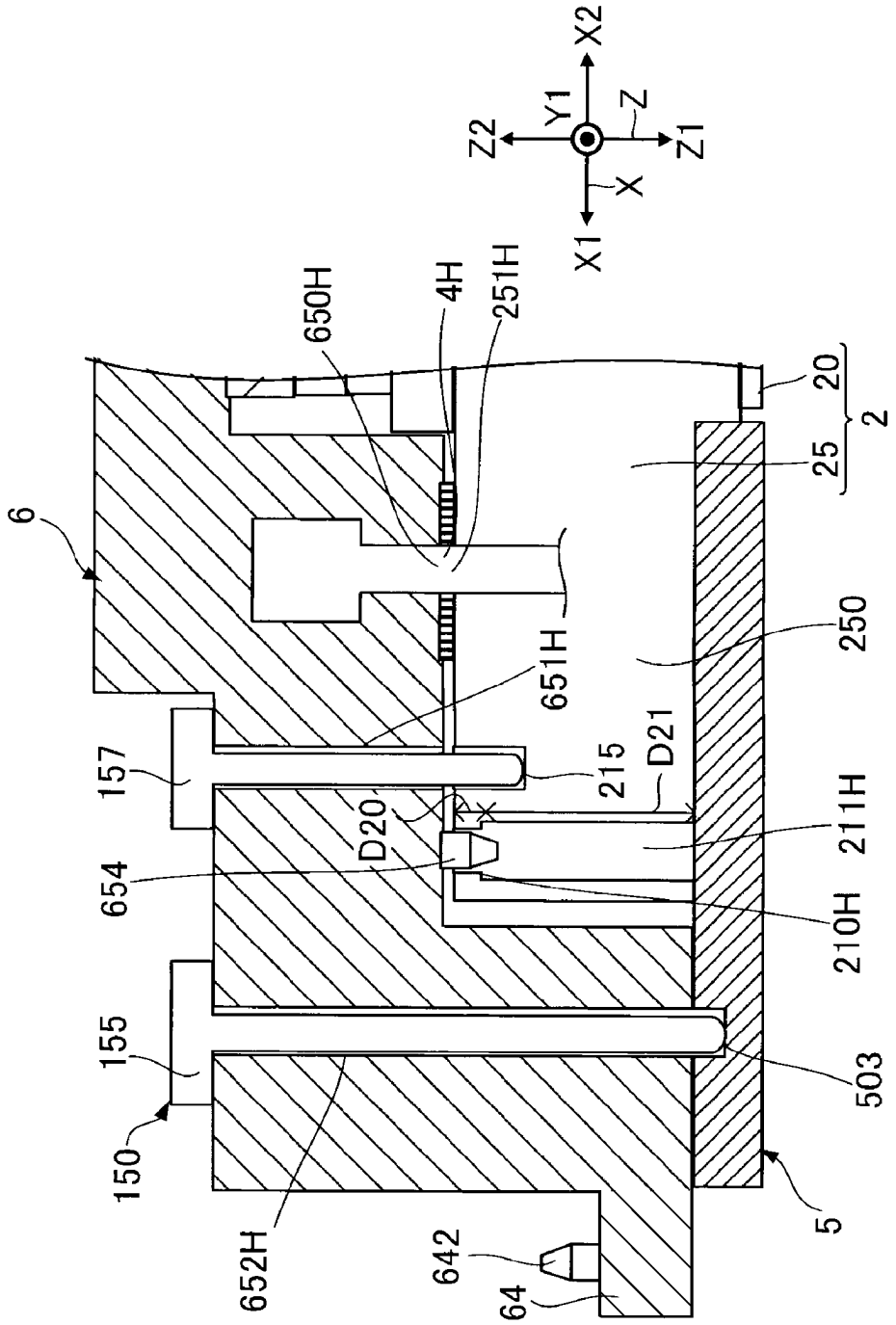

X2
Y1
Z
Z2
Z1
X
X1
650H
4H
251H
20
2
25
6
250
651H
157
215
D21
D20
211H
654
210H
155
503
150
5
652H
642
64

FIG. 9

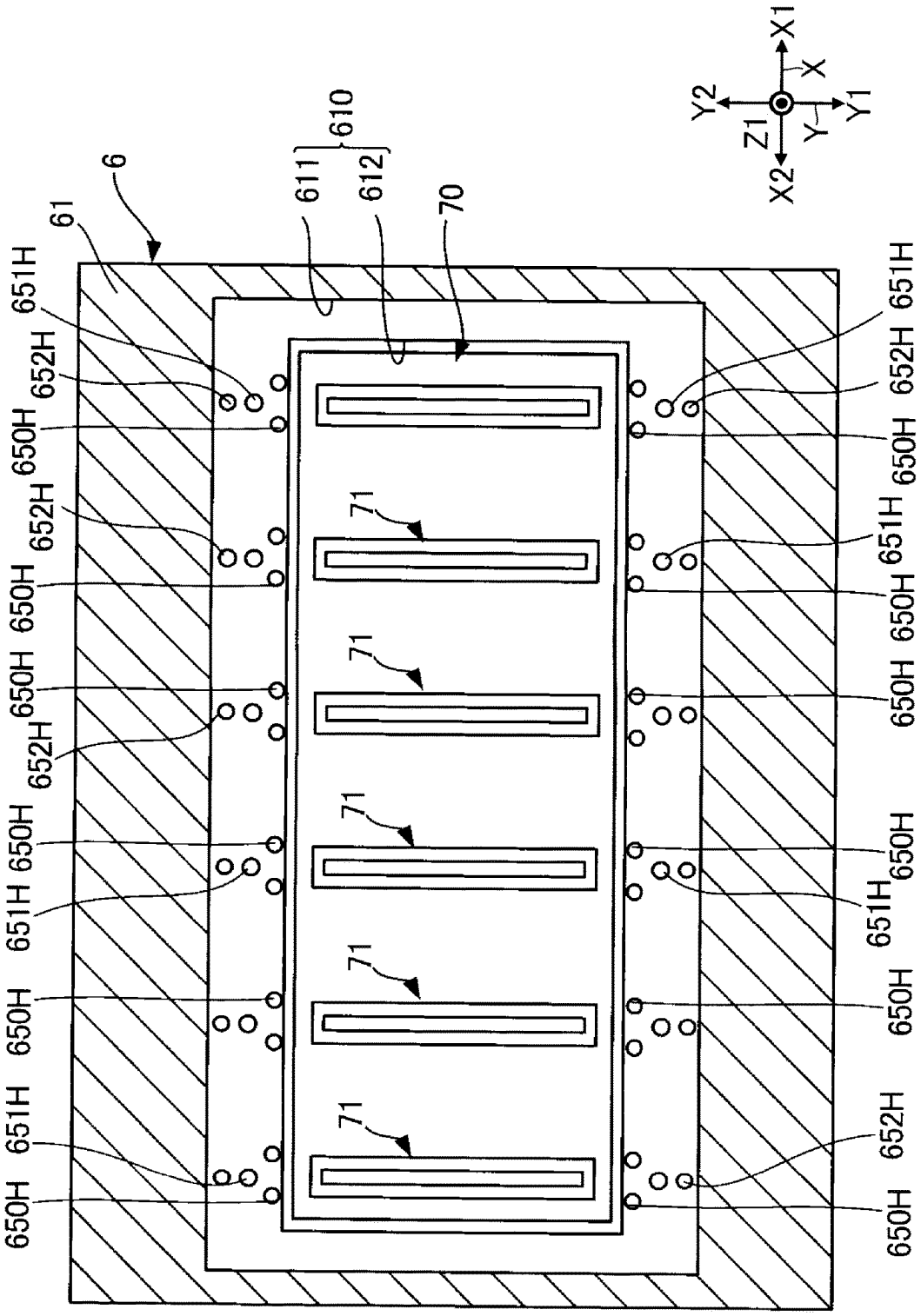


FIG. 10

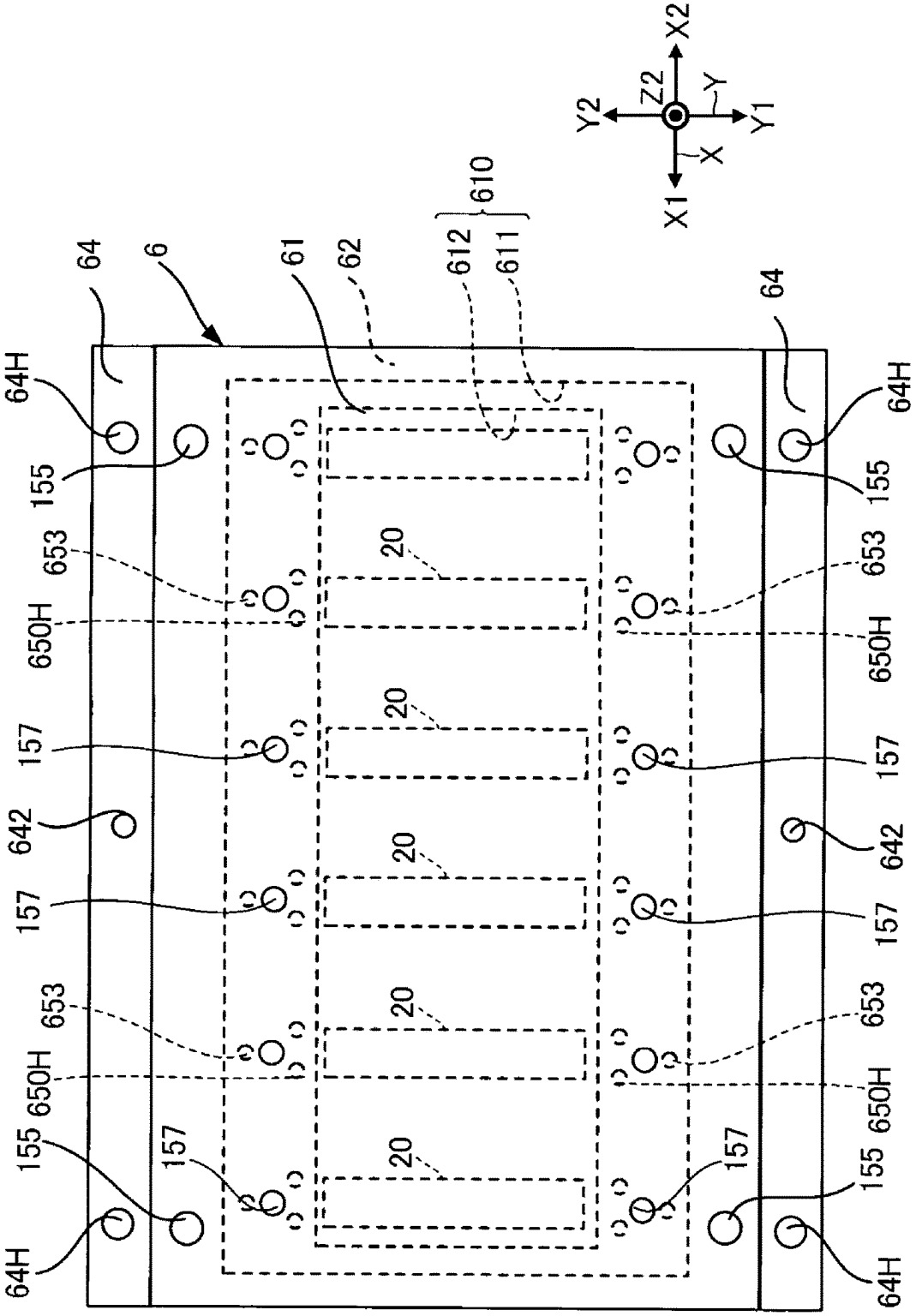


FIG. 11

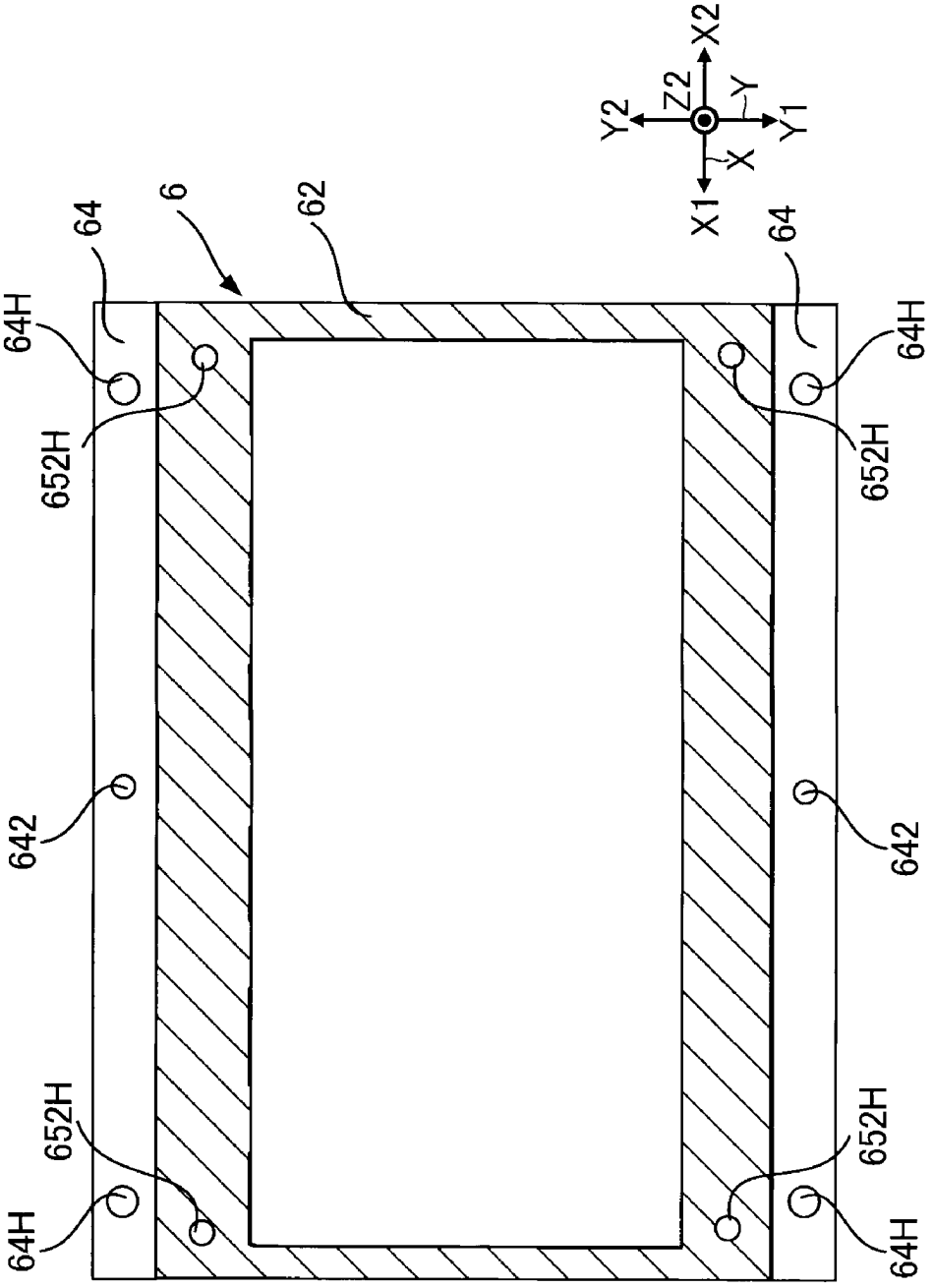

X2
Z2
Y
Y2
Y1
X
X1
64
6
62
64
64H
652H
652H
64H
642
642
652H
652H
64H
64H

FIG. 12

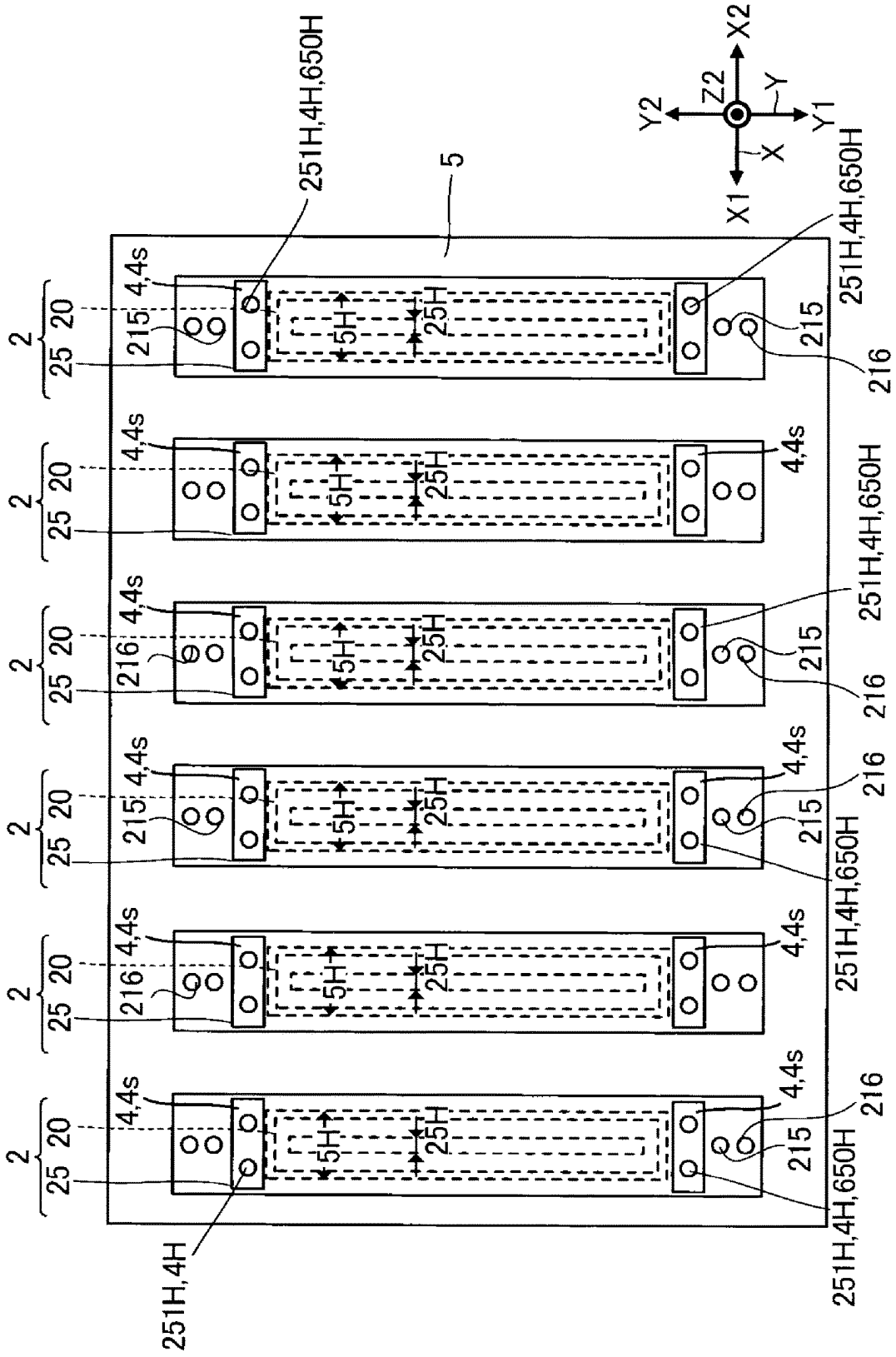


FIG. 13

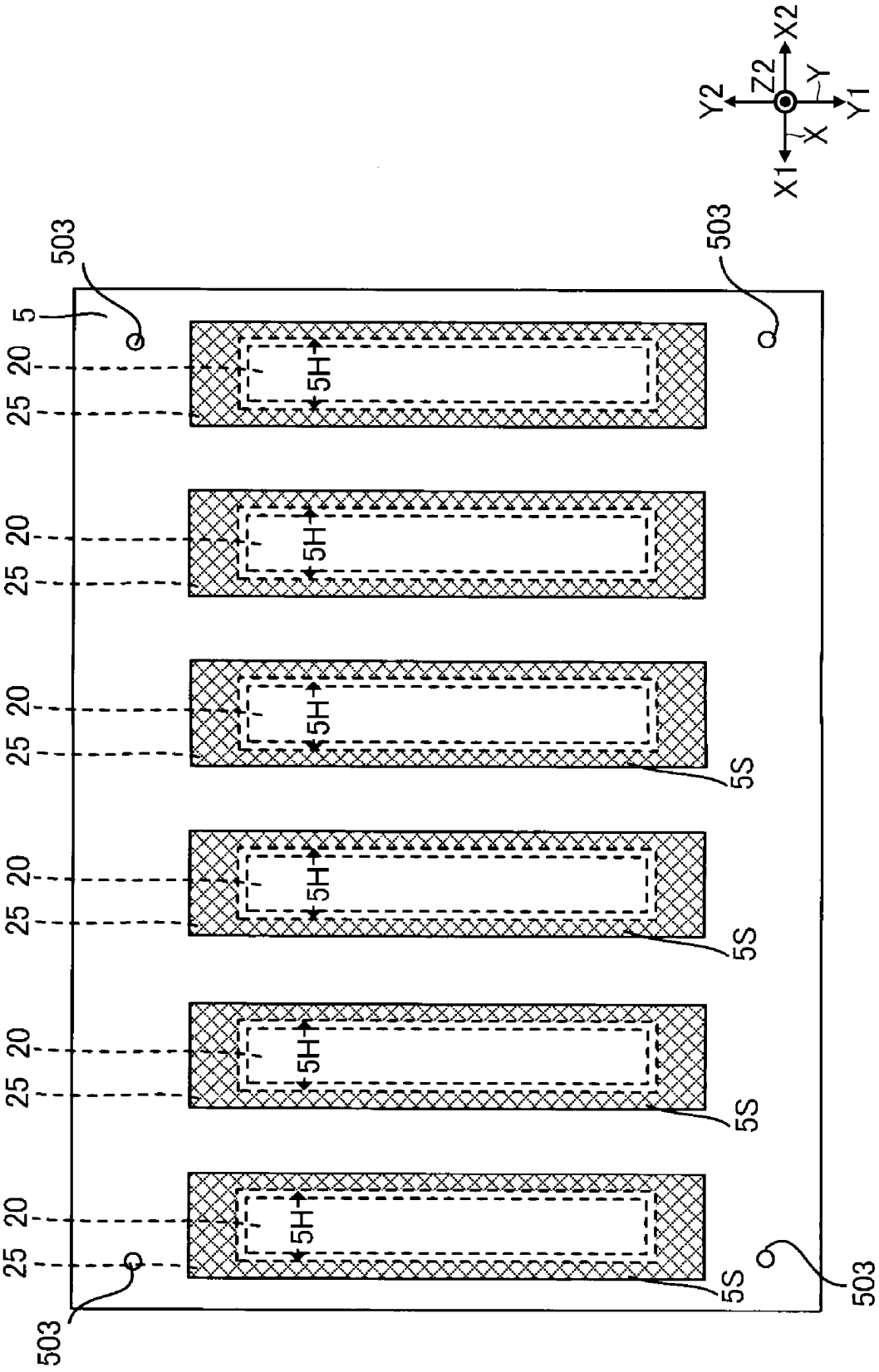


FIG. 14

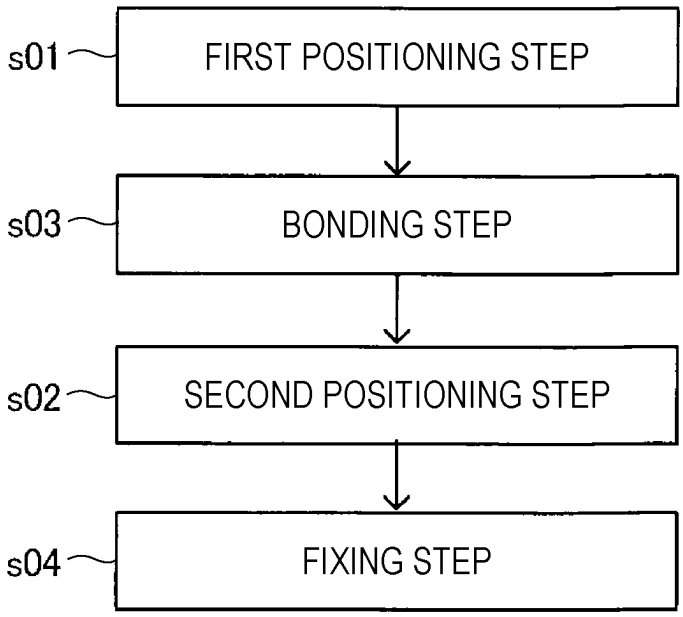

s01
FIRST POSITIONING STEP
s03
BONDING STEP
s02
SECOND POSITIONING STEP
s04
FIXING STEP

FIG. 15

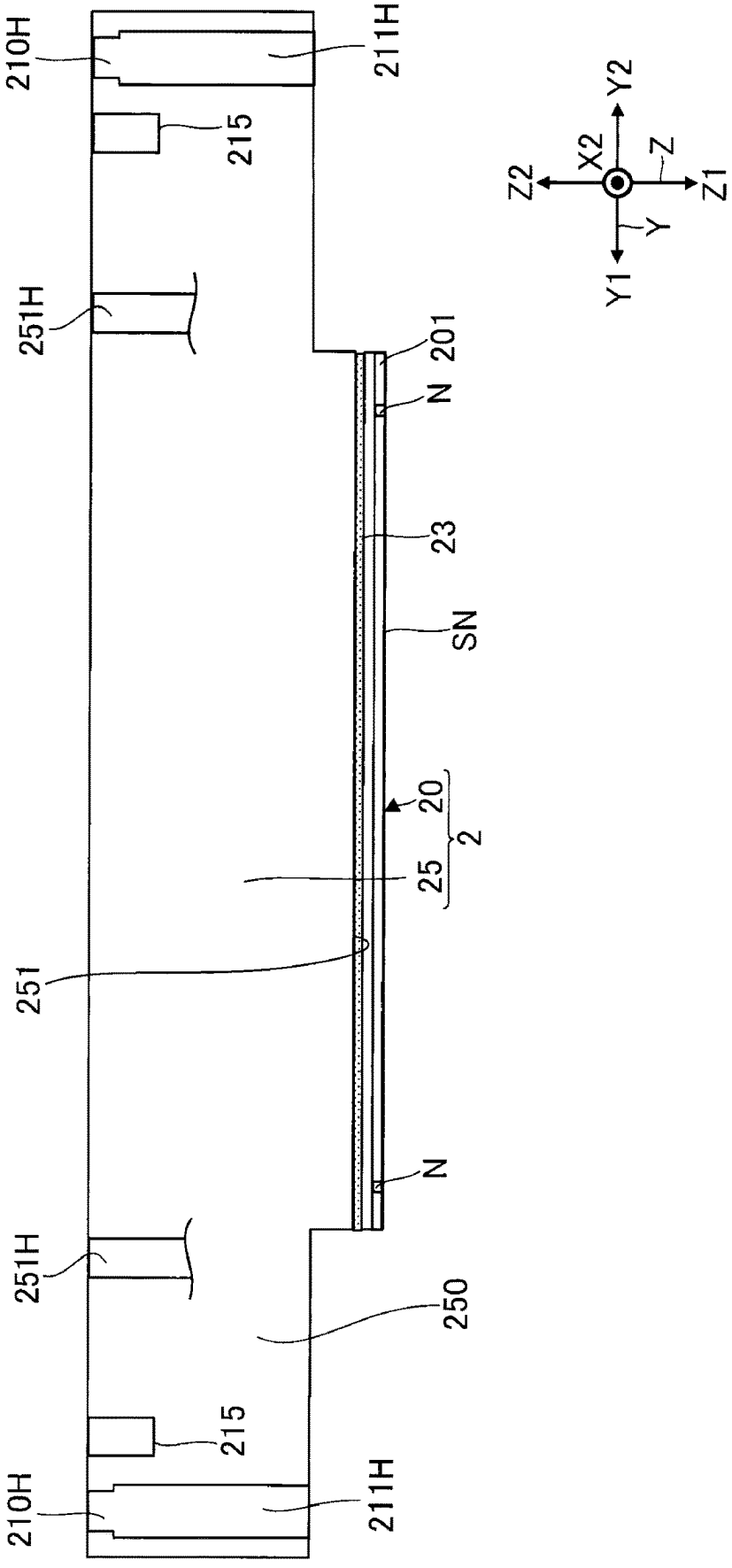

210H
211H
215
251H
201
N
23
SN
20
2
25
251
N
251H
250
215
210H
211H
Y2
X2
Z
Z2
Z1
Y
Y1

FIG. 16

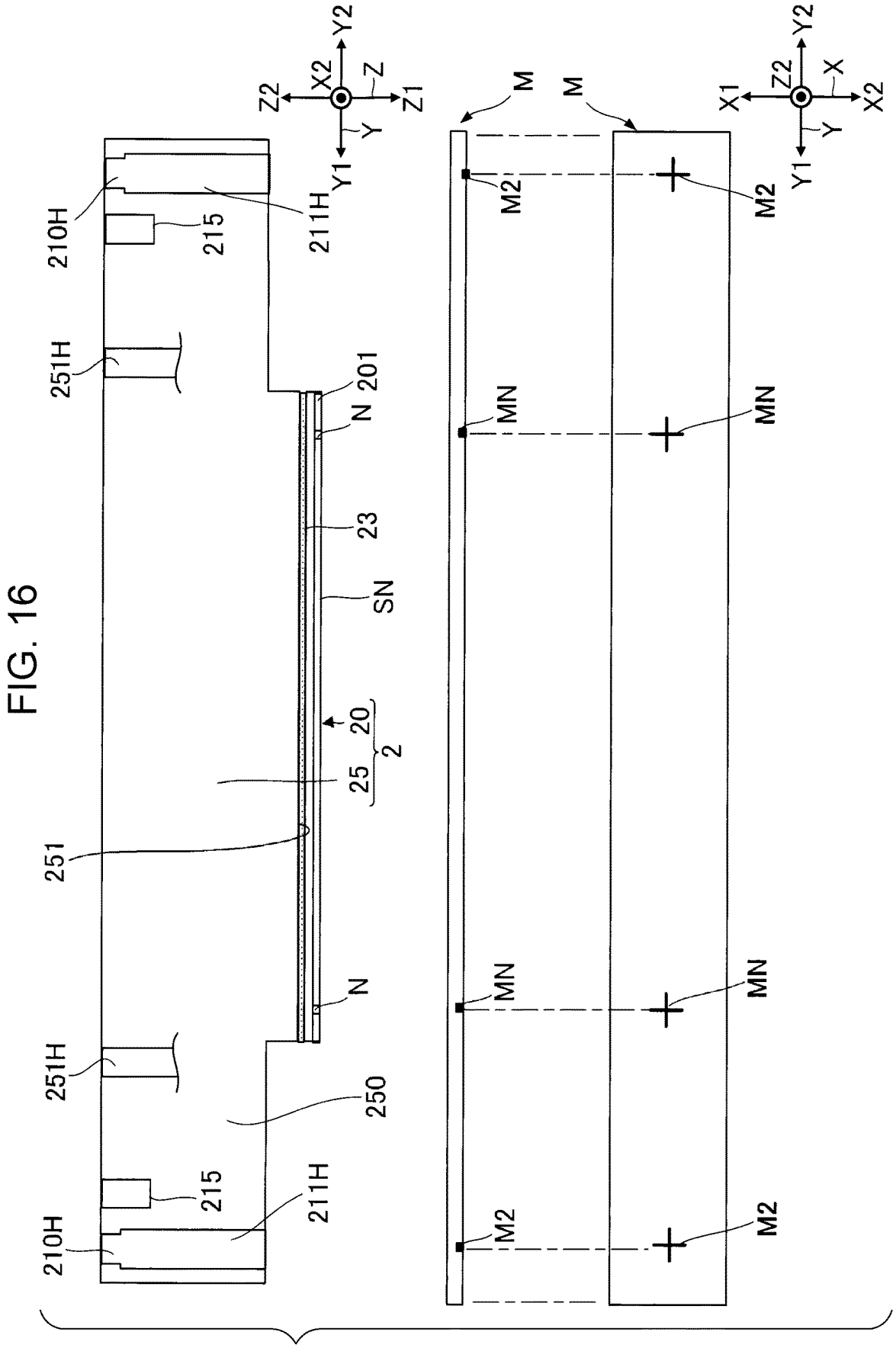

Z2
X2
Y2
Z
Z1
Y
Y1
X1
Z2
X
X2
Y2
Y
Y1
M
M
M2
M2
MN
MN
MN
MN
M2
M2
210H
215
211H
251H
201
N
23
SN
20
2
25
251
N
251H
250
215
211H
210H

FIG. 17

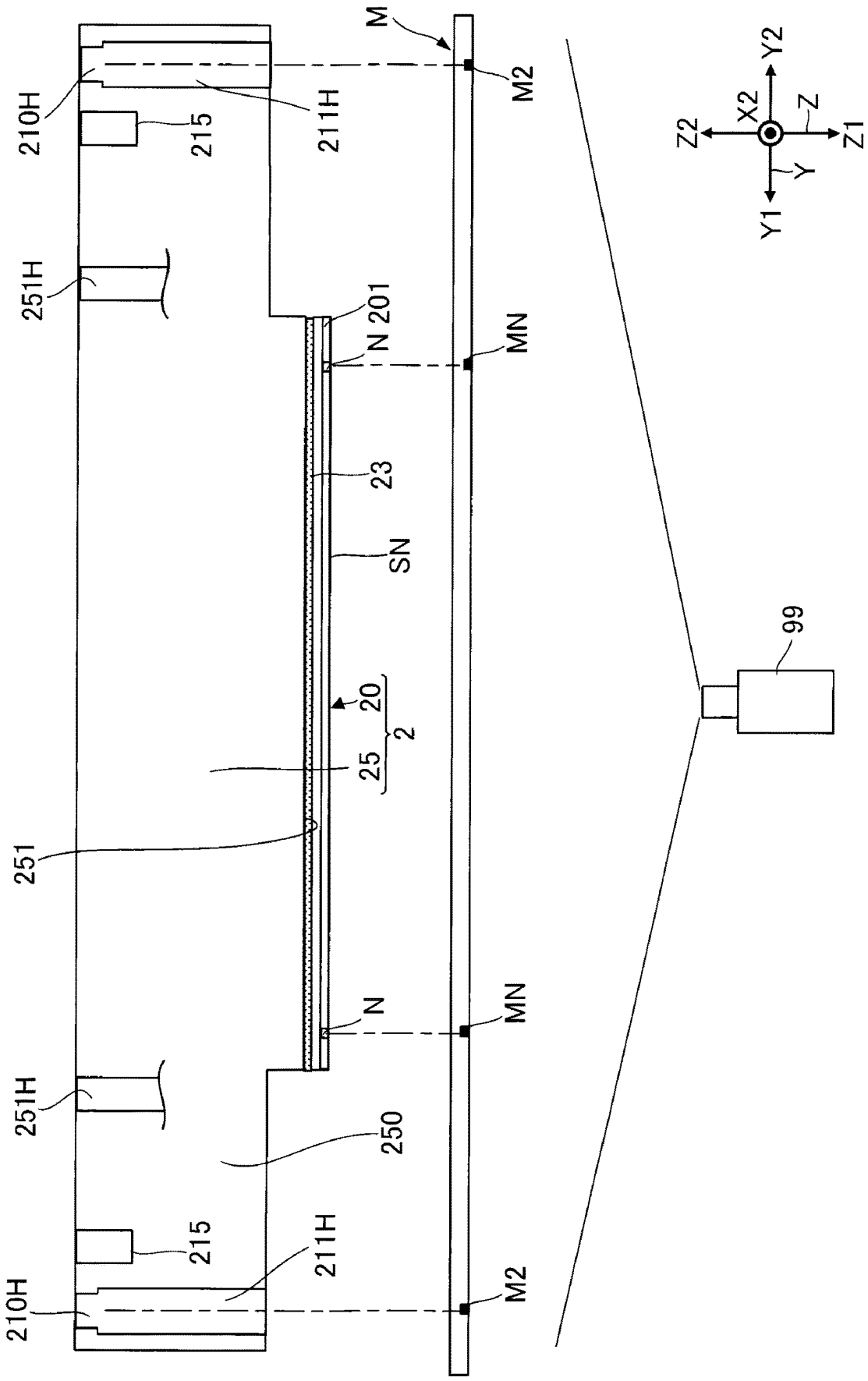

M
M2
210H
215
211H
251H
N 201
MN
23
SN
20
2
25
251
N
MN
250
251H
215
211H
210H
M2
99
Y2
X2
Z
Z2
Z1
Y
Y1

FIG. 18

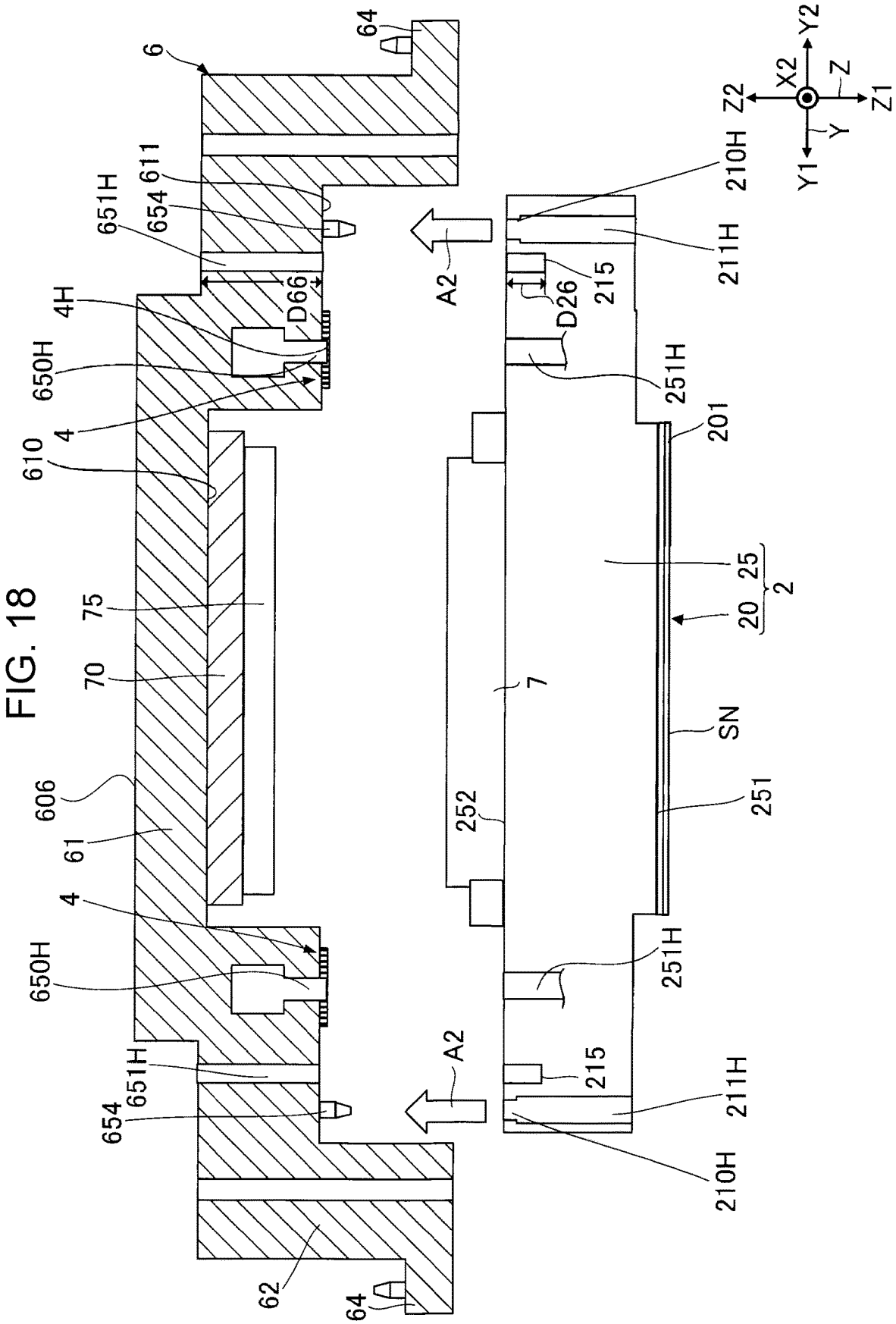

6
64
611
654
651H
4H
650H
4
610
D66
A2
210H
211H
215
D26
251H
201
25
20
2
7
SN
251
252
606
61
75
70
62
Y2
X2
Z
Z2
Z1
Y
Y1

FIG. 19

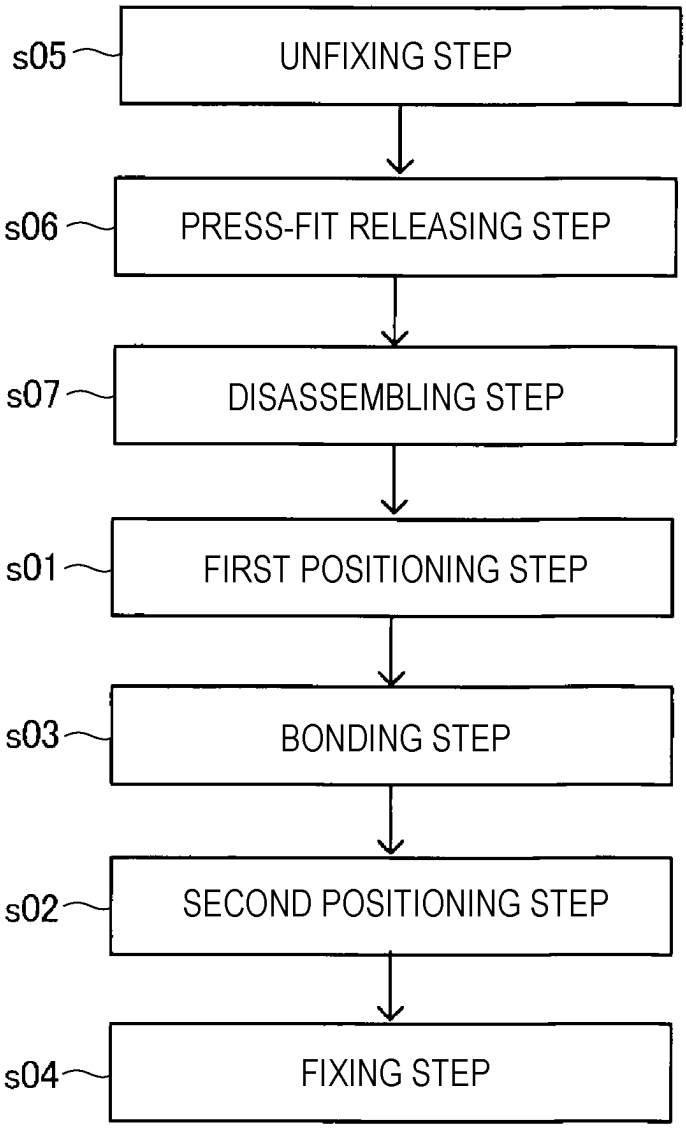

s05
UNFIXING STEP
s06
PRESS-FIT RELEASING STEP
s07
DISASSEMBLING STEP
s01
FIRST POSITIONING STEP
s03
BONDING STEP
s02
SECOND POSITIONING STEP
s04
FIXING STEP

FIG. 20

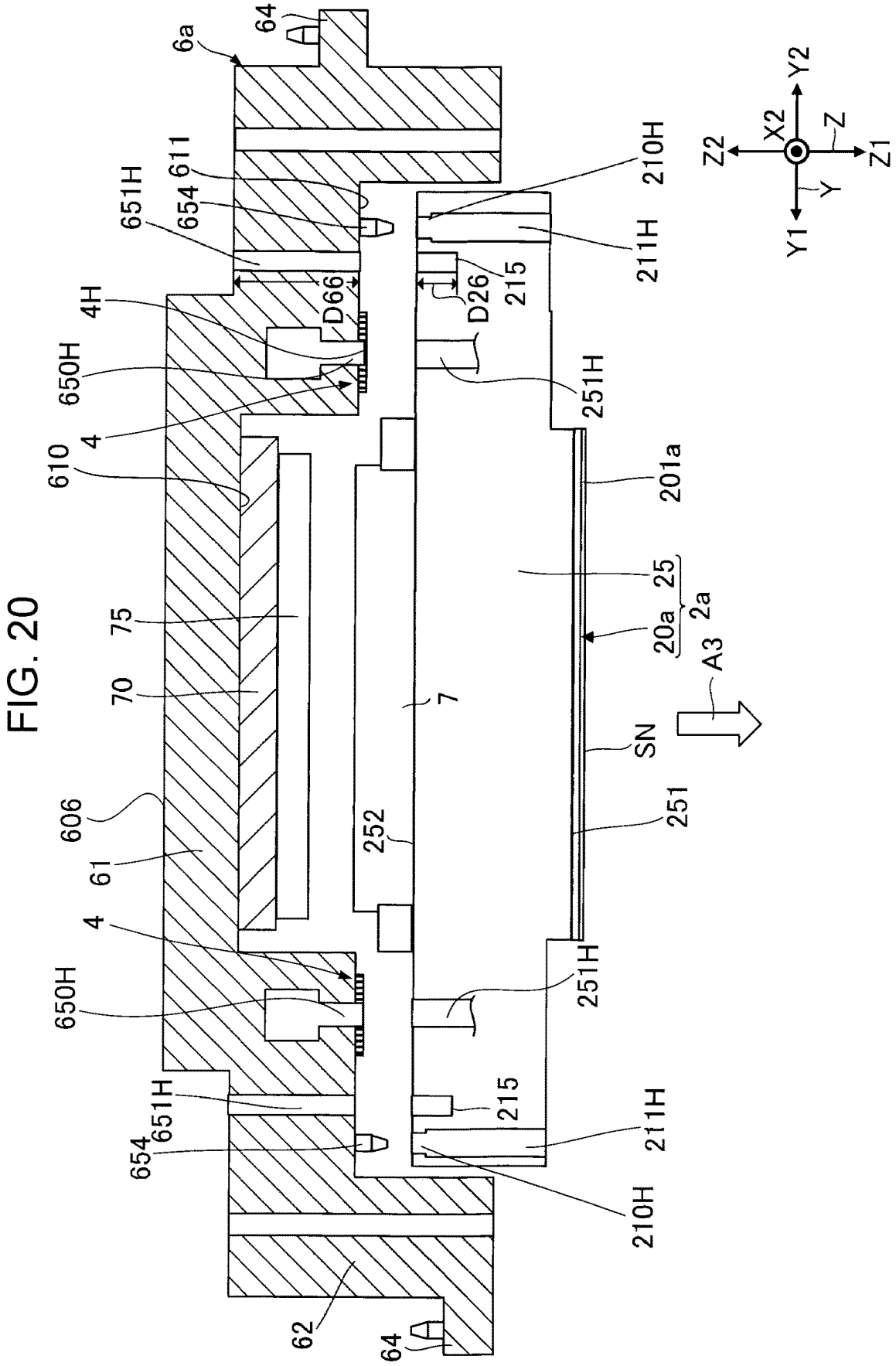

64
6a
611
654
651H
4H
650H
4
610
75
70
606
61
4
650H
651H
654
62
64
D66
D26
215
210H
211H
251H
201a
25
20a
2a
A3
7
SN
251
252
215
211H
210H
Y2
X2
Z
Z2
Z1
Y
Y1

FIG. 21

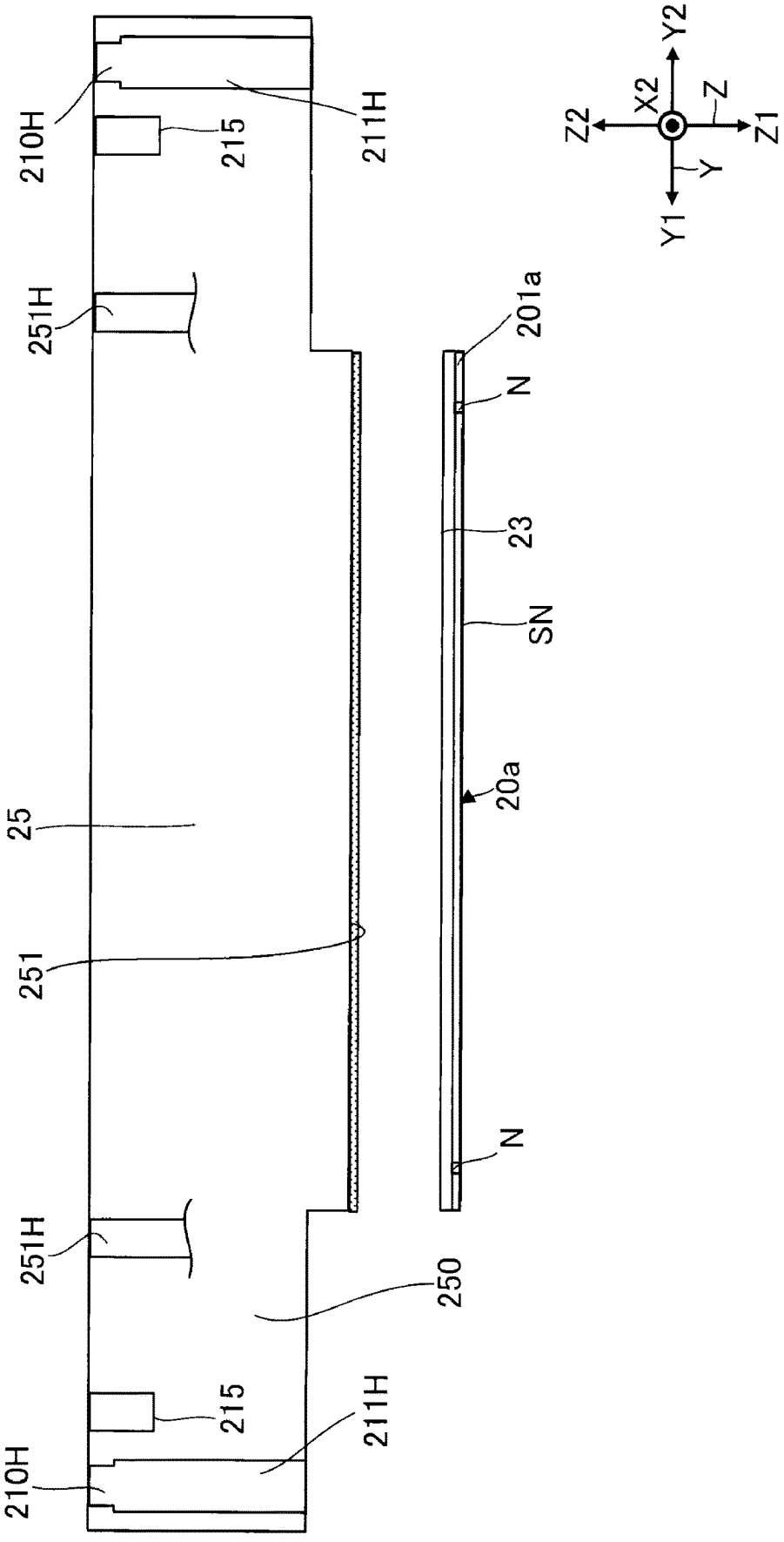

210H
215
211H
251H
201a
N
23
SN
25
20a
251
N
251H
250
215
211H
210H
Y2
X2
Z
Z2
Z1
Y
Y1

FIG. 22

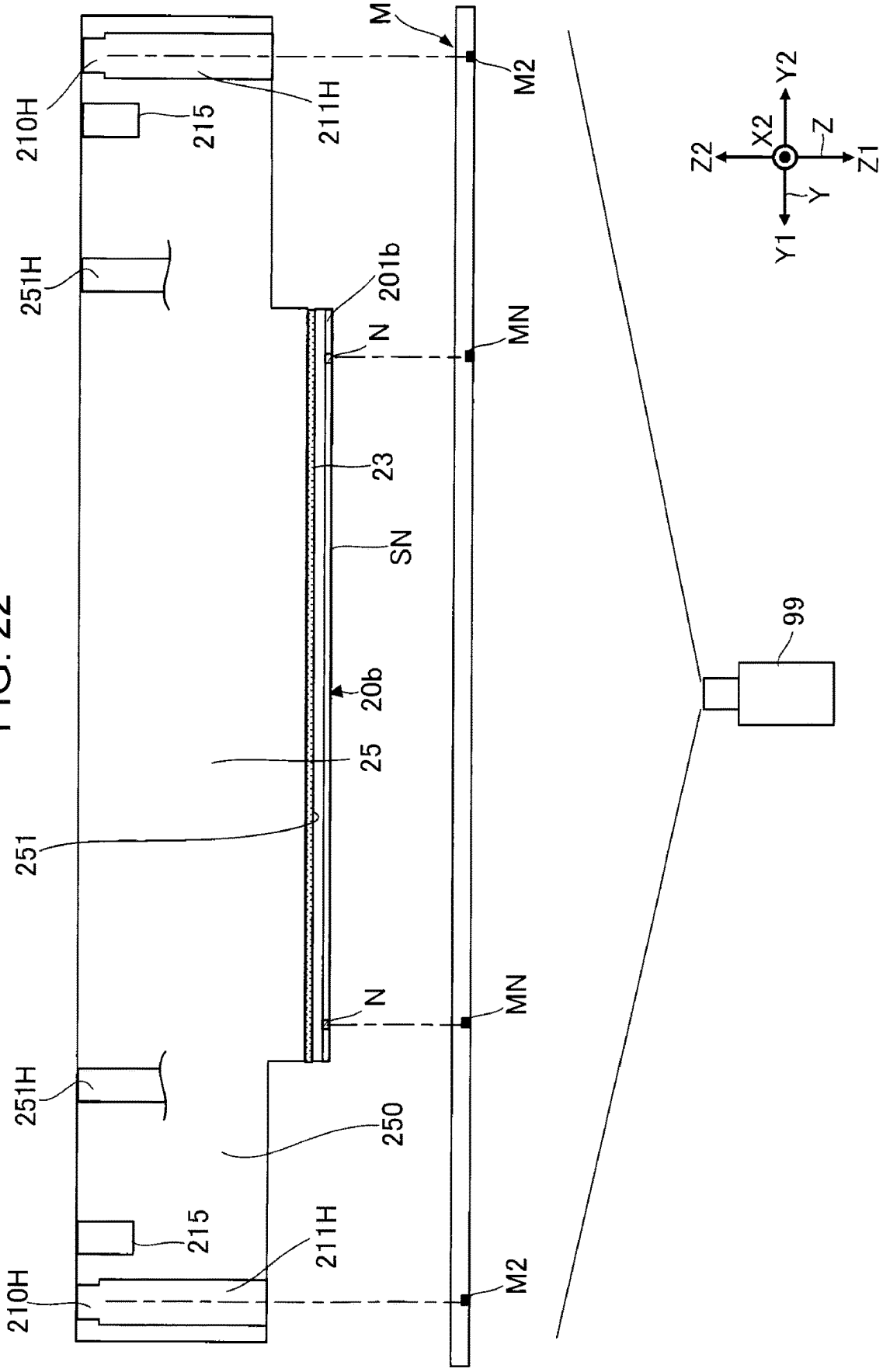
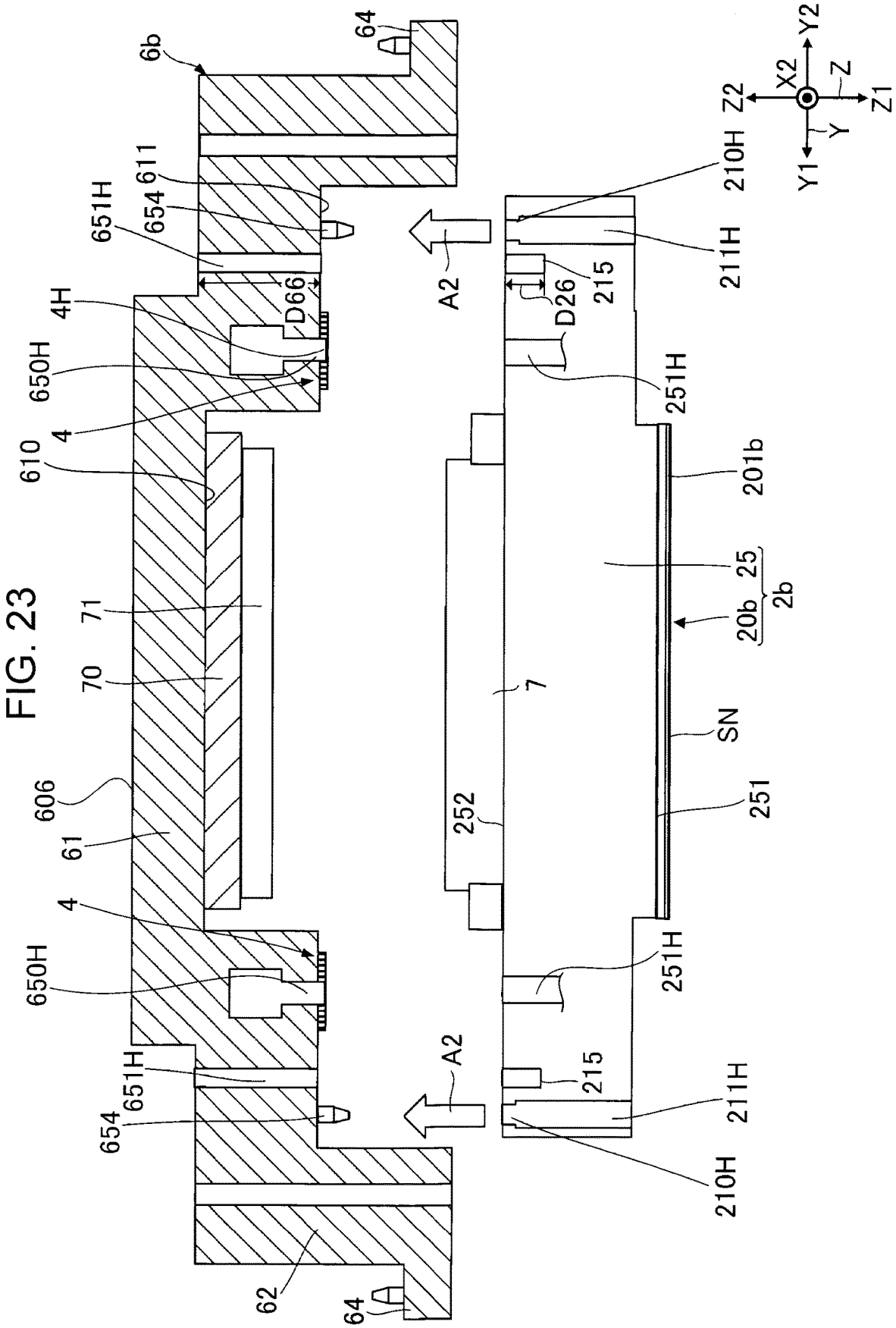

M
M2
210H
215
211H
251H
201b
N
MN
23
SN
20b
25
251
N
MN
251H
250
215
211H
210H
M2
99
Y2
X2
Z
Z2
Z1
Y
Y1

FIG. 23


6b
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611
654
651H
4H
650H
4
610
71
70
606
61
4
650H
651H
654
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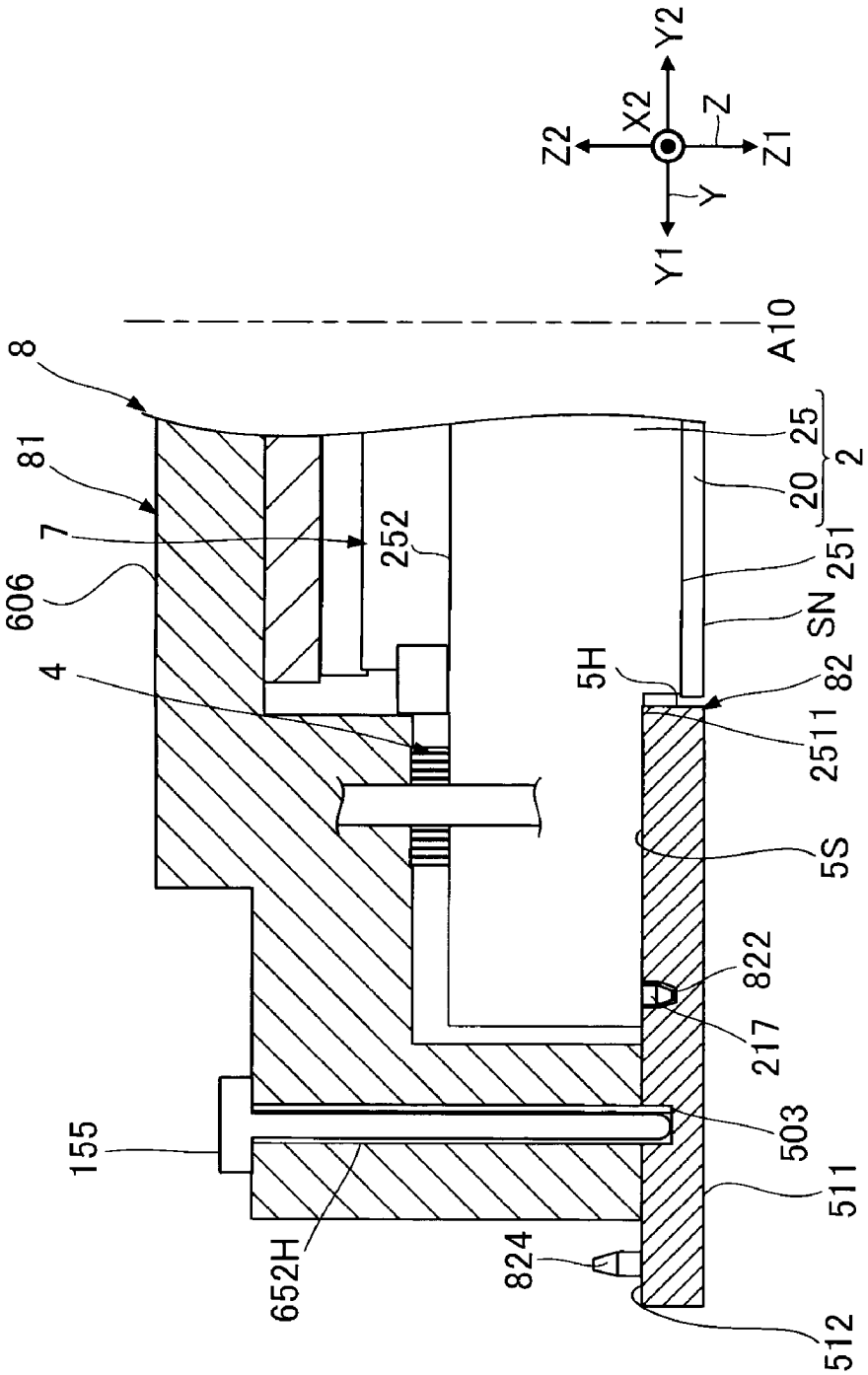
64
A2
A2
D66
D26
215
215
210H
211H
211H
210H
251H
251H
201b
25
20b
2b
7
SN
252
251
Y2
X2
Z
Z2
Z1
Y
Y1

FIG. 24


Y2
X2
Z
Z2
Z1
Y
Y1
A10
8
81
7
606
4
252
5H
25
20
2
251
SN
82
2511
5S
822
217
503
511
512
824
652H
155

MANUFACTURING METHOD OF LIQUID EJECTING HEAD

[0001] The present application is based on, and claims priority from JP Application Serial Number 2024-022217, filed Feb. 16, 2024, the disclosure of which is hereby incorporated by reference herein in its entirety.

BACKGROUND

1. Technical Field

[0002] The present disclosure relates to a method of manufacturing a liquid ejecting head.

2. Related Art

[0003] A liquid ejecting apparatus including a liquid ejecting head that ejects a liquid such as ink onto a medium such as printing paper has been proposed in the past.

[0004] The liquid ejecting head described in JP-A-2022-42753 includes a plurality of head chips (head module), a fixing plate, and a holder. The plurality of head chips is housed in a space enclosed by the fixing plate and the holder. The plurality of head chips is aligned with the fixing plate and fixed to the fixing plate with an adhesive. The fixing plate is fixed to the holder with an adhesive.

[0005] When some of a plurality of head modules fail, there is a desire to repair the liquid ejecting head by removing only the failed head modules and replacing them with new head modules.

[0006] However, in the previous literature, the fixing plate is required to be removed from the holder when some head modules are to be removed from the holder. This may cause misalignment between a plurality of head modules with the fixing plate as a reference. Hence, it is desirable to be able to easily align a plurality of head modules with each other when repairing and replacing a liquid ejecting head by replacing some of the plurality of head modules included in one liquid ejecting head. Furthermore, it is desired that the alignment between modules of a plurality of heads be performed with high precision not only at the work of replacing the liquid ejecting head, but also at the manufacture of the liquid ejecting head.

SUMMARY

[0007] According to an aspect of the present disclosure, in a method of manufacturing a liquid ejecting head including a plurality of head modules each having a chip including at least a nozzle plate in which a plurality of nozzles is formed and a flow path opening forming member, and a holder holding the plurality of head modules, the method includes a first positioning step of optically positioning the nozzle plate and the flow path opening forming member with reference to the nozzles, and a second positioning step of positioning the head module and the holder by press fitting one of a first positioning portion of the flow path opening forming member and a second positioning portion of the holder into the other of first positioning portion and the second positioning portion.

[0008] According to an aspect of the present disclosure, in a method of manufacturing a liquid ejecting head the method including manufacturing a second liquid ejecting head including a second holder, a first liquid ejecting head including a plurality of first head modules and a first holder that holds the plurality of first head modules, the manufacturing including using a portion of the first head module of the first liquid ejecting head, the method includes a press-fit releasing step of releasing a press-fit state in which one of a first positioning portion of the first head module and a second positioning portion of the first holder are press-fitted to the other of the first positioning portion and the second positioning portion, a disassembling step of disassembling the first head module in which the press-fit state with the first holder is released in the press-fit releasing step into a first chip including at least a first nozzle plate in which a plurality of nozzles is formed and a flow path opening forming member including the first positioning portion, a first positioning step of optically positioning a flow path opening forming member separated from the first chip in the disassembling step and a second chip that includes at least a second nozzle plate different from the first nozzle plate, that is, the second nozzle plate and the flow path opening forming member, with nozzles of the second nozzle plate as a reference, and a second positioning step of positioning, by press-fitting one of the first positioning portion of the flow path opening forming member and a second positioning portion of the second holder of a second head module including the second chip and the flow path opening forming member positioned in the first positioning step into the other of the first positioning portion and the second positioning portion, the second head module and the second holder.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** is a schematic view of an example configuration of a liquid ejecting apparatus according to the first embodiment.

[0010] FIG. **2** is a plan view of a head unit shown in FIG. **1**.

[0011] FIG. **3** is a cross-sectional view of the liquid ejecting head shown in FIG. **2** viewed along the X axis.

[0012] FIG. **4** is a cross-sectional view of the liquid ejecting head shown in FIG. **2** viewed along the Y axis.

[0013] FIG. **5** is a bottom view of the liquid ejecting head shown in FIG. **3**.

[0014] FIG. **6** is a cross-sectional view of the chip of the head module shown in FIG. **3**.

[0015] FIG. **7** is a top view of the flow path opening forming member of the head module shown in FIG. **4**.

[0016] FIG. **8** is an enlarged view of the flow path opening forming member shown in FIG. **4**.

[0017] FIG. **9** is a bottom view of the holder and the relay board shown in FIG. **4**.

[0018] FIG. **10** is a top view of the holder shown in FIG. **4**.

[0019] FIG. **11** is a plan view of the lower part of the holder shown in FIG. **4**.

[0020] FIG. **12** is a top view of the sealing member shown in FIG. **4**.

[0021] FIG. **13** is a top view of the cover shown in FIG. **4**.

[0022] FIG. **14** is a flow diagram showing part of the method of manufacturing a liquid ejecting head of the first embodiment.

[0023] FIG. **15** is a diagram for describing the first positioning step shown in FIG. **14**.

[0024] FIG. **16** is a diagram for describing the first positioning step shown in FIG. **14**.

[0025] FIG. **17** is a diagram for describing the first positioning step shown in FIG. **14**.

[0026] FIG. **18** is a diagram for describing the second positioning step shown in FIG. **14**.

[0027] FIG. **19** is a flow diagram showing part of the method of manufacturing a liquid ejecting head of the second embodiment.

[0028] FIG. **20** is a diagram for describing the press-fit releasing step shown in FIG. **19**.

[0029] [FIG. **21** is a diagram for describing the disassembling step shown in FIG. **19**.

[0030] FIG. **22** is a diagram for describing the first positioning step shown in FIG. **19**.

[0031] FIG. **23** is a diagram for describing the second positioning step shown in FIG. **19**.

[0032] FIG. **24** is a cross-sectional view of part of the liquid ejecting head of the first modification.

DESCRIPTION OF EMBODIMENTS

[0033] Hereinafter, preferred embodiments according to the present disclosure will be described with reference to the accompanying drawings. In the drawings, the dimensions or scales of each part are appropriately different from the actual ones, and some parts are schematically shown for easy understanding. Further, the scope of the present disclosure is not limited to these forms unless it is stated in the following description that the present disclosure is particularly limited. "The element β above the element γ" is not limited to a configuration in which the element γ and the element β are in direct contact, but also includes a configuration in which the element γ and the element β are not in direct contact. "The element γ and the element β are equal" means that the elements γ and β is only required to be substantially equal, including a measurement error and a manufacturing error. "The element γ and the element β are the same" means that the element γ and the element β are substantially the same, including a measurement error and a manufacturing error.

1. First Embodiment

1-1. Overall Configuration of Liquid Ejecting Apparatus **100**

[0034] FIG. **1** is a schematic diagram showing the configuration of a liquid ejecting apparatus **100** of the first embodiment. In the following, for convenience of description, the description will be given by appropriately using X axis, Y axis, and Z axis orthogonal to each other. Further, one direction along the X axis is donated as the X**1** direction, and a direction opposite to the X**1** direction is donated as the X**2** direction. Similarly, one direction along the Y axis is denoted as the Y**1** direction, and a direction opposite to the Y**1** direction is denoted as the Y**2** direction. One direction along the Z axis is denoted as the Z**1** direction, and a direction opposite to the Z**1** direction is denoted as the Z**2** direction. The Z**1** direction corresponds to "a first direction". The Z**2** direction corresponds to "a second direction, which is opposite to the first direction". The Z**1** direction with respect to a point is referred to as "downward" and the Z**2** direction with respect to a point is referred to as "upward". Viewing in the Z**1** direction or the Z**2** direction is referred to as "plan view".

[0035] As shown in FIG. **1**, the liquid ejecting apparatus **100** includes a liquid storage unit **9**, a control unit **91**, a transport unit **92**, a head unit **10**, and a movement mechanism **40**.

[0036] The liquid storage unit **9** is a container that stores ink. Specific forms of the liquid storage unit **9** include, for example, a cartridge that can be attached to and detached from the liquid ejecting apparatus **100**, a bag-shaped ink pack made of flexible film, and an ink tank that can be refilled with ink. The type of ink stored in the liquid storage unit **9** is not limited and is optional.

[0037] The control unit **91** controls the operations of respective elements of the liquid ejecting apparatus **100**. The control unit **91** includes, for example, a processing circuit such as a central processing unit (CPU) or field programmable gate array (FPGA) and a memory circuit such as semiconductor memory to control the operations of respective elements of the liquid ejecting apparatus **100**.

[0038] The transport unit **92** transports a medium **90** in a direction DM under control by the control unit **91**. The direction DM in the present embodiment is the Y**1** direction. In the example shown in FIG. **1**, the transport unit **92** includes a long transport roller along the X axis and a motor that rotates the transport roller. The transport unit **92** is not limited to a configuration including the transport roller, but may include, for example, a drum or an endless belt that transports the medium **90** with the medium **90** adsorbed on the outer circumference of the drum or endless belt by electrostatic force or other means.

[0039] The movement mechanism **40** includes a transport belt to which a unit base **11** of the head unit **10** is fixed and reciprocably moves the head unit **10** back in the X**1** direction and the X**2** direction under control by the control unit **91**. The head unit **10** ejects, under control by the control unit **91**, ink supplied from the liquid storage unit **9** onto the medium **90** in the Z**1** direction from each of a plurality of nozzles N. The ejection of ink from the head unit **10** is performed in parallel with the movement of the head unit **10** by the movement mechanism **40** to form an image with ink on the face of the medium **90**.

[0040] The number and the arrangement of the plurality of liquid ejecting heads **1** of the head unit **10** are not limited to the example shown in FIG. **1**, but are any number and any arrangement. When the head unit **10** is configured to be able to circulate ink, the head unit **10** may be coupled to the liquid storage unit **9** via a circulation mechanism for circulating the ink in the head unit **10**.

1-2. Head Unit **10**

[0041] FIG. **2** is a plan view of the head unit **10** shown in FIG. **1**. As shown in FIG. **2**, the head unit **10** includes the unit base **11** and the plurality of liquid ejecting heads **1**. The plurality of liquid ejecting heads **1** is fixed to the unit base **11**. The unit base **11** is a component that holds the plurality of liquid ejecting heads **1**. In the example shown in the figure, the number of the liquid ejecting heads **1** on the unit base **11** is not limited and can be any number as long as the number is equal to or more than one.

[0042] The unit base **11** is, for example, a plate-shaped member with the direction along the Z axis as the thickness direction. The unit base **11** has a recess **111**. The recess **111** is a depression in the unit base **11**. The bottom of the recess **111** has a plurality of through holes **11**H. The planar shape of each through hole **11**H is, for example, a rectangle. The through hole **11**H is provided for each liquid ejecting head **1**. A portion of the liquid ejecting head **1** is inserted into each through hole **11**H. In FIG. **2**, illustration of several liquid

ejecting heads **1** that are disposed at a portion of the unit base **11** are omitted to show the through holes **11**H.

[0043] The unit base **11** has four mounting holes **101** and two third positioning portions **102** for each through hole **11**H. The four mounting holes **101** and the two third positioning portions **102** are provided outside the through hole **11**H in plan view. The number and the arrangement of the mounting holes **101** and the third positioning portion **102** are not limited to the example in FIG. **2**, but are any number and any arrangement.

[0044] Each of the **101** mounting holes is provided, for example, near the four corners of the through hole **11**H in plan view. Each of the **101** mounting holes is used to attach the liquid ejecting head **1** to the unit base **11**. Each of the **101** mounting holes, for example, penetrates the unit base **11** in the thickness direction.

[0045] Each third positioning portion **102** is provided, for example, between two mounting holes **101** aligned in the direction along the X axis and is away from the two mounting holes. Each third positioning portion **102** is used to position the unit base **11** of the liquid ejecting head **1**. Each third positioning portion **102** is, for example, a bottomed hole opening in the face of the unit base **11** in the Z**1** direction. Each third positioning portion **102** can be said to be a recess formed in the face of the unit base **11** in the Z**1** direction.

[0046] Each of the mounting holes **101** does not have to penetrate the unit base **11** in the thickness direction. Each third positioning portion **102** may penetrate the unit base **11** in the thickness direction. The shape of the unit base **11** is not limited to a plate shape, but can be box-shaped, for example.

1-3. Liquid Ejecting Head **1**

[0047] FIG. **3** is a cross-sectional view of the liquid ejecting head **1** shown in FIG. **2**, viewed along the X axis. FIG. **4** is a cross-sectional view of the liquid ejecting head **1** shown in FIG. **2**, viewed along the Y axis. As shown in FIG. **4**, the liquid ejecting head **1** in the present embodiment has a configuration that is almost symmetrical about a central virtual plane A**10** along the X-Z plane. The liquid ejecting head **1** may not have a configuration that is symmetrical about the central virtual plane A**10**.

[0048] As shown in either FIG. **3** or FIG. **4**, the liquid ejecting head **1** includes a plurality of head modules **2**, a sealing member **4**, a plurality of covers **5**, a holder **6**, a plurality of circuit boards **7**, and a relay board **70**.

[0049] In the liquid ejecting head **1**, the cover **5**, the holder **6**, and the plurality of head modules **2** are removable from each other. After removing the cover **5** from the holder **6**, each head module **2** can be removed individually from the holder **6**. Each head module **2** can be individually removed from the holder **6**.

[0050] Hence, for example, when some of the plurality of head modules **2** included in the head unit **10** are broken, the liquid ejecting head **1** can be reused by replacing a subunit **15** including the broken head module **2** with another subunit **15** including the head module **2** that has not broken.

[0051] Although it is preferable that the cover **5** and the plurality of head modules **2** is fixed with an adhesive, the head module **2** may be configured to be removable from the cover **5** by removing the adhesive.

1-3A. Head Module **2**

[0052] In the example in FIG. **3**, the plurality of head module **2** includes six head modules **2**. The number of the head modules **2** is not limited to six, but may be equal to or more than one and equal to or less than five, or equal to or more than seven.

[0053] In the present embodiment, the plurality of head modules **2** is disposed along the X axis. As shown in FIG. **4**, each head module **2** is long along the Y axis. Each head module **2** ejects ink in the Z**1** direction. The head module **2** includes a chip **20** and a flow path opening forming member **25**. The chip **20** is positioned in the Z**1** direction with respect to the flow path opening forming member **25**.

[0054] FIG. **5** is a bottom view of the liquid ejecting head **1** shown in FIG. **3**. As shown in FIG. **5**, each head module **2** includes a plurality of nozzles N through which ink is ejected. The plurality of nozzles N is disposed along the Y axis. The plurality of nozzles N is divided into a nozzle row La and a nozzle row Lb that are mutually spaced in the X axis. Each of the nozzle row La and the nozzle row Lb is a set of a plurality of nozzles N disposed in a linear array in the Y axis. The face of the head module **2** in which openings of a plurality of nozzle N are formed is a nozzle face SN. The nozzle face SN is a face of the chip **20** of the head module **2**, the face facing the Z**1** direction. For example, the plurality of nozzles N may be disposed in a direction that intersects the X and Y axes when viewing the Z**1** direction.

1-3Aa. Chip **20**

[0055] FIG. **6** shows a cross-sectional view of the chip **20** of the head module **2** shown in FIG. **3**. The chip **20** has a structure in which the element associated with each nozzle N in the nozzle row La and the element associated with each nozzle N in the nozzle row Lb are disposed in a generally plane symmetrical manner. In the following description, emphasis will be placed on the elements corresponding to nozzle row La, and description of the elements corresponding to the nozzle row Lb will be omitted where appropriate. In the following, when the nozzle row La and the nozzle row Lb are not distinguished, they are referred to as a nozzle row L.

[0056] As shown in FIG. **6**, the chip **20** of each head module **2** includes, for example, a communication plate **202**, a pressure chamber substrate **203**, a vibration plate **204**, a nozzle plate **201**, a cover **206**, a plurality of drive elements E, and a sealing substrate **205**.

[0057] Each of the communication plate **202**, the pressure chamber substrate **203**, the vibration plate **204**, the nozzle plate **201**, and the cover **206** is a long plate-like member in the Y axis. The pressure chamber substrate **203** is installed on the face of the communication plate **202** in the Z**2** direction. The nozzle plate **201** and cover **206** are installed on the face of the communication plate **202** in the z**1** direction. For example, the components are fixed to each other with an adhesive.

[0058] The nozzle plate **201** is a plate-like member with a plurality of nozzles N formed. The nozzle plate **201** is a member of the head module **2**, the member being located in the most Z**1** direction. The face, of the nozzle plate **201**, that faces the Z**1** direction is the nozzle face SN. Each of the plurality of nozzles N is a circular through hole through which ink is ejects. For example, the nozzle plate **201** is fabricated by processing a single-crystal substrate of silicon (Si) using semiconductor manufacturing techniques such as photolithography and etching.

[0059] The communication plate **202** has a plurality of apertures R**1** and a plurality of communication flow paths R**2**, a communication space Ra, and a common flow path Rb. Each of the apertures R**1** and each of the communication flow path R**2** are through holes that extend in the Z**1** direction and are formed for each nozzle N. The communication flow path R**2** overlaps the nozzle N in plan view. The communication space Ra is a long-shaped opening in the Y axis. The communication space Ra extends in the Y axis. The common flow path Rb communicates with the communication space Ra and overlaps the communication space Ra in plan view. The common flow path Rb extends in the Y axis. The common flow path Rb communicates with the plurality of apertures R**1**. The communication space Ra communicates with a space Rc that the flow path opening forming member **25** has.

[0060] The communication space Ra, the common flow path Rb, and the space Rc form a common space R communicating with a plurality of nozzles N. The common space R serves as an ink reservoir. Ink stored in the common space R is supplied into a plurality of pressure chambers C in parallel by branching into each aperture R**1** and the chambers are filled with the ink.

[0061] The pressure chamber substrate **203** has a plurality of pressure chambers C. The pressure chamber C is a space located between the communication plate **202** and the vibration plate **204** and formed by the walls of the pressure chamber substrate **203**. The pressure chamber C is formed for each nozzle N. The pressure chamber C is a long space extending in the X**1** direction. The plurality of pressure chambers C is disposed in the Y axis.

[0062] The communication plate **202** and pressure chamber substrate **203** are manufactured by machining a semiconductor substrate, such as a single-crystal substrate of silicon, for example.

[0063] The elastically deformable vibration plate **204** is disposed above the pressure chamber C. The vibration plate **204** is stacked on the pressure chamber substrate **203** and contacts a surface of the pressure chamber substrate **203**, the surface being opposite to the communication plate **202**. The vibration plate **204** is a long rectangular plate-like member in the Y axis in plan view. The pressure chamber C communicates with the communication flow path R**2** and the aperture R**1**. Therefore, the pressure chamber C communicates with the nozzle N via the communication flow path R**2** and communicates with the communication space Ra via the aperture R**1**. The nozzle N, the communication flow path R**2**, the pressure chamber C, and the aperture section R**1** form an individual flow path for each nozzle N. In FIG. **6**, the pressure chamber substrate **203** and the vibration plate **204** are shown as separate substrates for ease of explanation, but they are actually stacked on one silicon substrate.

[0064] The drive element E is formed on the face, of the vibration plate **204**, opposite the pressure chamber C, for each pressure chamber C. The drive element E is a long piezoelectric element in the X axis in plan view. The drive element E includes, for example, a pair of electrodes and a piezoelectric material sandwiched between the pair of electrodes. The drive element E may be an electrothermal conversion element that generates thermal energy.

[0065] The sealing substrate **205** is a structure that protects the plurality of drive elements E. The sealing substrate **205** is fixed to the surface of the vibration plate **204** with, for example, an adhesive. The plurality of drive elements E is housed inside a recess formed at a face of the sealing substrate **205**, the face being opposite to the vibration plate **204**. In addition, the sealing substrate **205** has a wiring hole **20**H for inserting the circuit board **7** described below.

[0066] The cover **206** is a thin metal plate that constitutes the wall face of the common flow path Rb. The cover **206** has a thickness similar to the nozzle plate **201**. The planar shape of the cover **206** is, for example, a frame surrounding the nozzle plate **201**. A mold **207** made of resin is provided between the cover **206** and the nozzle plate **201**. The face, of the cover **206**, that faces the Z**1** direction constitutes part of the nozzle face SN.

[0067] In such a chip **20**, when the drive element E contracts due to energization, the vibration plate **204** bends and flexes in the direction in which the volume of the pressure chamber C decreases, and the pressure in the pressure chamber C increases, causing ink droplets to be ejected from the nozzle N. At this time, pressure propagates from the pressure chamber C to the aperture R**1**, and ink flows into the common flow path Rb through the aperture R**1**. After ink is ejected, the drive element E is restored to its original position. In this case, the ink from nozzle N to the common flow path Rb vibrates. Then, the ink is supplied from the aperture R**1** at the same time when the meniscus of nozzle N is restored. Through the above series of operations, the ink is ejected from nozzle N.

[0068] In the preceding description, the chip **20** includes each of the components shown in FIG. **6**, but the chip **20** is not required to have all of the components described above, and may have an additional component.

[0069] The chip **20** is, for example, a component that has a monolithic structure and is thinner than the flow path opening forming member **25**, for example, less than 3000 μm thick. The chip **20** may have a thickness of 1500 μm or less, or 1000 μm or less. The chip **20** may have a thickness of ⅕ or less of the length of the short side of the chip **20** viewed in the direction of the thickness of the chip **20**. Furthermore, the chip **20** is only required to include at least the nozzle plate **201**, includes more preferably the pressure chamber substrate **203**, and includes especially preferably the communication plate **202**. At least one of the nozzle plate **201**, the pressure chamber substrate **203**, the communication plate **202** or the drive element E, and the sealing substrate **205** may be regarded the chip **20**. The chip **20** may be a laminate of thin sheets of ceramic or metal or a laminate of thin sheet members of the aforementioned materials, as well as a laminate of silicon substrates manufactured by MEMS.

1-3A b. Flow Path Opening Forming Member **25**

[0070] As shown in FIGS. **4** and **6**, the flow path opening forming member **25** is disposed in the Z**2** direction of the chip **20**. The flow path opening forming member **25** and the chip **20** are fixed to each other with, for example, an adhesives. The flow path opening forming member **25** has, for example, a flow path that supplies ink to the chip **20**.

[0071] The flow path opening forming member **25** is, for example, preferably a member with a thickness of 3000 μm or more, preferably a member with a thickness of 5000 μm or more, and preferably a member with a thickness of 8000 μm or more. The flow path opening forming member **25** may be formed of one member or a laminate of a plurality of members.

[0072] The flow path opening forming member **25** is made of metal, but may be made of resin. The flow path opening forming member **25** is made of resin such as thermosetting

resin, which allows for lower cost. However, when the flow path opening forming member **25** is made of metal, it is easy to reuse the flow path opening forming member **25** when the head module **2** is replaced. Hence, it is easier to repeatedly use the flow path opening forming member **25** than when the flow path opening forming member is made of resin. In addition, the metal material allows for positioning of the flow path opening forming member **25** with high precision with respect to the holder **6**, compared with when the flow path opening forming member is made of resin.

[0073] As shown in FIG. **4**, the length, or the thickness, of the flow path opening forming member **25** in the direction in the Z axis is thicker than a thickness D**2** of the chip **20**. The thickness of the flow path opening forming member **25** here is a thickness at the position where the flow path opening forming member overlaps a seal region **4**S described below when viewing the Z**1** direction. In other words, the chip **20** is thinner than the flow path opening forming member **25**. The flow path opening forming member **25** has a face **251** that faces the Z**1** direction and a face **252** that faces the Z**2** direction.

[0074] FIG. **7** is a top view of the flow path opening forming member **25** of the head module **2** shown in FIG. **4**. As shown in FIG. **7**, the planar shape of the flow path opening forming member **25** is larger than the planar shape of the chip **20**. In other words, the chip **20** has a smaller outer shape than the flow path opening forming member **25** when viewing the Z**1** direction. The flow path opening forming member **25** overlaps the chip **20** and covers the chip **20** when viewing the Z**1** direction.

[0075] As shown in FIGS. **4** and **7**, the flow path opening forming member **25** includes a flange **250** for fixing to the cover **5**, described below. The planar shape of the flange **250** is a rectangular frame that surrounds an opening **5**H of the cover **5** described below. As shown in FIG. **4**, the face, of the flange **250**, that faces the Z**1** direction is a supported face **2511** that is supported by the cover **5** described below. Since the planar shape of the flange **250** is a rectangular frame surrounding the opening **5**H, the planar shape of the supported face **2511** is also a rectangular frame surrounding the opening **5**H. The supported face **2511** is located in the Z**2** direction of the chip **20**. Therefore, the supported face **2511** is located in the Z**2** direction of the nozzle plate **201**.

[0076] As shown in FIG. **7**, the flow path opening forming member **25** has a wiring hole **25**H. The circuit board **7** (described below) is inserted into the wiring hole **25**H. The wiring hole **25**H is provided at the center of the flow path opening forming member **25** in plan view. Referring to FIG. **6**, the wiring hole **25**H overlaps the wiring hole **20**H of the sealing substrate **205** in plan view.

[0077] As shown in FIGS. **4** and **6**, the flow path opening forming member **25** has a flow path **25**R therein. The flow path **25**R is provided to supply ink to the chip **20**. As shown in FIG. **6**, the space Rc is provided close to the chip **20** in the flow path **25**R, or downstream of the flow path **25**R. The flow path **25**R communicates with the space Rc.

[0078] As shown in FIG. **4**, a plurality of flow path openings **251**H is provided in the flow path **25**R that the flow path opening forming member **25** has, the openings being opposite to the chip **20**, that is, being located upstream. Each flow path opening **251**H is an opening end of the flow path **25**R in the Z**2** direction. The flow path opening **251**H is an opening for flow-path-communicating the flow path **25**R that the flow path opening forming member **25** of the head module **2** has with a flow path **6**R of the holder **6** described below. As shown in FIGS. **4** and **7**, the plurality of flow path openings **251**H is provided in the flange **250** of the flow path opening forming member **25**. The flow path opening **251**H is located outside of the chip **20** when viewing the Z**1** direction. In the present embodiment, two flow path openings **251**H are provided for each nozzle row L.

[0079] As shown in FIGS. **4** and **7**, each flow path opening forming member **25** has two fixing holes **215**. The head module **2**, including the flow path opening forming member **25**, can be attached to and detached from the holder **6**. Each of the **215** fixing holes is used for fixing the head module **2** to the holder **6**.

[0080] Each fixing hole **215** is provided in the face **252**, of the flow path opening forming member **25**, that faces the Z**2** direction. Each fixing hole **215** has a bottomed hole opening in the face **252**, of the flow path opening forming member **25**, that faces the Z**2** direction. Each fixing hole **215** is a recess in the face **252**, of the flow path opening forming member **25**, that faces the Z**2** direction, that can be regarded as a depression formed in the face **252**. One of the two fixing holes **215** is located in the Y**1** direction of the chip **20** and the other is located in the Y**2** direction of the chip **20** when viewing the Z**1** direction.

[0081] FIG. **8** is an enlarged view of the flow path opening forming member **25** shown in FIG. **4**. In FIG. **8**, illustration of bushings **522** and **526**, described below, is omitted.

[0082] As shown in FIG. **8**, each flow path opening forming member **25** has a first positioning portion **210**H and a through hole **211**H. The first positioning portion **210**H and the through hole **211**H constitute a hole penetrating the flow path opening forming member **25** in the thickness direction. Each of the first positioning portion **210**H and the through hole **211**H is used for positioning the head module **2** to the holder **6**, and the like. Specifically, the first positioning portion **210**H is a positioning hole for positioning the head module **2** to the holder **6** and corresponds to a second positioning portion **654** described below.

[0083] The first positioning portion **210**H and the through hole **211**H are aligned along the Z axis and communicate with each other. The through hole **211**H is located in the Z**1** direction of the first positioning portion **210**H. The face **251**, of the flow path opening forming member **25**, that faces the Z**1** direction has the through hole **211**H, specifically the opening end of the through hole **211**H. The face **252**, of the flow path opening forming member **25**, that faces the Z**2** direction has the first positioning portion **210**H, specifically the open end of the first positioning portion **210**H.

[0084] In the present embodiment, the opening area of the through hole **211**H is larger than the opening area of the first positioning portion **210**H. In other words, the outer diameter of the through hole **211**H is larger than the outer diameter of the first positioning portion **210**H. The opening area of the through hole **211**H may be less than or equal to the opening area of the first positioning portion **210**H. The length of the through hole **211**H along the Z axis, or a depth D**21**, is greater than a depth D**20** of the first positioning portion **210**H. The depth D**21** may be less than or equal to the depth D**20**. The width and the opening area of the through hole **211**H are constant, but may not be constant. Similarly, the width and the opening area of the first positioning portion **210**H are constant, but may not be constant.

[0085] As shown in FIG. **7**, each flow path opening forming member **25** has two first positioning portions **210**H.

For this purpose, each flow path opening forming member **25** has two through holes **211**H. As shown in FIG. **7**, one of the two first positioning portions **210**H is located in the Y**1** direction of the chip **20** and the other is located in the Y**2** direction of the chip **20** when viewing the Z**1** direction.

[0086] In the example in FIG. **7**, the shortest distance between the chip **20** and the fixing hole **215** is shorter than the shortest distance between the chip **20** and the first positioning portion **210**H when viewing the Z**1** direction, but may be longer. The first positioning portion **210**H, the fixing hole **215** and the opening **5**H are aligned along the longitudinal direction of the cover **5**, but may not be aligned. For example, the first positioning portions **210**H may be provided on both sides of the opening **5**H in the X axis.

1-3B. Holder **6**

[0087] As shown in FIGS. **3** and **4**, the holder **6** holds and houses the plurality of head modules **2** and has a common flow path that supplies and distributes ink to the plurality of head modules **2**. The holder **6** is common to the plurality of head modules **2**.

[0088] As shown in FIG. **4**, the holder **6** has one flow path **6**R. The flow path **6**R supplies ink to the respective head modules **2** and distributes the ink to the respective head module **2**. The flow path **6**R is a common flow path shared by the plurality of head modules **2**, and has a common portion **6**RA extending in the X axis and a plurality of branch portions **6**RB branching from the common portion **6**RA and extending in the Z**1** direction. Although not shown in the figure, the holder **6** includes a flow path joint to communicate with the supply flow path outside the liquid ejecting head **1** for communicating with the liquid storage unit **9**. This flow path joint (not shown) is exposed to the outside of the liquid ejecting head **1**, for example, through an opening (not shown) in the holder **6**.

[0089] The holder **6** may have the plurality of flow paths **6**R that communicates with the plurality of head modules **2**. In other words, the flow path **6**R may have a configuration that does not include the common portion **6**RA that communicates with the plurality of head modules **2**, but includes a plurality of flow paths **6**R that communicates with the plurality of head modules **2**.

[0090] The flow path **6**R has a flow path opening **650**H close to the head module **2** or downstream thereof. The flow path opening **650**H is an opening end of the flow path **6**R in the Z**1** direction. The flow path opening **650**H is provided corresponding to the flow path opening **251**H that the head module **2** has. The flow path opening **650**H is an opening for flow-path-communicating the flow path **25**R of the head module **2** with the flow path **6**R of the holder **6**.

[0091] FIG. **9** is a bottom view of the holder **6** and the relay board **70** shown in FIG. **4**. As shown in FIGS. **3**, **4** and **9**, the holder **6** is box-shaped, having a recess **610** opening in the Z**1** direction. The plurality of head modules **2** is disposed in the housing space in the recess **610** of the holder **6**. It can be taken that the holder **6** and the cover **5** described below form the housing space for the plurality of head modules **2**. The holder **6** includes metals such as aluminum or stainless steel, for example.

[0092] As shown in FIGS. **4** and **9**, the recess **610** includes a first recess **611** and a second recess **612**. As shown in FIG. **4**, the bottom of the first recess **611** has the second recess **612**. The first recess **611** is located in the Z**1** direction of the center of the holder **6** in the Z axis. The second recess **612** is located in the Z**2** direction of the center of the holder **6** in the Z axis. The opening area of the second recess **612** is smaller than the opening area of the first recess **611**. Thus, the recess **610** has a stepped face.

[0093] The relay board **70** is bonded to the bottom of the recess **610**, specifically the bottom of the second recess **612**, for example with an adhesive. Although not shown in detail, the holder **6** has an opening for inserting a wiring member external to the liquid ejecting head **1** for electrically coupling the relay board **70** and the control unit **91**.

[0094] As shown in FIG. **3**, the holder **6** includes a flat plate portion **61**, a side wall **62**, and two flanges **64**. The flat plate portion **61**, the side wall **62**, and the two flanges **64** are formed as one piece.

[0095] FIG. **10** is a top view of the holder **6** shown in FIG. **3**. FIG. **11** is a plan view of the lower part of the holder **6** shown in FIG. **3**. As shown in FIG. **3**, **4** or **10**, the flat plate portion **61** is a flat section along the X-Y plane and is located in the Z**2** direction of the plurality of head modules **2**. The side wall **62** is a portion extending in the Z**1** direction from the outer edge of the flat plate portion **61**. The planar shape of the side wall **62** is a rectangular frame. The inner wall face of the side wall **62** has the aforementioned stepped face.

[0096] As shown in FIG. **4**, the holder **6** has a plurality of fixing holes **651**H, a plurality of fixing holes **652**H, and the plurality of second positioning portions **654**. Each fixing hole **651**H is used to fix the holder **6** and the head module **2**. Each of the **652**H fixing holes is used to fix the holder **6** and the cover **5**. Each second positioning portion **654** is used for positioning the head module **2** to the holder **6**.

[0097] Each fixing hole **651**H is a hole penetrating the holder **6** in the Z**1** direction. Two fixing holes **651**H are provided for each head module **2**. Each fixing hole **651**H is provided in the Y**1** direction or the Y**2** direction of the second recess **612** when viewing the Z**1** direction. The two fixing holes **651**H are provided corresponding to the two fixing holes **215** described above and overlap the two fixing holes **215** when viewing the Z**1** direction. Each fixing hole **651**H does not overlap the chip **20** when viewing the Z**1** direction, but overlaps the flow path opening forming member **25**. The opening end of each fixing hole **651**H in the Z**1** direction opens at the bottom of the first recess **611**.

[0098] Each fixing hole **652**H is a hole penetrating the holder **6** in the Z**1** direction. As shown in FIG. **11**, the plurality of fixing holes **652**H includes, for example, four fixing holes **652**H, and the fixing holes **652**H are provided at the four corners of the square holder **6** when viewing the Z**1** direction. Each fixing hole **652**H does not overlap the recess **610** when viewing the Z**1** direction.

[0099] Each second positioning portion **654** is a projection on a face **605**, of the holder **6**, that faces the Z**1** direction, specifically on the bottom of the first recess **611**. More specifically, each second positioning portion **654** is a positioning pin protruding from the first recess **611** in the Z**1** direction. In the present embodiment, the two second positioning portions **654** are provided for each head module **2**. The two second positioning portions **654** are provided corresponding to the two first positioning portions **210**H described above and overlap the two first positioning portions **210**H when viewing the Z**1** direction. Thus, the plurality of second positioning portions **654** correspond to the plurality of first positioning portions **210**H on a one-to-one basis.

[0100] Of the fixing hole **651**H, the second positioning portion **654**, and the fixing hole **652**H, the fixing hole **651**H is closest to the chip **20** and the fixing hole **652**H is farthest from the chip **20** when viewing the Z**1** direction. The distance between the fixing hole **651**H and the chip **20**, the distance between the second positioning portion **654** and the chip **20**, and the distance between the fixing hole **652**H, and the chip **20** when viewing the Z**1** direction may be the same or different.

[0101] Each second positioning portion **654** is press-fit into the aforementioned first positioning portion **210**H to position the cover **5** to the holder **6**. With the first positioning portion **210**H and the second positioning portion **654** being provided, the head module **2** can be easily positioned when attached to the holder **6**.

[0102] In addition, the simple method of press-fitting the first positioning portion **210**H into the second positioning portion **654** allows alignment between the plurality of head modules **2** with high precision. This makes it easy to replace a desired head module **2** of the plurality of head modules **2**. Hence, it is possible to replace the head module **2** by unit, thus facilitating repair of the liquid ejecting head **1**.

[0103] Furthermore, the first positioning portion **210**H and the second positioning portion **654** are provided in units of the head module **2**. The first positioning portion **210**H and the second positioning portion **654** are provided for each head module **2**, enabling alignment between the plurality of head modules **2** with high precision. Therefore, when replacing only some of the plurality of head modules **2**, there is no need to re-align all the head modules **2**.

[0104] As shown in FIG. **4**, the holder **6** has a plurality of fourth positioning portions **642**. As shown in FIG. **4**, the fourth positioning portion **642** is a projection protruding toward the **22** direction from the face, of the flange **64** of the holder **6**, in the Z**2** direction. The plurality of fourth positioning portions **642** is provided in correspondence with the plurality of third positioning portions **102** of the unit base **11** shown in FIG. **2** on a one-to-one basis.

[0105] The fourth positioning portion **642** is press-fit into one of the plurality of third positioning portions **102** on the unit base **11** to position the liquid ejecting head **1** in relation to the unit base **11**. This allows for more accurate alignment between the plurality of liquid ejecting heads **1** with respect to the unit base **11**.

[0106] As shown in FIG. **10**, the flange **64** has a mounting hole **64**H. The mounting hole **64**H corresponds to the mounting hole **101** of the unit base **11**. For example, the flange **64** and the unit base **11** are fixed by inserting screws or the like (not shown) into the mounting hole **64**H and the mounting hole **101** in this order, and then screwing them in place. As a result, the liquid ejecting head **1** is fixed to the unit base **11**.

1-3C. Sealing Member **4**

[0107] As shown in FIGS. **3** and **4**, the sealing member **4** is provided between each head module **2** and the holder **6** in the Z**1** direction. The sealing member **4** is provided for each head module **2**. The sealing member **4** is elastic. In the present embodiment where the sealing member **4** is an elastic material such as an elastomer, the length, or the thickness, of the sealing member **4** in the Z axis is constant. The thickness of the sealing member **4** is thinner than the thickness of each of the flow path opening forming member **25** and the holder **6**. The sealing member **4** is press-collapsed by the head module **2** and the holder **6**.

[0108] FIG. **12** is a top view of the sealing member **4** shown in FIG. **4**. In the example shown in FIG. **12**, two sealing members **4** are provided for each head module **2**. The two sealing members **4** are provided at both ends of one head module **2** in the longitudinal direction. Each sealing member **4** is a rectangle when viewing the Z**1** direction. Each sealing member **4** overlaps the flange **250** of the flow path opening forming member **25** of the head module **2** when viewing the Z**1** direction. On the other hand, in the present embodiment, the sealing member **4** is provided at a position different from that of the chip **20** when viewing the Z**1** direction. In other words, the sealing member **4** does not overlap the chip **20** when viewing the Z**1** direction.

[0109] As shown in FIGS. **4** and **12**, each sealing member **4** has two communication ports **4**H. As shown in FIG. **4**, each communication port **4**H is provided corresponding to one flow path opening **251**H of the flow path opening forming member **25** and one flow path opening **650**H of the holder **6**. As shown in FIG. **12**, the communication ports **4**H overlap each of the flow path openings **650**H and the flow path opening **251**H when viewing the Z**1** direction. As shown in FIG. **4**, the communication port **4**H communicates with the flow path **25**R via the flow path opening **251**H. The communication port **4**H communicates with the flow path **6**R via the flow path opening **650**H. Therefore, the flow path **25**R communicates with the flow path **6**R through the communication port **4**H. Specifically, the flow path **25**R and the flow path **6**R communicate with each other through the communication port **4**H by press-collapsing the sealing member **4** between the flow path opening forming member **25** and the holder **6**.

[0110] Such a sealing member **4** is a member that liquid-tightly communicates the flow path opening **251**H of the head module **2** with the flow path opening **650**H of the holder **6**. Ink flowing in the flow path **6**R of the holder **6** flows to the flow path **25**R of the flow path opening forming member **25** through the communication port **4**H and is supplied to the individual flow paths of the chip **20** through the common space R.

[0111] As shown in FIG. **12**, the sealing member **4** has the seal region **4**S. In the present embodiment, the entire region of the sealing member **4** corresponds to the seal region **4**S. The seal region **4**S is in contact with both the flow path opening forming member **25** and the holder **6**, and is a region, of the sealing member **4**, that is sandwiched between the flow path opening forming member **25** and the holder **6**. The seal region **4**S is a region where the sealing member is collapsed under load from the flow path opening forming member **25** and the holder **6** in order to cause the flow path opening **251**H and the flow path opening **650**H liquid-tightly communicate with each other. In other words, a region, of the sealing member **4**, that is sandwiched between both the flow path opening forming member **25** and the holder **6**, but is not collapsed under load from both members and does not contribute to cause the flow path opening **251**H and the flow path opening **650**H substantially liquid-tightly communicate with each other, is not included in the seal region **4**S.

[0112] As shown in FIG. **12**, the seal region **4**S is provided at a position different from that of the chip **20** when viewing the Z**1** direction because the sealing member **4** is provided at a position different from that of the chip **20** when viewing the Z**1** direction. In other words, the seal region **4**S does not

overlap the chip **20** when viewing the Z**1** direction. The seal region **4**S does not overlap the chip **20** when viewing the Z**1** direction, so that it is unlikely that influence of the reaction force of the sealing member **4** acts on the chip **20**, compared with the case where the seal region overlaps the chip. This improves the reliability of the head module **2**.

[0113] The seal region **4**S is located in the Y**1** direction or the Y**2** direction, which is the longitudinal direction of the head module **2**, from the chip **20**, when viewing the Z**1** direction. The seal region **4**S is located in the longitudinal direction of the chip **20**, so that it is possible to avoid the seal region **4**S from being located between adjacent chips **20**. Therefore, the seal region **4**S is provided, so that it is possible to avoid the distance between adjacent chips **20** from increasing. Therefore, print quality is not easily affected.

[0114] The seal region **4**S may be provided in the direction in which the plurality of head modules **2** is aligned with respect to the chip **20**, that is, in the short direction of the head module **2**. The sealing member **4** may be provided in the direction in which the plurality of head modules **2** is aligned with respect to the chip **20**, that is, in the short direction of the head modules **2**.

1-3D. Cover **5**

[0115] The cover **5**, shown in FIGS. **3** and **4**, is a support member that supports the plurality of head module **2**. The cover **5** is common to the plurality of head modules **2**, but may be provided individually for each head module **2**. The cover **5** is a plate-shaped member with the direction in the Z axis as the thickness direction. The cover **5** is positioned in the Z**1** direction of the plurality of flow path opening forming members **25**. The cover **5** is a member for sandwiching the sealing member **4** and the flow path opening forming member **25** between the cover and the holder **6**. As shown in FIG. **4**, the cover **5** has a face **511** that faces the Z**1** direction and a face **512** that faces the Z**2** direction. The cover **5** is a member that does not have a flow path through which ink flows.

[0116] The cover **5** is made of metal, for example. The cover **5** includes metals such as aluminum and stainless steel, for example. The cover **5** is rigid to support the plurality of head module **2**.

[0117] FIG. **13** shows the top view of the cover **5** shown in FIG. **4**. As shown in FIGS. **4** and **13**, the cover **5** has the plurality of openings **5**H. Each opening **5**H is a hole penetrating the cover **5** in the thickness direction. Each opening **5**H is provided to expose part of the head module **2** to the outside. Specifically, the chip **20** is exposed through the opening **5**H. Therefore, the plurality of nozzles N is exposed through the opening **5**H.

[0118] The cover **5** includes a plurality of support faces **5**S. The support face **5**S is a face that is part of the face **512**, of the cover **5**, that faces the Z**2** direction, contacts the flow path opening forming member **25**, and supports the flow path opening forming member **25**. The support face **5**S is a frame that surrounds the opening **5**H of the cover **5**. In FIG. **13**, the support face **5**S is shaded.

[0119] As shown in FIG. **4**, part of the face **251**, of the aforementioned flow path opening forming member **25**, that faces the Z**1** direction has the supported face **2511**. The supported face **2511** is a face that contacts the support face **5**S of the cover **5** and is supported by the support face **5**S. The head module **2** is held by the cover **5** when the supported face **2511** contacts the support face **5**S.

[0120] The flow path opening forming member **25**, not the chip **20**, is held by the cover **5**, so that the chip **20** can be positioned within the opening **5**H of the cover **5**. This avoids excessively exposing the chip **20** in the Z**1** direction of the cover **5**. Hence, it is possible to suppress an increase in the distance between the chip **20** and the medium **90**, that is, the paper gap.

[0121] A thickness D**5** of the cover **5** in the Z**1** direction is thicker than the thickness D**2** of the chip **20** in the Z**1** direction. This reduces the possibility of deformation of the cover **5** due to the reaction force of the sealing member **4**.

[0122] Furthermore, the nozzle face SN of the chip **20** and the face **511**, of the cover **5**, that faces the Z**1** direction are generally flush. This suppresses an increase in the paper gap. Furthermore, it is easy to wipe the face **511**, of the cover **5**, that faces the Z**1** direction and the nozzle face SN in a batch. The nozzle face SN and the face **511**, of the cover **5**, that faces the Z**1** direction are generally flush means not only that they are completely flush, but also that there are steps to the extent that manufacturing errors and the like are included. The nozzle face SN and the face **511**, of the cover **5**, that faces the Z**1** direction do not have to be generally flush.

[0123] As shown in FIG. **4**, the cover **5** has a plurality of fixing holes **503**. Each of the **503** fixing holes is used to fix the cover **5** to the holder **6**. As shown in FIG. **4**, each fixing hole **503** is provided in the face **512**, of the cover **5**, that faces the Z**2** direction. Each fixing hole **503** is a bottomed hole provided in the face **512**, of the cover **5**, that faces the Z**2** direction. Each fixing hole **503** is a recess provided in the face **512**, of the cover **5**, that faces the Z**2** direction, that can be regarded as a depression formed in the face **512**. The plurality of fixing holes **503** correspond, on a one-to-one basis, to and overlaps the aforementioned plurality of fixing holes **652**H when viewing the Z**1** direction.

[0124] One cover **5** described above is provided for one holder **6**, but a plurality of covers may be provided for one holder **6**. For example, the cover **5** holding three of the six head modules **2** and the cover **5** holding the remaining 3 head modules **2** may be provided.

[0125] For example, two or more head modules **2** to be replaced at the similar timing are held together by one cover **5**. This facilitates work because two or more head modules **2** to be replaced at the similar timing can be replaced together.

[0126] Specifically, for example, the cover **5** preferably holds the plurality of head modules **2** that ejects the same type of liquid among the plurality of head modules **2**. This allows chips that have a similar service life, such as chips for colors that are frequently discharged, to be replaced together. This improves work efficiency in replacement. Two or more head modules **2** held in one cover **5** do not have to eject the same type of ink. One head module **2** may be capable of ejecting one type of ink or more than one type of ink.

1-3E. Fixing Member Group **150**

[0127] As shown in FIG. **4**, a fixing member group **150** includes a plurality of fixing members **155** and a plurality of fixing members **157**.

[0128] The fixing member **155** fixes the holder **6** and the cover **5**. The fixing member **155** is inserted into the fixing hole **652**H, which is a through hole, and the recess-shaped

fixing hole **503** in this order. Therefore, the fixing member **155** is not exposed to the nozzle face SN. On the other hand, part of the fixing member **155** is exposed to the face **606**, of the holder **6**, that faces the Z**2** direction.

[0129] The fixing member **157** directly fixes the holder **6** and the head module **2**. The fixing member **157** is inserted into the fixing hole **651**H, which is a through hole, and the recess-shaped fixing hole **215** in this order. Therefore, the fixing member **157** is not exposed to the nozzle face SN. On the other hand, part of the fixing member **157** is exposed to the face **606**, of the holder **6**, that faces the Z**2** direction.

[0130] The fixing members **155** and **157** are not exposed to the nozzle face SN, so that it is possible to avoid the adhesion and solidification of ink mist on the fixing members **155** and **157**. Therefore, it is possible to prevent mist adhesion from making it difficult to remove the fixing members **155** and **157**.

[0131] As shown in FIG. **10**, the plurality of fixing members **155** is provided near the corners of the holder **6**, which is, for example, square-shaped when viewing the Z**1** direction. The plurality of **157** fixing members is provided in in units of the head module **2**. Specifically, the two fixing members **157** are provided for each head module **2**. One of the two fixing members **157** is disposed in the Y**1** direction of the head module **2** when viewing the Z**1** direction, and the other is disposed in the Y**2** direction of the head module **2**.

[0132] Each of the fixing members **155** and **157** is preferably a screw. In this case, for example, wall faces forming the fixing hole **651**H, the fixing hole **652**H, the fixing hole **215**, and the fixing hole **503** form female screws. The fixing members **155** and **157** are screws, so that the cover **5** and a plurality of head module **2** can be easily unfixed from the holder **6** by rotating and undoing the screws. The fixing members **155** and **157** are screws, so that the plurality of head modules **2** and covers **5** can be attached to and removed from the holder **6** at will, without using an adhesive.

[0133] The fixing members **155** and **157** may be other than screws. For example, the fixing members may have a configuration that includes an L- or T-shaped pin with its tip in the Z**1** direction bent at a right angle and an elastic member such as a plate spring or a coil spring, and fixes the holder **6** and the cover **5** to each other using the elastic force of the elastic member.

[0134] Thus, the fixing member **155** can be of any configuration as long as it is a member that fixes the holder **6** and the cover **5** to each other. The fixing member **157** can be of any configuration as long as the fixing member is a member that fixes the holder **6** and the head module **2** to each other.

1-3F. Circuit Board **7**, Relay Board **70** and Connector **71**

[0135] As shown in FIG. **3**, the circuit board **7** is provided for each head module **2**. The circuit board **7** is inserted into the wiring hole **25**H of the chip **20** and the wiring hole **20**H of the flow path opening forming member **25**. The relay board **70** is electrically coupled to the plurality of head module **2**. The circuit board **7** is joined to the vibration plate **204**. The circuit board **7** protrudes in the Z**2** direction from the vibration plate **204**. The circuit board **7** is a mounting component with a plurality of wires formed to electrically couple the chip **20** to the relay board **70**. The circuit board **7** includes, for example, a flexible substrate such as a flexible printed circuit (FPC) or a chip on film (COF) or a rigid substrate. The drive signal and the reference voltage for driving the drive element E are supplied to each drive element E from the circuit board **7**.

[0136] The relay board **70** is fixed to the bottom face of the recess **610** of the face **605**, of the flat plate portion **61** of the holder **6**, in the Z**1** direction. The relay board **70** is flat and is fixed to the holder **6** with an adhesive or the like. The relay board **70** is electrically coupled to the control unit **91**. A plurality of connectors **71** is mounted on the relay board **70**. The plurality of connectors **71** is provided on the plurality of circuit boards **7** on a one-to-one basis. The end, of the circuit board **7**, with a plurality of terminals is removably inserted into each connector **71**. The circuit board **7** is preferably rigid to facilitate insertion and removal of the end of the circuit board **7** into and from the connector **71**. When the circuit board **7** is composed of a flexible substrate, it is desirable to attach a rigid body for supporting the flexible substrate. By inserting the end of the circuit board **7** into the connector **71**, the circuit board **7** is electrically coupled to the control unit **91** via the relay board **70**.

1-3G. Bushing

[0137] As shown in FIG. **4**, the bushing **526** is disposed between the flow path opening forming member **25** and the cover **5**. Although not shown in detail, for example, the bushings **526** are provided in the Y**1** direction and the Y**2** direction of each flow path opening forming member **25** when viewing the Z**1** direction. The bushing **522** is disposed between the holder **6** and the cover **5**. Although not shown in detail, for example, the bushing **522** is disposed in a rectangular frame along the outer edge of the holder **6** when viewing the Z**1** direction. Each of the bushings **526** and **522** is, for example, an elastic resin material. The bushings **526** and **522** are provided, so that it is possible to reduce the possibility of ink mist or other substances entering the housing space in the recess **610** of the holder **6** from the outside of the liquid ejecting head **1**.

1-4. Method of Manufacturing Liquid Ejecting Head **1**

[0138] FIG. **14** is a flow diagram showing part of the method of manufacturing the liquid ejecting head **1** of the first embodiment. As shown in FIG. **14**, the method of manufacturing the liquid ejecting head **1** includes a first positioning step s**01**, a bonding step s**03**, a second positioning step s**02**, and a fixing step s**04** in this order. The head module **2** is manufactured by attaching the chip **20** to the flow path opening forming member **25** in the first positioning step s**01** and the bonding step s**03**. The head module **2** is attached to the holder **6** in the second positioning step s**02** and the fixing step s**04**.

[0139] The first positioning step S**01** and the second positioning step S**02** are provided, so that it is possible to achieve alignment of the plurality of head modules **2**, especially alignment of nozzles N between the plurality of head modules **2** with high precision.

1-4A. First Positioning Step s**01**

[0140] In the first positioning step s**01**, the chip **20** and the flow path opening forming member **25** are positioned. Specifically, the nozzle plate **201** of the chip **20** and the flow path opening forming member **25** are optically positioned with respect to any nozzle N of the plurality of nozzles N.

[0141] Each of FIGS. **15**, **16**, and **17** is a diagram for describing the first positioning step s**01** shown in FIG. **14**. In

the first positioning step s**01**, the nozzle plate **201** and the flow path opening forming member **25** are positioned by positioning the relative positions of the first positioning portion **210**H and the nozzle N with respect to a predetermined nozzle N. In FIGS. **15**, **16**, and **17**, the predetermined nozzle N of the plurality of nozzles N is shown in a simplified manner.

[0142] As shown in FIG. **15**, in the first positioning step s**01**, first, for example, a thermosetting adhesive **23** is applied to the face **251**, of the flow path opening forming member **25**, that faces the Z**1** direction, and then the chip **20** is brought into contact with the adhesive **23**. In this case, the nozzle plate **201** of the chip **20** is positioned away from the adhesive **23**.

[0143] Next, as shown in FIG. **16**, a translucent mask M is disposed in the Z**1** direction of the chip **20** with being away from the chip **20**. The mask M is, for example, a plate-shaped member with visible light transmission of 70% or more. The mask M is made of a light-transmitting material such as glass, for example.

[0144] The mask M has a mark MN corresponding to a predetermined nozzle N and a mark M**2** corresponding to the first positioning portion **210**H. The marks MN and M**2** are provided at the positions where the distance between the predetermined nozzle N and the first positioning portion **210**H is a desired distance. The marks MN and M**2** have light-shielding with visible light transmission of 70% or less so that they can be imaged.

[0145] Each of the mark MN and the mark M**2** is provided in plurality from the viewpoint of improving positioning accuracy. In the shown example, two marks MN and two marks M**2** are provided on the mask M. Furthermore, the two marks MN and the two marks M**2** is preferably aligned in a straight line from the viewpoint of improving positioning precision. The respective number and the arrangement of the marks MN and M**2** are not limited to the example shown in the figure.

[0146] Next, as shown in FIG. **17**, the two marks MN and the two marks M**2** of the mask M, and the two predetermined nozzles N of the nozzle plate **201** and the two first positioning portions **210**H of the flow path opening forming member **25** are positioned using an imaging unit **99**. Each of the two predetermined nozzles N of the nozzle plate **201** and the two first positioning portions **210**H of the flow path opening forming member **25** serve as alignment marks for positioning.

[0147] The imaging unit **99** is disposed away from the chip **20** in the Z**1** direction of the chip **20** with the mask M disposed therebetween. Therefore, the mask M is disposed between the imaging unit **99** and the chip **20**. The mask M and the imaging unit **99** are away from each other.

[0148] The imaging unit **99** includes, for example, a camera including an imaging element such as a CMOS image sensor or CCD image sensor and a condensing lens that collects and condenses light onto the imaging element. The two marks MN and the two marks M**2** of the mask M are optically positioned with the two predetermined nozzles N and the two first positioning portions **210**H using the imaging unit **99**.

[0149] Specifically, using an image and the like captured by the imaging unit **99**, the two predetermined nozzles N and the two first positioning portions **210**H that are the plurality of alignment marks, and the plurality of marks of the mask M is superimposed with each other. As a result, the chip **20** and the flow path opening forming member **25** are positioned with respect to the nozzle N. The first positioning portion **210**H is imaged through the through hole **211**H. In the shown example, one camera capable of capturing the entire mask M is shown as the imaging unit **99**, but the imaging unit **99** may include a plurality of cameras positioned at respective locations facing the plurality of alignment marks.

[0150] According to the first positioning step s**01** described above, the chip **20** and the flow path opening forming member **25** can be positioned with high precision with respect to the nozzle N.

[0151] As mentioned above, in the first positioning step s**01**, the chip **20** and the flow path opening forming member **25** are positioned by positioning the relative positions of the first positioning portion **210**H and the nozzle N using the first positioning portion **210**H as an alignment mark.

[0152] The first positioning portion **210**H is used to position the head module **2** and the holder **6** in the second positioning step s**02** described below. Therefore, by using the first positioning portion **210**H used in the second positioning step s**02** as an alignment mark in the first positioning step s**01**, no other alignment mark is required in the first positioning step s**01**. Furthermore, by using the same first positioning portion **210**H in the first positioning step s**01** and second positioning step s**02**, the positioning precision of the chip **20**, the flow path opening forming member **25**, and the holder **6** can be improved.

[0153] In the first positioning step s**01**, another alignment mark may be provided at the flow path opening forming member **25** without using the first positioning portion **210**H as an alignment mark.

[0154] As mentioned above, in the first positioning step s**01**, the first positioning portion **210**H and the nozzle N are optically detected by the imaging unit **99** located in the Z**1** direction where the nozzle N opens for the nozzle plate **201** and the flow path opening forming member **25**. According to such a method, the nozzle plate **201** and the flow path opening forming member **25** can be easily positioned with high precision with respect to the nozzle N.

[0155] Specifically, the first positioning portion **210**H is optically detected through the through hole **211**H that opens to the face **251**, of the flow path opening forming member **25**, that faces the Z**1** direction. As mentioned above, the through hole **211**H is disposed in the Z**1** direction of the first positioning portion **210**H and communicates with the first positioning portion **210**H, and has a larger outer shape than the first positioning portion **210**H. Such a through hole **211**H is provided, so that it is easy to optically detect the position of the first positioning portion **210**H through the through hole **211**H.

[0156] As shown in FIG. **8**, the depth D**21** of the through hole **211**H is deeper than the depth D**20** of the first positioning portion **210**H. In other words, the depth D**20** is shallower than the depth D**21**. This allows positioning to be made with high precision. It is easy to attach and detach the second positioning portion **654** to and from the first positioning portion **210**H when the depth D**20** is shallower than the depth D**21**, compared with when the depth D**20** is deeper than D**21**.

[0157] The first positioning portion **210**H does not overlap the chip **20** when viewing the Z**1** direction. Thus, the nozzle N and the first positioning portion **210**H do not overlap with each other when viewing the Z**1** direction. Therefore, it is

possible to position the chip **20** and the flow path opening forming member **25** from below the chip **20** using the nozzle N and the first positioning portion **210**H as alignment marks.

1-4B. Bonding Step s**03**

[0158] In the bonding step s**03**, after the first positioning step s**01**, the adhesive **23** for fixing the chip **20** and the flow path opening forming member **25** is cured. For example, when the adhesive **23** is a thermosetting resin, heat is applied to cure the adhesive **23**.

[0159] In the present embodiment, the bonding step s**03** is performed between the first positioning step s**01** and the second positioning step s**02**. After the first positioning step s**01**, the chip **20** and the flow path opening forming member **25** are bonded, so that it is possible to improve positioning precision of the chip **20** with nozzle N and the flow path opening forming member **25**. Thus, for example, the positioning of the wiring hole **20**H and the wiring hole **25**H, and the positioning of the space Rc and the communication space Ra can be made with high precision.

1-4C. Second Positioning Step s**02**

[0160] In the second positioning step s**02**, the head module **2** and the holder **6** are positioned. Specifically, the head module **2** and the holder **6** are positioned by press fitting the second positioning portion **654** of the holder **6** into the first positioning portion **210**H of the flow path opening forming member **25**.

[0161] FIG. **18** is a diagram for describing the second positioning step s**02** shown in FIG. **14**. In the second positioning step s**02**, the head module **2** is brought closer to the holder **6** as shown by an arrow A**2**. The second positioning portion **654** is then press-fitted into the first positioning portion **210**H. This allows positioning of the head module **2** and the holder **6**.

[0162] When the second positioning portion **654** is press-fitted into the first positioning portion **210**H, the sealing member **4** is interposed between the head module **2** and the holder **6**. In this case, for example, the sealing member **4** is disposed so that the communication port **4**H of the sealing member **4** overlaps the flow path opening **650**H that the holder **6** has when viewing the Z**1** direction. When the second positioning portion **654** is press-fitted into the first positioning portion **210**H, the circuit board **7** is inserted into the connector **71**.

1-4D. Fixing Step s**04**

[0163] In the fixing step s**04**, the head module **2** is attached to the holder **6**. Specifically, the fixing member **157** is inserted into the fixing hole **651**H and the fixing hole **215** in this order. When the fixing member **157** is a screw, the head module **2** is fixed to the holder **6** by being screwed by the fixing member **157**.

[0164] In the above method, the chip **20** is attached to the flow path opening forming member **25** and the head module **2** is attached to the holder **6**.

[0165] As mentioned above, the method of manufacturing the liquid ejecting head **1** includes the first positioning step s**01** and the second positioning step s**02**. Since the chip **20** and the flow path opening forming member **25** are positioned with respect to the nozzle N in the first positioning step s**01**, the head module **2** and the holder **6** are positioned with respect to the nozzle N simply by press fitting the flow path opening forming member **25** into the holder **6**. This improves positioning precision of each head module **2** with respect to the holder **6**. Furthermore, the nozzle alignment between the plurality of head modules **2** can be made with high precision. Therefore, when some of the head modules **2** of the plurality of head modules **2** of the liquid ejecting head **1** need to be replaced with other head modules **2** due to malfunction or other reasons, nozzle alignment between the plurality of head modules **2** can be ensured with high-precision simply by press-fitting the flow path opening forming member **25** into the holder **6**. Therefore, the work to replace the head module **2** to achieve regeneration can be easily performed.

[0166] As mentioned above, the direction in which one of the first positioning portion **210**H and the second positioning portion **654** is press-fitted into the other is the same as the direction in which the flow path opening **650**H and the flow path opening **251**H overlap with each other. Therefore, by attaching the head module **2** to the holder **6**, the flow-path-communication between the flow path **6**R and the flow path **25**R can be easily made with high precision.

[0167] The plurality of second positioning portions **654** is disposed at the bottom of the first recess **611**. The first positioning portion **210**H is disposed at the face **252**, of the cover **5**, that faces the Z**2** direction, which is opposite to the Z**1** direction. The first positioning portion **210**H and the second positioning portion **654** are positioned in this manner, so that only the head module **2** to be replaced can be easily attached and detached from below the holder **6**.

[0168] As shown in FIG. **4**, the fixing member **157** is disposed so that the fixing member does not overlap the chip **20** and sandwiches the sealing member **4** between the fixing member **157** and the chip **20** when viewing the Z**1** direction. The fixing member **157** does not overlap the chip **20** when viewing the Z**1** direction, so that it is unlikely that the chip **20** is subjected to the load generated by fixing the fixing member **157** in the fixing step s**04**, compared with the case where the fixing member overlaps the chip. Furthermore, the sealing member **4** is disposed between the fixing member **157** and the chip **20** when viewing the Z**1** direction, so that the distance of the chip **20** to the fixing member **157** can be made farther by the thickness of the sealing member **4**. As a result, it is unlikely that the chip **20** is subjected to the load generated by fixing the fixing member **157**.

2. Second Embodiment

[0169] The second embodiment of the present disclosure is described below. In the following examples, elements whose actions or functions are the same as those of the first embodiment will be abbreviated using the same symbols as those used in the description of the first embodiment, and detailed descriptions of each will be omitted as appropriate.

2-1. Method of Manufacturing Liquid Ejecting Head **1**

[0170] The method of manufacturing the liquid ejecting head **1** in the present embodiment is a method of removing a head module **2** of a certain liquid ejecting head **1**, repairing the head module **2**, and manufacture a new liquid ejecting head **1** including the repaired head module **2**. In the following, a certain liquid ejecting head **1** will be referred to as "a first liquid ejecting head **1***a*" and a new liquid ejecting head **1** will be referred to as "a second liquid ejecting head **1***b*.

[0171] Specifically, the method of manufacturing the liquid ejecting head **1** in the present embodiment includes removing a specific head module **2** from a certain holder **6**, manufacturing a new head module **2** by repairing that specific head module, and then installing the new head module **2** in another holder **6**.

[0172] In the following, a certain holder **6** is referred to as "a first holder **6***a*" and a plurality of head modules **2** attached to the first holder **6***a* is referred to as "a first head module **2***a*". The specific head module **2** above is one or more of the plurality of first head modules **2***a*. Another new holder **6** is referred to as "a second holder **6***b*" and the plurality of head modules **2** attached to the second holder **6***b* is referred to as "a second head modules **2***b*". The new head module **2** obtained by replacing the first head module **2***a* is the second head module **2***b*. The chip **20** of the first head module **2***a* is referred to as "a first chip **20***a*" and the nozzle plate **201** of the first chip **20***a* is referred to as "a first nozzle plate **201***a*. The chip **20** of the second head module **2***b* is referred to as "a second chip **20***b*" and the nozzle plate **201** of the second chip **20***b* is referred to as "a second nozzle plate **201***b*".

[0173] FIG. **19** is a flow diagram showing part of the method of manufacturing the liquid ejecting head **1** in the second embodiment. As shown in FIG. **19**, the method of manufacturing the liquid ejecting head **1** in the present embodiment includes an unfixing step s**05**, a press-fit releasing step s**06**, a disassembling step s**07**, a first positioning step s**01**, a bonding step s**03**, a second positioning step s**02**, and a fixing step s**04**.

2-1A. Unfixing Step s**05**

[0174] In the unfixing step s**05**, the first holder **6***a* and the first head module **2***a* of the first liquid ejecting head **1***a* are unfixed. Specifically, the first holder **6***a* and the first head module **2***a* can be unfixed by removing the fixing member **157** from the fixing hole **651**H and the fixing hole **215**. Before the unfixing step s**05**, the cover **5** should be removed from the first holder **6***a*.

2-1B. Press-Fit Releasing Step s**06**

[0175] FIG. **20** is a diagram for describing the press-fit releasing step s**06** shown in FIG. **19**. As shown in FIG. **20**, in the press-fit releasing step s**06**, the state of press-fit of the second positioning portion **654** of the first holder **6***a* into the first positioning portion **210**H of the first head module **2***a* is released. The operator grasps the first head module **2***a* and pulls it downward in the direction indicated by an arrow A**3** to release the above press fit, so that the first head module **2***a* is removed from the first holder **6***a*. For example, after removing the fixing member **157**

[0176] from the fixing hole **651**H and the fixing hole **215**, a long bar-shaped member is inserted into the fixing hole **651**H and the fixing hole **215**, and the first head module **2***a* is pressed in the Z**1** direction with the member. This allows easy release of the press fit of the first head module **2***a* into the first holder **6***a*. In other words, by using the fixing hole **651**H as a hole for releasing the press-fit, the press-fit of the first head module **2***a* into the first holder **6***a* can be easily released. The depth of the fixing hole **651**H is deeper than the depth of the fixing hole **215**. This makes it easy to remove the flow path opening forming member **25** from the holder **6**.

[0177] The relay board **70** is disposed in the Z**2** direction of the plurality of head modules **2**. The first positioning portion **210**H is provided at the face **252**, of the flow path opening forming member **25**, that faces the Z**2** direction. This makes it easy to attach and detach the first head module **2***a* and the circuit board **7** to be replaced from below the first holder **6***a* and the relay board **70**. Hence, the electrical disconnection of the first head module **2***a* other than the component to be replaced is not necessary, simplifying the attachment and detachment process.

[0178] The press-fit state refers to a tight fit or intermediate fit, where the second positioning portion **602** is in contact with the first positioning portion **502** at least two points upon completion of insertion of the second positioning portion **602** into the first positioning portion **502**. Before press fitting, the length of the longest line segment linking two points on the outer circumference of the second positioning portion **602**, which is the positioning pin, is larger than the diameter of the largest circle inscribed in the first positioning portion **502**, which is the positioning hole when viewing the direction along the Z axis. In the press-fit state, the head module **2** is fitted to the holder **6** by the force caused by the press fit to the extent that the head module does not fall under its own weight.

2-1C. Disassembling Step s**07**

[0179] FIG. **21** is a diagram for describing the disassembling step s**07** shown in FIG. **19**. As shown in FIG. **21**, in the disassembling step s**07**, the first chip **20***a* and the flow path opening forming member **25** of the first head module **2***a* are disassembled. In other words, the first chip **20***a* with the first nozzle plate **201***a* is removed from the flow path opening forming member **25**. For example, when the adhesive **23** is a thermosetting resin, a release agent or the like is used for removing the adhesive **23**. When the adhesive **23** is a thermoplastic resin, heat treatment is applied to the adhesive **23** by a heater (not shown) to soften the adhesive **23**, thereby separating the first chip **20***a* from the flow path opening forming member **25**.

2-1D. First Positioning Step s**01**

[0180] FIG. **22** is a diagram for describing the first positioning step s**01** shown in FIG. **19**. As shown in FIG. **22**, in the first positioning step s**01** of the present embodiment, the flow path opening forming member **25** separated from the first chip **20***a* in the disassembling step s**07** and the second chip **20***b* including at least the second nozzle plate **201***b* that is different from the first nozzle plate **201***a* are optically positioned with respect to the nozzle N of the second nozzle plate **201***b*. In other words, the second nozzle plate **201***b* and the flow path opening forming member **25** are optically positioned with respect to the nozzle N.

[0181] The positioning method is the same as that in the first embodiment. Specifically, as shown in FIG. **22**, the mask M and the imaging unit **99** are used for such positioning. Therefore, even in a case of the second chip **20***b* including the new second nozzle plate **201***b*, the positioning of the second chip **20***b* and the flow path opening forming member **25** can be performed with high precision.

[0182] The bonding step s**03** in the present embodiment is the same as the bonding step s**03** in the first embodiment. In the bonding step s**03** of the present embodiment, the second chip **20***b* and the flow path opening forming member **25** are

bonded by the adhesive **23**. As a result, the second head module **2***b* including the second chip **20***b* and the flow path opening forming member **25** is generated.

2-1E. Second Positioning Step s**02**

[0183] FIG. **23** is a diagram for describing the second positioning step s**02** shown in FIG. **19**. As shown in FIG. **23**, in the second positioning step s**02**, the second head module **2***b* and the second holder **6***b* are positioned by press fitting the second positioning portion **654** of the new second holder **6***b* that is different from the first holder **6***a* into the first positioning portion **210**H of the flow path opening forming member **25** of the second head module **2***b*.

[0184] Since the second chip **20***b* and the flow path opening forming member **25** are positioned with respect to the nozzle N in the first positioning step s**01**, the second head module **2***b* and the second holder **6***b* are positioned with respect to the nozzle N simply by press fitting the flow path opening forming member **25** into the second holder **6***b*. Therefore, nozzle N alignment with high precision between the plurality of second head modules **2***b* can be ensured simply by press-fitting the flow path opening forming member **25** into the second holder **6***b*. Therefore, the replacement of the liquid ejecting head **1** can be facilitated using the head module **2** that has been repaired by reusing the flow path opening forming member **25**.

[0185] Next, the second head module **2***b* is fixed to the second holder **6***b* by the fixing step s**04** same as that in the first embodiment.

[0186] The first holder **6***a* may be an example of "a second holder". In other words, the first holder **6***a* and the second holder **6***b* described above may be the same holder **6**. Specifically, the second head module **2***b* that is manufactured by repairing the first head module **2***a* removed from the first holder **6***a* of the first liquid ejecting head **1***a* by the unfixing step s**05** to the bonding step s**03** may be positioned and fixed to the first holder **6***a* of the liquid ejecting head **1***a* in the second positioning step s**02** and the fixing step s**04** to manufacture the second liquid ejecting head **1***b*.

[0187] According to the method described above, the second liquid ejecting head **1***b* can be manufactured from the first liquid ejecting head **1***a*. From another viewpoint, according to the method described above, the liquid ejecting head **1** can be reused in the form of reusing the flow path opening forming member **25**.

[0188] The flow path opening forming member **25** is preferably made of metal. It is easy to repeatedly use the flow path opening forming member **25** when the flow path opening forming member **25** is made of metal, compared with when the flow path opening forming member **25** is made of resin.

3. Modifications

[0189] The first embodiment shown above can be modified in various ways. Specific aspects of the modifications that may be applied to the aforementioned first embodiment are described below. Two or more aspects optionally selected from the following exemplifications can be appropriately merged within a range not inconsistent with each other.

3-1. First Modification

[0190] FIG. **24** is a cross-sectional view of part of the liquid ejecting head **1** of the first modification. The first modification of the liquid ejecting head **1** shown in FIG. **24** includes a holder **8**. The holder **8** includes a first holder **81** and a second holder **82**. The first holder **81** is almost the same as the holder **6** of the first embodiment, except that the flange **64** is omitted.

[0191] The second holder **82** is the same as the cover **5** of the first embodiment except for the following element. The second holder **82** has a portion extending in the Y**1** direction or the Y**2** direction of the first holder **81** when viewing the Z**1** direction. The extending portion has a fourth positioning portion **824**. The fourth positioning portion **824** has the same configuration as the fourth positioning portion **642** of the first embodiment and is press-fitted into the third positioning portion **102** of the unit base **11**.

[0192] The second holder **82** includes a plurality of second positioning portions **822**. The two second positioning portions **822** are provided for each head module **2**. Although not shown in detail, one of the two second positioning portions **822** is located in the Y**1** direction of the chip **20** when viewing the Z**1** direction, and the other is located in the Y**2** direction. The second positioning portion **822** is a hole opening in the face **512**, of the second holder **82**, that faces the Z**2** direction. The second positioning portion **822** is a recess formed in the face **512**, of the second holder **82**, that faces the Z**2** direction, and can also be said to be a depression in the face **512**.

[0193] The head module **2** includes a first positioning portion **217** corresponding to the second positioning portion **822**. The first positioning portion **217** is a projection protruding from the face **251**, of the flow path opening forming member **25**, that faces the Z**1** direction toward the Z**1** direction. The first positioning portion **217** is press-fitted into the second positioning portion **822**. This positions the head module **2** to the holder **8** including the second holder **82**.

[0194] For example, the second holder **82** and each head module **2** are fixed with an adhesive or the like. When the second holder **82** and each head module **2** are fixed with an adhesive, for example, in a case in which they can be separated by melting the adhesive with heat, it can be said that the second holder **82** and each head module **2** are removably fixed to each other.

[0195] In the modification of the liquid ejecting head **1**, in the first positioning step s**01**, the first positioning portion **217** disposed at the face **251**, of the flow path opening forming member **25**, that faces the Z**1** direction and the nozzle N that opens to the nozzle face SN, the nozzle face, of the nozzle plate **201** of the chip **20**, that faces the Z**1** direction can be optically detected by an imaging unit located in the Z**1** direction of the nozzle plate **201** and the flow path opening forming member **25**, so that it is possible to easily optically position the nozzle plate **201** and the flow path opening forming member **25** with reference to the nozzle N with high precision.

3-2. Other Modifications

[0196] For example, the holder **6** may have a dedicated through hole for releasing the press-fit between the first positioning portion **210**H and the second positioning portion

654. For example, the through hole may be a hole with an opening area larger than the opening area of the fixing hole **651**H.

[0197] In the foregoing description, the sealing member **4** is provided for each head module **2**, but the sealing member **4** may be integrated with and shared by the plurality of head modules **2**.

[0198] "The first positioning portion" and "the second positioning portion" are not limited to have the configurations of the embodiments and the modification described above, as long as one is press-fitted into the other. Therefore, in each of the aforementioned embodiments, "the second positioning portion" is configured to be press-fitted into "the first positioning portion", but "the first positioning portion" may be configured to be press-fitted into "the second positioning portion".

[0199] "The liquid ejecting apparatus" can be used in various devices such as facsimile machines, copy machines, and the like, in addition to devices dedicated to printing. The application of the liquid ejecting apparatus 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 that forms a color filter of a display device such as a liquid crystal display panel. The liquid ejecting apparatus that ejects a solution of a conductive material is used as a manufacturing apparatus that forms wiring and electrodes of a relay board. The liquid ejecting apparatus that ejects a solution of an organic substance relating to a living body is used as a manufacturing apparatus that manufactures a biochip, for example.

[0200] Although the present disclosure is described above based on suitable embodiments, the present disclosure is not limited to the aforementioned embodiments. The configuration of each part of the present disclosure can be replaced with any configuration that performs the functions same as those of the aforementioned embodiments, and any configuration can be added.

What is claimed is:

1. A method of manufacturing a liquid ejecting head including a plurality of head modules each having a chip including at least a nozzle plate in which a plurality of nozzles is formed and a flow path opening forming member, and a holder holding the plurality of head modules, the method comprising:

a first positioning step of optically positioning the nozzle plate and the flow path opening forming member with reference to the nozzles; and

a second positioning step of positioning the head module and the holder by press fitting one of a first positioning portion of the flow path opening forming member and a second positioning portion of the holder into the other of first positioning portion and the second positioning portion.

2. The method of manufacturing the liquid ejecting head according to claim **1**, further comprising:

a bonding step of curing an adhesive for fixing the chip and the flow path opening forming member after the first positioning step.

3. The method of manufacturing the liquid ejecting head according to claim **1**, wherein

the first positioning step includes positioning relative positions of the first positioning portion and the nozzles.

4. The method of manufacturing the liquid ejecting head according to claim **3**, wherein

the first positioning step includes optically detecting the first positioning portion and the nozzles by an imaging unit located in a first direction where the nozzles open to the nozzle plate and the flow path opening forming member.

5. The method of manufacturing the liquid ejecting head according to claim **4**, wherein

the first positioning step includes optically detecting the first positioning portion and the nozzles, the first positioning portion being disposed at a face, of the flow path opening forming member, that faces the first direction.

6. The method of manufacturing the liquid ejecting head according to claim **4**, wherein

the first positioning portion is a positioning hole into which a positioning pin that is the second positioning portion is press-fitted, and wherein

a face, of the flow path opening forming member, that faces the first direction has a through hole that is disposed in the first direction of the positioning hole, communicates with the positioning hole, and has a larger outer shape than the positioning hole.

7. The method of manufacturing the liquid ejecting head according to claim **6**, wherein

a depth of the through hole is deeper than a depth of the positioning hole.

8. A method of manufacturing a liquid ejecting head, the method comprising manufacturing a second liquid ejecting head including a second holder, a first liquid ejecting head including a plurality of first head modules and a first holder that holds the plurality of first head modules, the manufacturing including using a portion of the first head module of the first liquid ejecting head, the method comprising:

a press-fit releasing step of releasing a press-fit state in which one of a first positioning portion of the first head module and a second positioning portion of the first holder are press-fitted to the other of the first positioning portion and the second positioning portion;

a disassembling step of disassembling the first head module in which the press-fit state with the first holder is released in the press-fit releasing step into a first chip including at least a first nozzle plate in which a plurality of nozzles is formed and a flow path opening forming member including the first positioning portion;

a first positioning step of optically positioning a flow path opening forming member separated from the first chip in the disassembling step and a second chip that includes at least a second nozzle plate different from the first nozzle plate, that is, the second nozzle plate and the flow path opening forming member, with nozzles of the second nozzle plate as a reference; and

a second positioning step of positioning, by press-fitting one of the first positioning portion of the flow path opening forming member and a second positioning portion of the second holder of a second head module including the second chip and the flow path opening forming member positioned in the first positioning step

into the other of the first positioning portion and the second positioning portion, the second head module and the second holder.

9. The method of manufacturing the liquid ejecting head according to claim **8**, wherein

the flow path opening forming member is made of metal.

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