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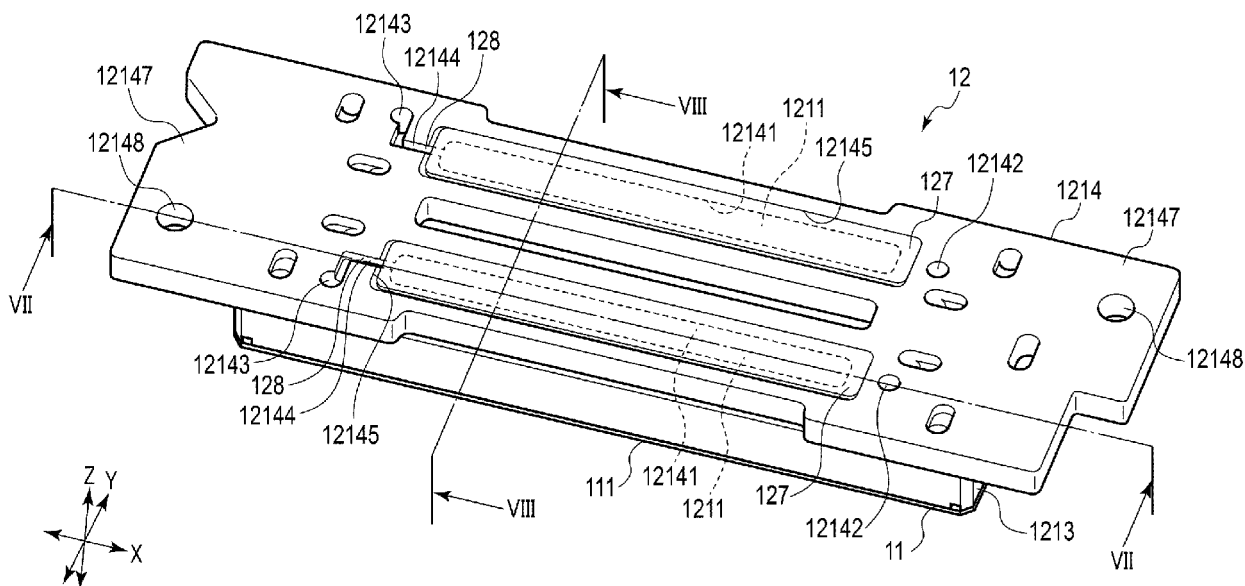
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(54)

LIQUID DISCHARGE HEAD

- (57) Provided is a liquid discharge head capable of securing a compact size even when a discharge performance is secured. According to one embodiment, the liquid discharge head includes: an actuator; a base plate; a first manifold; and a second manifold. The actuator includes a plurality of pressure chambers. The base plate is provided with the actuator on one surface thereof, and is formed with a supply hole that is configured to supply a liquid to the actuator and that is an elongated hole. The first manifold is provided on the other surface of the base plate and is formed with a first opening continuous with the supply hole. The second manifold is provided on the first manifold and is formed with a second opening forming a supply path together with the first opening.

FIG. 5



Description

FIELD

[0001] Embodiments described herein relate to a liquid discharge head.

BACKGROUND

[0002] An inkjet head that discharges an ink as a liquid is known as an example of a liquid discharge head used in a liquid discharge apparatus. The liquid discharge head is provided with an actuator and a manifold on a base plate. A standard base plate in the related art is mainly ink supply in which a plurality of holes are arranged. Further, an ink liquid chamber formed inside the manifold is mainly ink supply at a low position along a bottom surface of the manifold. However, in recent years, in a printer industry in which there is a demand for high-speed printing with high productivity, there is a concern that ink supply in a structure in the related art cannot catch up with the demand, and a liquid discharge head capable of supplying a large amount of ink quickly is required.

[0003] However, when a stable discharge performance capable of withstanding the supply in a large amount is secured, components become large, and a size and a cost of the liquid discharge head increase, which results in a burden on a customer side printer apparatus.

[0004] To this end, there is provided a liquid discharge head according to claim 1.

[0005] Preferably, the surface of the base plate on which the actuator is provided extends in a first direction and a second direction.

[0006] Preferably, the supply hole, the first opening, and the second opening each extend in the first direction.

[0007] Preferably, the supply hole, the first opening, and the second opening are arranged in parallel in a third direction perpendicular to the first direction and the second direction.

[0008] The head may further comprise a frame body provided on the one surface of the base plate and around the actuator.

[0009] The head may further comprise a nozzle plate covering the actuator and the frame body and formed with a plurality of nozzles facing the plurality of pressure chambers.

[0010] The actuator may comprise a pair of actuators.

[0011] The head may comprise a common liquid chamber formed by the base plate, the nozzle plate, and the frame body and continuous between the pair of actuators and between the actuator and the frame body.

[0012] The supply hole may be arranged between the pair of actuators.

the second manifold may be formed with a supply flow path connected to the first opening and an ink supply pipe configured to supply the liquid.

[0013] The head may further comprise a pair of head bodies each comprising the actuator and the base plate.

[0014] The second manifold may be formed with a datum hole configured to define a position of the head body.

[0015] Preferably, the length of the first opening of the first manifold in the first direction is larger than the length of the supply hole in the first direction.

[0016] Preferably, the first opening is a rectangular through hole formed across both main surfaces of the first manifold.

[0017] Preferably, the length of the first opening in the first direction is larger than the length in the first direction of a zone of the actuator in which the pressure chambers are formed.

[0018] A third opening may be formed on the first manifold.

[0019] A fourth opening connected to the second opening may be formed on the second manifold.

[0020] The fourth opening may connect the third opening and an ink discharge pipe for discharging the liquid.

[0021] A pair of the first openings may be formed on the first manifold.

[0022] A pair of said second openings may be formed on the second manifold.

[0023] A pair of supply holes may be formed on the base plate.

[0024] Each first opening may be continuous with the corresponding supply hole.

[0025] Each second opening may form the supply path together with the corresponding first opening to form a pair of the supply paths.

[0026] The second opening may form a ceiling portion of the supply path.

[0027] The length of the second opening in the first direction may be smaller than the length of the first opening in the first direction.

[0028] The present invention further relates to an inkjet printer including said liquid discharge head.

DESCRIPTION OF THE DRAWINGS

[0029]

FIG. 1 is a perspective view illustrating a configuration of a liquid discharge head according to an embodiment.

FIG. 2 is an exploded perspective view illustrating the configuration.

FIG. 3 is a side view illustrating the configuration.

FIG. 4 is a bottom view illustrating the configuration.

FIG. 5 is a perspective view illustrating configurations of a head body and a manifold unit.

FIG. 6 is an exploded perspective view illustrating the configurations.

FIG. 7 is a perspective view illustrating the configurations taken along a line VII-VII in FIG. 5.

FIG. 8 is a cross sectional view illustrating the configurations taken along the line VII-VII in FIG. 5.

FIG. 9 is a perspective view illustrating the configurations taken along a line VIII-VIII in FIG. 5.
 FIG. 10 is a cross sectional view illustrating the configurations taken along an arrow IX in FIG. 9.
 FIG. 11 is an enlarged cross sectional view illustrating the configurations.
 FIG. 12 is a perspective view illustrating the configuration of the manifold unit.
 FIG. 13 is a perspective view illustrating the configuration taken along a line XIII-XIII in FIG. 12.
 FIG. 14 is a perspective view illustrating a configuration of a base plate of the head body.
 FIG. 15 is a perspective view illustrating the configuration taken along a line XV-XV in FIG. 14.
 FIG. 16 is a bottom view illustrating the configuration of the head body with a part thereof omitted.
 FIG. 17 is a perspective view illustrating a part of a flow path configuration of the head body and the manifold unit.
 FIG. 18 is a top view illustrating a part of the flow path configuration.
 FIG. 19 is a side view illustrating a part of the flow path configuration.
 FIG. 20 is a side view illustrating a part of the flow path configuration.
 FIG. 21 is a view illustrating a configuration of a liquid discharge apparatus.

DETAILED DESCRIPTION

[0030] In general, according to one embodiment, a liquid discharge head capable of securing a compact size even when a discharge performance is secured is provided.

[0031] According to an embodiment, a liquid discharge head includes: an actuator; a base plate; a first manifold; and a second manifold. The actuator includes a plurality of pressure chambers. The base plate is provided with the actuator on one surface thereof, and is formed with a supply port (supply hole) that is configured to supply a liquid to the actuator and that is an elongated hole. The first manifold is provided on the other surface of the base plate and is formed with a first opening continuous with the supply port. The second manifold is provided on the first manifold and is formed with a second opening forming a supply path together with the first opening.

[0032] Hereinafter, a liquid discharge head 1 and a liquid discharge apparatus 2 using a liquid discharge head 1 according to an embodiment will be described with reference to FIGS. 1 to 21. FIG. 1 is a perspective view illustrating a configuration of the liquid discharge head 1 according to the embodiment. FIG. 2 is an exploded perspective view illustrating the configuration of the liquid discharge head 1. FIG. 3 is a side view illustrating the configuration of the liquid discharge head 1. FIG. 4 is a bottom view illustrating the configuration of the liquid discharge head 1.

[0033] FIG. 5 is a perspective view illustrating configurations of a head body 11 and a manifold unit 12 of the liquid discharge head 1 according to the embodiment.

FIG. 6 is an exploded perspective view illustrating the configurations of the head body 11 and the manifold unit 12 according to the embodiment. FIG. 7 is a perspective view illustrating the configurations of the head body 11 and the manifold unit 12, taken along a line VII-VII in FIG. 5. FIG. 8 is a cross sectional view illustrating the configurations of the head body 11 and the manifold unit 12, taken along the line VII-VII in FIG. 5. FIG. 9 is a perspective view illustrating the configurations of the head body 11 and the manifold unit 12, taken along a line VIII-VIII in FIG. 5. FIG. 10 is a cross sectional view illustrating the configurations of the head body 11 and the manifold unit 12, taken along an arrow IX in FIG. 9. FIG. 11 is an enlarged cross sectional view illustrating the configurations of the head body 11 and the manifold unit 12.

[0034] FIG. 12 is a perspective view illustrating the configuration of the manifold unit 12. FIG. 13 is a perspective view illustrating the configuration of the manifold unit 12, taken along a line XIII-XIII in FIG. 12. FIG. 14 is a perspective view illustrating a configuration of a base plate 111 of the head body 11. FIG. 15 is a perspective view illustrating a configuration of the base plate 111, taken along a line XV-XV in FIG. 14. FIG. 16 is a bottom view illustrating the configuration of the head body 11 with a part thereof omitted.

[0035] FIG. 17 is a perspective view illustrating a part of a flow path configuration of the head body 11 and the manifold unit 12. FIG. 18 is a top view illustrating a part of the flow path configuration of the head body 11 and the manifold unit 12. FIG. 19 is a side view illustrating a part of the flow path configuration of the head body 11 and the manifold unit 12. FIG. 20 is a side view illustrating a part of the flow path configuration of the head body 11 and the manifold unit 12. FIG. 21 is a view illustrating a configuration of the liquid discharge apparatus 2. In FIGS. 13 to 16, an example of a flow of a liquid is illustrated by arrows.

[0036] In FIGS. 1 to 21, an X axis, a Y axis, and a Z axis orthogonal to each other are illustrated. In the following description, a direction along the X axis is referred to as a first direction X, a direction along the Y axis is referred to as a second direction Y, and a direction along the Z axis is referred to as a third direction Z. In addition, in the drawings, configurations are enlarged, reduced, or omitted as appropriate for the sake of description.

[0037] The liquid discharge head 1 is, for example, an inkjet head provided in the liquid discharge apparatus 2 such as an inkjet record apparatus illustrated in FIG. 21. The liquid discharge head 1 is provided in a head unit 2130 including a supply tank 2132 as a liquid storage unit provided in the liquid discharge apparatus 2.

[0038] The liquid discharge head 1 is supplied with an ink as a liquid stored in the supply tank 2132. The liquid discharge head 1 may be a non-recycling head that does not recycle the ink, or may be a recycling head that recycles the ink. In the present embodiment, the liquid dis-

charge head 1 is described using a non-recycling head as an example.

[0039] As illustrated in FIGS. 1 to 3, the liquid discharge head 1 includes the head body 11, the manifold unit 12, a circuit board 13, and a cover 14. For example, the liquid discharge head 1 is a side chute type four-row integrated structure head including two sets of head bodies 11 each having a pair of actuators 113.

[0040] The head body 11 discharges the liquid. As illustrated in FIGS. 1 to 11 and 16, the head body 11 includes the base plate 111, a frame body 112, the actuators 113, a nozzle plate 114, and a mask plate 115. In addition, the head body 11 includes a common liquid chamber 116. The present embodiment will be described using an example of one head body 11 including two actuators 113.

[0041] As illustrated in FIGS. 14 to 16, the base plate 111 is formed of, for example, a ceramic material in a rectangular plate shape. The base plate 111 is formed in, for example, a rectangular shape long in one direction (first direction X). The base plate 111 has a single supply port (hole) 1111 and a single or a plurality of discharge ports 1112. The base plate 111 is provided with a pair of actuators 113, and is formed with a wiring pattern for driving the actuators 113. The supply port 1111 and the discharge port 1112 are through holes that penetrate both main surfaces of the base plate 111.

[0042] The single supply port 1111 is provided, for example, at a position facing a first common liquid chamber 1161 of the common liquid chamber 116, which will be described later. The supply port 1111 is, for example, an elongated hole long in one direction along a longitudinal direction of the first common liquid chamber 1161 (first direction X). The supply port 1111 is, for example, a rectangular shape long in one direction, or an elongated hole that is semicircular and has a uniform width at both ends. A width of the supply port 1111 in the longitudinal direction is set to, for example, a length equal to or greater than a width (length) of the actuator 113 in the longitudinal direction, or a length smaller than a length of the actuator 113 and substantially equal to a range (entire nozzle range) in which a pressure chamber 1131 driven during normal ink discharge and formed in the actuator 113 is provided.

[0043] For example, two discharge ports 1112 are provided at positions facing at least a third common liquid chamber 1163 of two third common liquid chambers 1163 of the common liquid chamber 116, which will be described later. For example, as illustrated in FIG. 14, two discharge ports 1112 are provided in each third common liquid chamber 1163 of the common liquid chamber 116. As illustrated in FIG. 16, the discharge ports 1112 may be provided in the base plate 111 adjacent to one end of the pair of actuators 113 in the longitudinal direction.

[0044] As illustrated in FIG. 16, the frame body 112 is fixed to one main surface of the base plate 111 via an adhesive or the like. The frame body 112 surrounds the supply port 1111, the plurality of discharge ports 1112,

and the actuators 113 provided on the base plate 111.

[0045] For example, the frame body 112 is formed in a rectangular frame shape long in one direction (first direction X), thereby forming an opening long in one direction along the longitudinal direction of the frame body 112. The pair of actuators 113, the supply port 1111, and two discharge ports 1112 are arranged in the opening of the frame body 112.

[0046] The actuator 113 is formed in a long plate shape in one direction (first direction X). The pair of actuators 113 is adhered to a mounting surface of the base plate 111. As illustrated in FIG. 16, the pair of actuators 113 is provided on the base plate 111 and arranged in two rows in a lateral direction (second direction Y) orthogonal to the longitudinal direction of the actuator 113 with the supply port 1111 interposed therebetween. The actuators 113 are arranged in the opening of the frame body 112 and adhered to a main surface of the base plate 111. As a specific example, the actuator 113 is formed by adhering two rectangular plate-shaped piezoelectric materials, which are long in one direction, to face each other such that polarization directions thereof are opposite to each other. Here, the piezoelectric material is, for example, lead zirconium titanate (PZT). The actuator 113 is adhered to the mounting surface of the base plate 111 via, for example, a thermosetting epoxy adhesive.

[0047] The actuator 113 includes, for example, a plurality of pressure chambers 1131 arranged at equal intervals in the longitudinal direction (first direction X). In the actuator 113, a plurality of grooves are formed in the longitudinal direction of the actuator 113 on a main surface side opposite to a base plate 111 side, and the pressure chambers 1131 are formed by the grooves. In other words, the actuator 113 has a plurality of walls 1133 arranged at equal intervals in the longitudinal direction and forming grooves therebetween. The plurality of walls 1133 form the plurality of pressure chambers 1131 between adjacent walls. That is, the plurality of walls 1133 are partition walls that separate the plurality of pressure chambers 1131. In addition, the wall 1133 is a piezoelectric body serving as a drive element that changes a volume of the pressure chamber 1131 when a drive voltage is applied thereto.

[0048] A surface of the actuator 113 opposite to the base plate 111 is adhered to the nozzle plate 114. In addition, in the actuator 113, a wiring pattern for driving the plurality of pressure chambers 1131 is formed.

[0049] The pressure chamber 1131 is a pressure chamber for ejecting the ink from a nozzle 1141 during an operation such as printing by the liquid discharge head 1. In the present embodiment, an example in which the actuator 113 includes the plurality of pressure chambers 1131 is described. Alternatively, the actuator 113 may include air chambers that are alternately arranged with the plurality of pressure chambers 1131 and that do not discharge the ink.

[0050] As illustrated in FIGS. 4, 7, 8, 10, and 11, the nozzle plate 114 is formed in a plate shape. The nozzle

plate 114 is fixed to a main surface of the frame body 112 on a side opposite to the base plate 111 via an adhesive or the like. The nozzle plate 114 includes a plurality of nozzles 1141 formed at positions facing the plurality of pressure chambers 1131. In the present embodiment, the nozzle plate 114 has two nozzle rows 1142 in which the plurality of nozzles 1141 are arranged in one direction (first direction X).

[0051] The plurality of nozzles 1141 facing the plurality of pressure chambers 1131 are holes for ejecting the ink during the operation such as printing by the liquid discharge head 1.

[0052] The mask plate 115 covers, for example, a main surface of the nozzle plate 114 on an outer surface side, an outer peripheral side of the nozzle plate 114, an outer peripheral surface of the frame body 112, and an outer peripheral surface of the base plate 111. In addition, the mask plate 115 covers a first manifold 1213 of the manifold unit 12, which will be described later.

[0053] As illustrated in FIG. 2, the mask plate 115 includes a pair of windows 1151 that exposes the nozzle rows 1142 implemented by the plurality of nozzles 1141 for discharging the liquid from a pair of nozzle plates 114.

[0054] As illustrated in FIG. 16, the common liquid chamber 116 communicates with the supply port 1111. The common liquid chamber 116 is provided around the pair of actuators 113. Specifically, the common liquid chamber 116 communicates with a primary side and a secondary side of the plurality of pressure chambers 1131 of each actuator 113. In addition, the common liquid chamber 116 communicates with the discharge ports 1112.

[0055] As a specific example, as illustrated in FIG. 16, the common liquid chamber 116 includes the first common liquid chamber 1161 long in one direction (first direction X), two second common liquid chambers 1162 long in one direction (first direction X), and the third common liquid chambers 1163 continuous with two ends of the first common liquid chamber 1161 and two ends of each of the two second common liquid chambers 1162. In addition, the common liquid chamber 116 communicates with the supply port 1111 and one opening of each of the plurality of pressure chambers 1131 of the actuator 113 via the first common liquid chamber 1161, and communicates with the third common liquid chambers 1163 and the other opening of each of the plurality of pressure chambers 1131 via the second common liquid chambers 1162.

[0056] The first common liquid chamber 1161 is formed between the pair of actuators 113. The first common liquid chamber 1161 forms an ink flow path from the supply port 1111 to one opening of each of the plurality of pressure chambers 1131 of each actuator 113. In addition, the first common liquid chamber 1161 forms an ink flow path from the supply port 1111 to the two third common liquid chambers 1163 on both end sides of the first common liquid chamber 1161 (actuator 113) in the longitudinal direction (first direction X).

[0057] The second common liquid chamber 1162 is formed between each actuator 113 and the frame body 112. The second common liquid chambers 1162 form an ink flow path from the third common liquid chambers 1163 to the other opening of each of the plurality of pressure chambers 1131.

[0058] The third common liquid chamber 1163 is adjacent to both ends of the actuator 113 in the longitudinal direction. The third common liquid chamber 1163 communicates with the first common liquid chamber 1161 and the two second common liquid chambers 1162 on both end sides of the pair of actuators 113 in the longitudinal direction. The third common liquid chambers 1163 form a part of an ink flow path from the first common liquid chamber 1161 to the second common liquid chambers 1162 without passing through the plurality of pressure chambers 1131 of each actuator 113. In addition, the third common liquid chambers 1163 form an ink flow path from the first common liquid chamber 1161 and the two second common liquid chambers 1162 to the discharge ports 1112.

[0059] As illustrated in FIGS. 1 to 13, the manifold unit 12 includes a manifold 121, a top plate 122, an ink supply pipe 123, an ink discharge pipe 124, a damper 127, and a bypass flow path 128. The number of the ink supply pipe 123 and the number of the ink discharge pipe 124 can be set as appropriate.

[0060] The manifold 121 is formed in a plate shape or a block shape. As illustrated in FIGS. 10 and 11, the manifold 121 includes a supply path 1211 that is continuous with the supply port 1111 of the base plate 111 and that forms a liquid supply path, and a discharge path 1212 that is continuous with the discharge port 1112 of the base plate 111 and that forms a liquid discharge path. The manifold 121 includes a pair of supply paths 1211 and a pair of discharge paths 1212 because of being connected to the pair of head bodies 11. FIGS. 17 to 20 illustrate one flow path configuration formed by one head body 11 and the manifold unit 12.

[0061] One main surface of the manifold 121 is fixed to the main surface of the base plate 111. In addition, the top plate 122 is fixed to a main surface opposite to the main surface of the manifold 121 to which the base plate 111 is fixed. In the manifold 121, the ink supply pipe 123 and the ink discharge pipe 124 are fixed via, for example, the top plate 122.

[0062] The manifold 121 includes the first manifold 1213 and a second manifold 1214. The manifold 121 is formed by integrally assembling the first manifold 1213 and the second manifold 1214.

[0063] The supply path 1211 is a rectangular parallelepiped liquid chamber formed in the manifold 121 by a hole and a groove and is long in one direction (first direction X). The supply path 1211 fluidly connects the ink supply pipe 123 and the supply port 1111 of the base plate 111.

[0064] For example, the supply path 1211 is a rectangular parallelepiped liquid chamber extending along the

longitudinal direction of the actuators 113 and the longitudinal direction of the supply port 1111. The supply path 1211 is a liquid flow path between the ink supply pipe 123 and the supply port 1111. The supply port 1111 is continuous below the supply path 1211, and the damper 127 is provided on a ceiling portion 12111 which is an upper portion of the supply path 1211.

[0065] For example, a width of the supply path 1211 along the longitudinal direction (first direction X) on the base plate 111 side is larger than a width of the supply port 1111 in the longitudinal direction (first direction X), and a width of the upper ceiling portion 12111 in the longitudinal direction (first direction X) is smaller than a width of a lower bottom 12112 in the longitudinal direction (first direction X) on the base plate 111 side. In addition, for example, in the supply path 1211, in the lateral direction (second direction Y) orthogonal to the longitudinal direction (first direction X) of the supply path 1211, the width of the ceiling portion 12111 is larger than the width of the bottom 12112. In other words, the ceiling portion 12111 and the bottom 12112 are formed in a rectangular parallelepiped shape long in one direction (first direction X), and the ceiling portion 12111 is larger in the lateral direction (second direction Y) and smaller in the longitudinal direction (first direction X) than the bottom 12112. For example, in the supply path 1211, the bottom 12112 is formed by the first manifold 1213, and the ceiling portion 12111 is formed by the second manifold 1214.

[0066] The discharge path 1212 is a flow path formed in the manifold 121 by a hole and a groove. The discharge path 1212 fluidly connects, for example, the ink discharge pipe 124 and the two discharge ports 1112 of the base plate 111.

[0067] The first manifold 1213 is formed in a rectangular plate shape. In the first manifold 1213, for example, the groove and the opening that form a part of the pair of supply paths 1211 and a part of the pair of discharge paths 1212 are formed. Arrangement, sizes, and the like of the groove and the opening that form a part of the supply paths 1211 and the discharge paths 1212 are set as appropriate based on shapes of the supply path 1211 and the discharge path 1212 and a shape of another fluid flow path.

[0068] In the present embodiment, for example, a pair of first openings 12131 forming the bottom 12112 of the supply path 1211 and a pair of second openings 12132 forming a part of the discharge path 1212 are formed in the first manifold 1213.

[0069] The first opening 12131 is a rectangular hole formed across both main surfaces of the first manifold 1213. In other words, the first opening 12131 is a rectangular through hole formed in the same shape as the bottom 12112. The first opening 12131 is formed longer than the supply port 1111 of the base plate 111. A width of the first opening 12131 in the longitudinal direction (first direction X) is formed to be larger than the range (entire nozzle range) in which the pressure chamber 1131 driven during the normal ink discharge and formed in the actu-

ator 113 is provided.

[0070] The second opening 12132 is formed of, for example, a groove provided in both the main surfaces of the first manifold 1213, a hole formed in a thickness direction (third direction Z), or the like.

[0071] The second manifold 1214 is formed in a rectangular plate shape. In the second manifold 1214, for example, the groove and the opening that form a part of the pair of supply paths 1211 and a part of the pair of discharge paths 1212 are formed. The arrangement, the sizes, and the like of the groove and the opening that form a part of the supply path 1211 and the discharge path 1212 are set as appropriate based on the shapes of the supply path 1211 and the discharge path 1212 and the shape of another fluid flow path.

[0072] In the present embodiment, for example, a pair of third openings 12141 (second opening according to claims), a pair of fourth openings 12142, a pair of fifth openings 12143, a pair of sixth openings 12144, and a pair of attachment grooves 12145 are formed in the second manifold 1214.

[0073] The third opening 12141 forms the ceiling portion 12111 of the supply path 1211. The third opening 12141 is a rectangular hole formed across both main surfaces of the second manifold 1214. In other words, the third opening 12141 is a rectangular through hole formed in the same shape as the ceiling portion 12111. The third opening 12141 has a width in the longitudinal direction (first direction X) smaller than the width of the first opening 12131 in the longitudinal direction and a width in the lateral direction (second direction Y) larger than a width of the first opening 12131 in the lateral direction. A width of the third opening 12141 in a thickness direction (third direction Z) of the second manifold 1214 is smaller than a width of the first opening 12131 in the thickness direction (third direction Z).

[0074] The fourth opening 12142 is connected to the first opening 12131. The fourth opening 12142 connects the bottom 12112 of the supply path 1211 and the ink supply pipe 123. For example, the fourth opening 12142 is arranged at a position facing the first opening 12131 forming the bottom 12112, and is formed by a hole formed in the thickness direction (third direction Z) of the second manifold 1214.

[0075] The fifth opening 12143 is connected to the second opening 12132. The fifth opening 12143 connects the second opening 12132 and the ink discharge pipe 124. The fifth opening 12143 is formed by a groove formed in the main surface of the second manifold 1214, a hole formed in the thickness direction (third direction Z), and the like.

[0076] The sixth opening 12144 forms the bypass flow path 128. The sixth opening 12144 is formed in the same shape as the bypass flow path 128. The sixth opening 12144 connects the fifth opening 12143 and the ceiling portion 12111 of the supply path 1211. The sixth opening 12144 is, for example, a groove formed in the main surface of the second manifold 1214 to which the top plate

122 is joined. The sixth opening 12144 is covered with, for example, the top plate 122 to form the bypass flow path 128.

[0077] The attachment groove 12145 is a groove for positioning the damper 127 and for joining the damper 127. The attachment groove 12145 is the main surface to which the top plate 122 of the second manifold 1214 is joined, and is formed around the third opening 12141. The attachment groove 12145 is, for example, a recess that is formed in a shape the same as an outer shape of the damper 127 or slightly larger than the outer shape of the damper 127, and in which the third opening 12141 is arranged at the center.

[0078] In addition, the second manifold 1214 fixes the liquid discharge head 1 in the liquid discharge apparatus 2, and also serves as a datum plate that defines the position of the head body 11. As a specific example, as illustrated in FIGS. 12 and 13, the second manifold 1214 includes a pair of flange portions 12147 formed at both ends in the longitudinal direction (first direction X). In the flange portion 12147, a datum hole 12148 for fixing and positioning the liquid discharge head 1 is formed.

[0079] That is, the second manifold 1214 is formed to have a length in the longitudinal direction longer than that of the first manifold 1213 by an amount corresponding to the pair of flange portions 12147. The pair of flange portions 12147 and the datum hole 12148 are used for positioning with respect to the liquid discharge apparatus 2 and attachment to the liquid discharge apparatus 2.

[0080] Such first manifold 1213 and second manifold 1214 are integrally joined to form the supply path 1211 and the discharge path 1212.

[0081] The top plate 122 is provided on a surface of the manifold 121 opposite to the surface on which the base plate 111 is provided. The top plate 122 has openings through which the ink supply pipe 123 and the ink discharge pipe 124 communicate with the supply path 1211 and the discharge path 1212 of the manifold 121.

[0082] The ink supply pipe 123 is connected to the supply path 1211. The ink discharge pipe 124 is connected to the discharge path 1212. In the present embodiment, the liquid discharge head 1 includes the pair of head bodies 11, and thus a pair of ink supply pipes 123 and a pair of ink discharge pipes 124 are provided.

[0083] In the present embodiment, the pair of ink supply pipes 123 is provided on one end side in the longitudinal direction of the manifold 121, and the pair of ink discharge pipes 124 is arranged at the other end side in the longitudinal direction of the manifold 121.

[0084] As illustrated in FIG. 6, the damper 127 is formed in an elastically deformable thin film shape or sheet shape. As illustrated in FIG. 7, the damper 127 covers the third opening 12141 forming the ceiling portion 12111 of the supply path 1211 formed in the second manifold 1214. The damper 127 elastically deforms in accordance with a pressure variation in the supply path 1211. The damper 127 is fixed to the attachment grooves 12145 around the third opening 12141 of the ceiling portion

12111 of the second manifold 1214. A lower surface of the damper 127 faces the supply path 1211.

[0085] As a specific example, the damper 127 is formed of a polyimide film. The damper 127 is formed in a rectangular shape which is long in the same direction as the longitudinal direction (first direction X) of the opening of the ceiling portion 12111 of the supply path 1211 which is long in one direction (first direction X).

[0086] As a preferred example, a width of the damper 127 in the lateral direction (second direction Y) is 4 mm or more. The width of the damper 127 in the lateral direction is a width that can be secure the use of the damper 127 in the head body 11. Here, the width of the damper 127 in the lateral direction is a width of the opening of the ceiling portion 12111 of the supply path 1211 in the lateral direction. In addition, a thickness of the damper 127 is 25 μm or less. The lower limit of the thickness of the damper 127 is a thickness at which deformation of the damper 127 does not become plastic deformation due to the pressure of the supply path 1211, and is set depending on characteristics of the damper 127. In addition, for example, the damper 127 is formed using a polyimide film having a Young's modulus of 3.4 GPa.

[0087] As illustrated in FIG. 5, the bypass flow path 128 connects the ceiling portion 12111 of the supply path 1211 and the common liquid chamber 116 or the secondary side of the common liquid chamber 116. The common liquid chamber 116 or the secondary side of the common liquid chamber 116 to which the bypass flow path 128 is connected is, for example, the second common liquid chamber 1162 or the third common liquid chamber 1163 of the common liquid chamber 116, the discharge path 1212, or the ink discharge pipe 124. A fluid resistance in the bypass flow path 128 is larger than a fluid resistance in the supply path 1211 and a fluid resistance in the common liquid chamber 116.

[0088] The bypass flow path 128 bypasses the supply path 1211 and the common liquid chamber 116 to discharge air bubbles in the supply path 1211 during maintenance or ink filling. The bypass flow path 128 has a flow path cross section formed in a rectangular shape or a circular shape. The shape of the bypass flow path 128 is, for example, a linear shape, a partially bent vent shape, or the like.

[0089] That is, a flow path cross sectional area, a length, and the shape of the bypass flow path 128 are set to an area, a length, and a shape that can prevent a flow of the ink more than necessary. Here, the flow of the ink more than necessary means a flow of the ink in which the air bubbles flow and that does not inhibit maintenance or ink filling and/or a flow of the ink that does not inhibit a function of the liquid discharge head 1 during maintenance or ink filling.

[0090] A specific example of the bypass flow path 128 according to the present embodiment will be described. As a fluid configuration illustrated in FIGS. 17 to 20, one end of the bypass flow path 128 is connected to the ceiling portion 12111 of the supply path 1211, directly below the

damper 127, and on a side opposite to a side of the supply path 1211 to which the ink supply pipe 123 is connected in the longitudinal direction (first direction X).

[0091] In other words, the one end of the bypass flow path 128 is connected to the secondary side of the ceiling portion 12111 of the supply path 1211 and directly below the damper 127. The other end of the bypass flow path 128 is connected to the ink discharge pipe 124 connected to the discharge path 1212.

[0092] In addition, the bypass flow path 128 has a flow path cross section in, for example, a rectangular shape. The flow path cross section of the bypass flow path 128 is, for example, 1 mm × 1 mm. In addition, the length of the bypass flow path 128 is 10 mm. The bypass flow path 128 is formed, for example, in a shape bent by 90° at three places.

[0093] As illustrated in FIGS. 1 to 3, one end of the circuit board 13 is connected to the wiring pattern of the actuator 113 via the wiring pattern of the base plate 111. The circuit board 13 includes, for example, a wiring film, a driver IC mounted on the wiring film, and a printed wiring board mounted on the wiring film.

[0094] The circuit board 13 drives the actuator 113 by applying a drive voltage to the wiring pattern of the actuator 113 by using the driver IC, and increases or decreases a volume of the pressure chamber 1131 to discharge liquid droplets from the nozzles 1141.

[0095] For example, a plurality of wiring films are provided. The wiring film is, for example, a chip on film (COF) on which the driver IC is mounted. The driver IC is electrically connected to, via the wiring films, the wiring pattern formed in the pressure chamber 1131. The printed wiring board is a printing wiring assembly (PWA) on which various electronic components and connectors are mounted.

[0096] The cover 14 covers or accommodates a part of the head body 11, a part of the manifold unit 12, and the circuit board 13.

[0097] The liquid discharge head 1 configured as described above is attached to, for example, an inkjet record apparatus, which is an example of the liquid discharge apparatus 2 illustrated in FIG. 21, via the second manifold 1214 that also serves as the datum plate. Hereinafter, the liquid discharge apparatus 2 is described as an inkjet record apparatus 2. The liquid discharge head 1 is connected to the supply tank 2132 as the liquid storage unit provided in the inkjet record apparatus 2. The liquid discharge head 1 is a recycling head that recycles ink with the supply tank 2132, or a non-recycling head that is supplied with ink from the supply tank 2132 and discharges the ink to a maintenance device 2117 during maintenance. The liquid discharge head 1 is arranged in a posture in which the nozzles 1141 of the nozzle plate 114 of the head body 11 face downward.

[0098] Hereinafter, the inkjet record apparatus 2 including the liquid discharge head 1 will be described with reference to FIG. 21. The inkjet record apparatus 2 includes a housing 2111, a medium supply unit 2112, an

image forming unit 2113, a medium discharge unit 2114, a conveyance device 2115 which is a support device, the maintenance device 2117, and a control unit 2118.

[0099] The inkjet record apparatus 2 is an inkjet printer in which a liquid such as an ink is discharged while conveying, for example, the sheet P as a recording medium which is a discharge target along a predetermined conveyance path 2001 from the medium supply unit 2112 to the medium discharge unit 2114 through the image forming unit 2113, thereby forming an image on the sheet P.

[0100] The medium supply unit 2112 includes a plurality of sheet feed cassettes 21121. The image forming unit 2113 includes a support unit 2120 that supports a sheet and a plurality of head units 2130 that are arranged above the support unit 2120 so as to face the support unit 2120. The medium discharge unit 2114 includes a sheet discharge tray 21141.

[0101] The support unit 2120 includes a conveyance belt 21201 provided in a loop shape in a predetermined region where an image is to be formed, a support plate 21202 that supports the conveyance belt 21201 from a back side, and a plurality of belt rollers 21203 provided on the back side of the conveyance belt 21201.

[0102] The head unit 2130 includes a plurality of liquid discharge heads 1 which are inkjet heads, a plurality of supply tanks 2132 which are liquid tanks mounted on the liquid discharge heads 1, pumps 2134 that supply the ink, and connection flow paths 2135 that connect the liquid discharge heads 1 and the supply tanks 2132.

[0103] The present embodiment includes liquid discharge heads 1 of four colors of cyan, magenta, yellow, and black as the liquid discharge heads 1, and the supply tanks 2132 of four colors for accommodating inks of these colors. The supply tank 2132 is connected to the liquid discharge head 1 via the connection flow path 2135.

[0104] The pump 2134 is, for example, a liquid feed pump implemented by a piezoelectric pump. The pump 2134 is connected to the control unit 2118 and is driven and controlled by the control unit 2118.

[0105] The connection flow path 2135 includes a supply flow path connected to the ink supply pipe 123 of the liquid discharge head 1. In addition, the connection flow path 2135 includes a collection flow path connected to the ink discharge pipe 124 of the liquid discharge head 1. For example, since the liquid discharge head 1 is of a non-recycling type, the collection flow path is connected to the maintenance device 2117. For example, when the liquid discharge head 1 is of a recycling type, the collection flow path is connected to the supply tank 2132.

[0106] The conveyance device 2115 conveys the sheet P along the conveyance path 2001 from the sheet feed cassette 21121 of the medium supply unit 2112 to the sheet discharge tray 21141 of the medium discharge unit 2114 through the image forming unit 2113. The conveyance device 2115 includes a plurality of guide plate pairs 21211 to 21218 and a plurality of conveyance rollers 21221 to 21228 arranged along the conveyance path 2001. The conveyance device 2115 supports the sheet

P to be relatively movable with respect to the liquid discharge head 1.

[0107] The maintenance device 2117 sucks and collects, for example, the ink remaining on an outer surface of the nozzle plate 114 during maintenance. When the liquid discharge head 1 is of a non-recycling type, the maintenance device 2117 collects the ink in the head body 11 from the nozzles 1141 during maintenance. The maintenance device 2117 described above includes a tray, a tank, and the like for storing the collected ink.

[0108] The control unit 2118 includes a CPU 21181 as an example of a processor, a memory such as a read only memory (ROM) that stores various programs and the like and a random access memory (RAM) that temporarily stores various variable data, image data, and the like, and an interface unit that inputs data from the outside and outputs data to the outside.

[0109] Next, a flow of the ink as the liquid of the liquid discharge head 1 configured as described above will be described. First, when the ink as the liquid is supplied to the ink supply pipes 123, the ink flows along the supply path 1211 of the manifold 121. Then, the ink moves to the first common liquid chamber 1161 through the supply ports 1111 of the base plate 111 facing the supply path 1211.

[0110] A part of the ink that moved to the first common liquid chamber 1161 moves to the plurality of pressure chambers 1131 as illustrated by the arrows in FIG. 16. In addition, a part of the ink that moved to the first common liquid chamber 1161 moves to the third common liquid chambers 1163 as illustrated by the arrows in FIG. 16. The ink that moved to the third common liquid chambers 1163 moves to the second common liquid chambers 1162. The ink that moved to the second common liquid chambers 1162 moves to the plurality of pressure chambers 1131. That is, in the present embodiment, the ink is supplied to the plurality of pressure chambers 1131 through both the first common liquid chamber 1161 and the second common liquid chambers 1162. When the pressure chamber 1131 is driven, the ink in the driven pressure chamber 1131 is discharged from the nozzle 1141.

[0111] In the present embodiment, since the liquid discharge head 1 is of a non-recycling type, the ink in the second common liquid chambers 1162 moves to the plurality of pressure chambers 1131. When the secondary side of the ink discharge pipe 124 is open during maintenance or ink filling, the ink in the second common liquid chambers 1162 moves to the ink discharge pipe 124 through the third common liquid chambers 1163, the discharge ports 1112 of the base plate 111, and the discharge paths 1212 of the manifold 121.

[0112] In addition, during maintenance or ink filling, when the pressure chamber 1131 is driven, the ink in the pressure chamber 1131 is discharged from the nozzle 1141 together with air accumulated in the first common liquid chamber 1161, the second common liquid chambers 1162, and the third common liquid chambers 1163,

for example.

[0113] In addition, in a posture in which the liquid discharge head 1 is provided in the liquid discharge apparatus 2, for example, the liquid discharge head 1 is in a posture in which the head body 11 is positioned downward and the manifold unit 12 is positioned upward in a gravity direction (third direction Z). In addition, in the posture in which the liquid discharge head 1 is provided in the liquid discharge apparatus 2, for example, in the liquid discharge head 1, the longitudinal direction (first direction X) and the lateral direction (second direction Y) of the actuator 113 are along a horizontal direction. That is, in the posture in which the liquid discharge head 1 is provided in the liquid discharge apparatus 2, main surface directions of the base plate 111 and the nozzle plate 114 are along the horizontal direction. Therefore, when air bubbles are present in the supply path 1211, the air bubbles in the supply path 1211 are directly below the damper 127. Therefore, during maintenance or ink filling, the ink and the air bubbles in the supply path 1211 pass through the bypass flow path 128 to move to the common liquid chamber 116 or the secondary side of the common liquid chamber 116 and are discharged through the supply path 1211. The air bubbles passing through the bypass flow path 128 from the supply path 1211 are discharged from the nozzles 1141. The air bubbles passing through the bypass flow path 128 from the supply path 1211 may be discharged from the ink discharge pipe 124 to the maintenance device 2117.

[0114] According to the liquid discharge head 1 and the liquid discharge apparatus 2 using the liquid discharge head 1 configured as described above, the supply port 1111, which is an elongated hole extending in the longitudinal direction (first direction X) parallel to the nozzle row 1142, is provided in the base plate 111. As illustrated in FIG. 16, since the supply port 1111 is provided along the longitudinal direction of the actuator 113, a width of the supply port 1111 comparable to that of the actuator 113 can be secured, so that the supplied ink can be spread over the entire nozzle range, that is, the plurality of pressure chambers 1131 to be driven. In addition, the ink can be supplied from the third common liquid chambers 1163 to the second common liquid chambers 1162 on both end sides of the base plate 111 in the longitudinal direction (first direction X), from the supply ports 1111 which are elongated holes in one row. In this way, the liquid discharge head 1 can efficiently supply the ink to the plurality of pressure chambers 1131 of the pair of actuators 113 by branching the ink supplied from the supply ports 1111 into two rows.

[0115] In addition, the liquid discharge head 1 forms the supply path 1211 to penetrate the manifold 121 in the thickness direction (third direction Z). In other words, the liquid discharge head 1 forms the supply path 1211 by the first opening 12131 penetrating the first manifold 1213 and the third opening 12141 penetrating the second manifold 1214. As illustrated in FIG. 7, the width of the first opening 12131 of the first manifold 1213 in the lon-

gitudinal direction (first direction X) is larger than the width of the supply port 1111 in the longitudinal direction (first direction X). Accordingly, since a liquid chamber shape of the supply path 1211 can be secured to be large in both width and height, the ink can be spread over the entire nozzle range through the supply ports 1111.

[0116] In addition, as illustrated in FIG. 7, when the main surface directions (first direction X and second direction Y) of the base plate 111 are defined as the horizontal direction, the supply port 1111 of the base plate 111, the supply path 1211 which is a liquid chamber of the manifold 121, an opening shape (window shape) of the supply path 1211 (third opening 12141) formed in the second manifold 1214, and the damper 127 all extend along the horizontal direction such that the longitudinal direction is the first direction X, and are arranged in parallel to a height direction (third direction Z) of the liquid discharge head 1. Therefore, the liquid discharge head 1 forms a consistent and smooth ink flow path, and can cope with high-speed printing.

[0117] A phase of the supply port 1111 of the base plate 111 is arranged in a range of the bottom 12112 of the supply path 1211 which is the liquid chamber of the manifold 121. Therefore, a size of the liquid discharge head 1 can be reduced to a compact size.

[0118] The second manifold 1214 also serves as the datum plate by having the datum holes 12148 in the pair of flange portions 12147. Therefore, in the liquid discharge head 1, it is not necessary to separately provide the datum plate, and a dimension of the liquid discharge head 1 in the height direction (third direction Z) can be reduced. The head body 11 has a configuration in which the discharge port 1112 formed in the base plate 111 is provided adjacent to the end portion of the actuator 113 in the longitudinal direction (first direction X), so that the width of the base plate 111 in the lateral direction (second direction Y) can be reduced. Therefore, a dimension of the liquid discharge head 1 in the lateral direction (second direction Y) (dimension in the thickness direction (second direction Y)) can be reduced, and the pair of head bodies 11 can be arranged side by side. Therefore, the size of the liquid discharge head 1 can be reduced to a compact size.

[0119] In addition, in the liquid discharge head 1, the damper 127 is provided in the ceiling portion 12111 of the supply path 1211 connected to the common liquid chamber 116. The damper 127 is in contact with the ink in the supply path 1211, and is deformed by a pressure variation of the ink. Accordingly, the damper 127 can prevent the pressure variation and make a negative pressure of the common liquid chamber 116 connected to the supply path 1211 constant or make the negative pressure of the common liquid chamber 116 substantially constant.

[0120] Therefore, the liquid discharge head 1 can prevent pressure variations in the flow paths of the liquid discharge head 1 such as the supply path 1211, the common liquid chamber 116 which is the secondary side of the supply path 1211, the actuator 113, and the like. The

liquid discharge head 1 can obtain high discharge stability by preventing the pressure variations. Therefore, in the liquid discharge head 1, a measure against pulsation is possible by using the damper 127 as a buffer, and a performance capable of high-speed printing can be secured.

[0121] The liquid discharge head 1 includes the damper 127 in the ceiling portion 12111 of the supply path 1211 facing the supply port 1111 of the base plate 111 continuous with the common liquid chamber 116. The liquid discharge head 1 has a simple configuration in which an opening for forming the supply path 1211 is provided in the manifold 121 and the damper 127 is fixed to the manifold 121 to cover the opening. Therefore, the liquid discharge head 1 can be easily produced. Since the liquid discharge head 1 is a configuration in which the damper 127 is formed in the supply path 1211 formed by the manifold 121, the damper 127 can secure a region having a sufficient size to come into contact with the liquid in the supply path 1211. In this way, the liquid discharge head 1 including the damper 127 can obtain a damper having a sufficient performance at a low cost, and can be easily produced.

[0122] The liquid discharge head 1 connects the supply path 1211 and the common liquid chamber 116 or the secondary side of the common liquid chamber 116 via the bypass flow path 128. Accordingly, the liquid discharge head 1 can easily discharge the air bubbles in the supply path 1211 during maintenance or ink filling. Therefore, the liquid discharge head 1 can easily perform maintenance including an ink filling operation and cleaning of the flow path of the liquid discharge head 1.

[0123] The liquid discharge head 1 connects the bypass flow path 128 to the ceiling portion 12111 of the supply path 1211 and directly below the damper 127. Accordingly, the liquid discharge head 1 can easily discharge air bubbles accumulated directly below the damper 127.

[0124] According to the liquid discharge head 1 and the liquid discharge apparatus 2 configured as described above, by providing the manifold 121 with the damper 127 and the supply path 1211 continuous with the supply port 1111 of the base plate 111, a compact size can be secured even when the discharge performance is secured.

[0125] The embodiments herein are not limited to the above-described configurations. For example, in the examples described above, the head body 11 is described using a non-recycling type head body as an example, but may be a recycling type head body.

[0126] In addition, in the examples described above, the bypass flow path 128 is described to connect the secondary side of the supply path 1211 to the flow path of the common liquid chamber 116 or the secondary side of the common liquid chamber 116, but the embodiments are not limited thereto. For example, the bypass flow path 128 may connect a primary side of the supply path 1211 to the flow path of the common liquid chamber 116 or the

secondary side of the common liquid chamber 116. In addition, a plurality of bypass flow paths 128 may be provided. For example, in the liquid discharge head 1, two bypass flow paths 128 may be provided. In the liquid discharge head 1 having such a configuration, one bypass flow path 128 may be connected to the secondary side of the supply path 1211 and the common liquid chamber 116 or the flow path on the secondary side of the common liquid chamber 116, and the other bypass flow path 128 may be connected to the primary side of the supply path 1211 and the common liquid chamber 116 or the flow path on the secondary side of the common liquid chamber 116. Further, the liquid discharge head 1 may not include the bypass flow path 128.

[0127] In the embodiments described above, an example is described in which the liquid discharge head 1 and the liquid discharge apparatus 2 are used in a recording apparatus that discharges an ink as a liquid, but the embodiments are not limited thereto. That is, the liquid discharge head 1 and the liquid discharge apparatus 2 can also be used for, for example, a 3D printer, an industrial manufacturing machine, and a medical application.

[0128] According to at least one of the embodiments described above, by providing a manifold with a supply path and a damper, a compact size can be secured even when the discharge performance is secured.

[0129] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the disclosure. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions, and changes in the form of the embodiments described herein may be made without departing from the scope of the disclosure. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope of the disclosure.

Claims

1. A liquid discharge head (1), comprising:

an actuator (113) comprising a plurality of pressure chambers;
a base plate (111) provided with the actuator on one surface thereof, and formed with a supply hole (1111) that is configured to supply a liquid to the actuator and that is an elongated hole;
a first manifold (1213) provided on the other surface of the base plate and formed with a first opening (12131) continuous with the supply hole; and
a second manifold (1214) provided on the first manifold and formed with a second opening forming (12141) a supply path (1211) together with the first opening.

2. The head according to claim 1, wherein

the surface of the base plate on which the actuator is provided extends in a first direction and a second direction,
the supply hole, the first opening, and the second opening each extend in the first direction, and
the supply hole, the first opening, and the second opening are arranged in parallel in a third direction perpendicular to the first direction and the second direction.

3. The head according to claim 2, further comprising:

a frame body (122) provided on the one surface of the base plate and around the actuator; and
a nozzle plate (114) covering the actuator and the frame body and formed with a plurality of nozzles facing the plurality of pressure chambers, wherein
the actuator comprises a pair of actuators,
the head comprises a common liquid chamber formed by the base plate, the nozzle plate, and the frame body and continuous between the pair of actuators and between the actuator and the frame body, and
the supply hole is arranged between the pair of actuators.

4. The head according to claim 3, wherein

the second manifold is formed with a supply flow path connected to the first opening and an ink supply pipe (123) configured to supply the liquid.

5. The head according to any one of claims 1 to 4, further comprising:

a pair of head bodies each comprising the actuator and the base plate, wherein
the second manifold is formed with a datum hole (12148) configured to define a position of the head body.

6. The head according to any one of claims 2 to 5, wherein the length of the first opening (12131) of the first manifold (1213) in the first direction is larger than the length of the supply hole (1111) in the first direction.

7. The head according to any one of claims 1 to 6, wherein the first opening (12131) is a rectangular through hole formed across both main surfaces of the first manifold (1213).

8. The head according to any one of claims 2 to 7, wherein the length of the first opening (12131) in the first direction is larger than the length in the first di-

rection of a zone of the actuator in which the pressure chambers (1131) are formed.

9. The head according to any one of claims 1 to 8, wherein a third opening (12132) is formed on the first manifold (1213) and a fourth opening (12143) connected to the second opening (12132) is formed on the second manifold, the fourth opening (12143) connecting the third opening (12132) and an ink discharge pipe (124) for discharging the liquid. 5 10
10. The head according to any one of claims 1 to 9, wherein a pair of said first openings (12131) are formed on the first manifold, a pair of said second openings (12141) are formed on the second manifold, and a pair of supply holes (1111) are formed on the base plate, each first opening (12131) being continuous with the corresponding supply hole, each second opening (12141) forming the supply path (1211) together with the corresponding first opening (12131) to form a pair of said supply paths (1211). 15 20
11. The head according to any one of claims 1 to 10, wherein the second opening (12141) forms a ceiling portion (12111) of the supply path (1211). 25
12. The head according to any one of claims 1 to 11, wherein the length of the second opening (12141) in the first direction is smaller than the length of the first opening (12131) in the first direction. 30
13. An inkjet printer including a liquid discharge head (1) according to any one of claims 1 to 12. 35

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FIG. 1

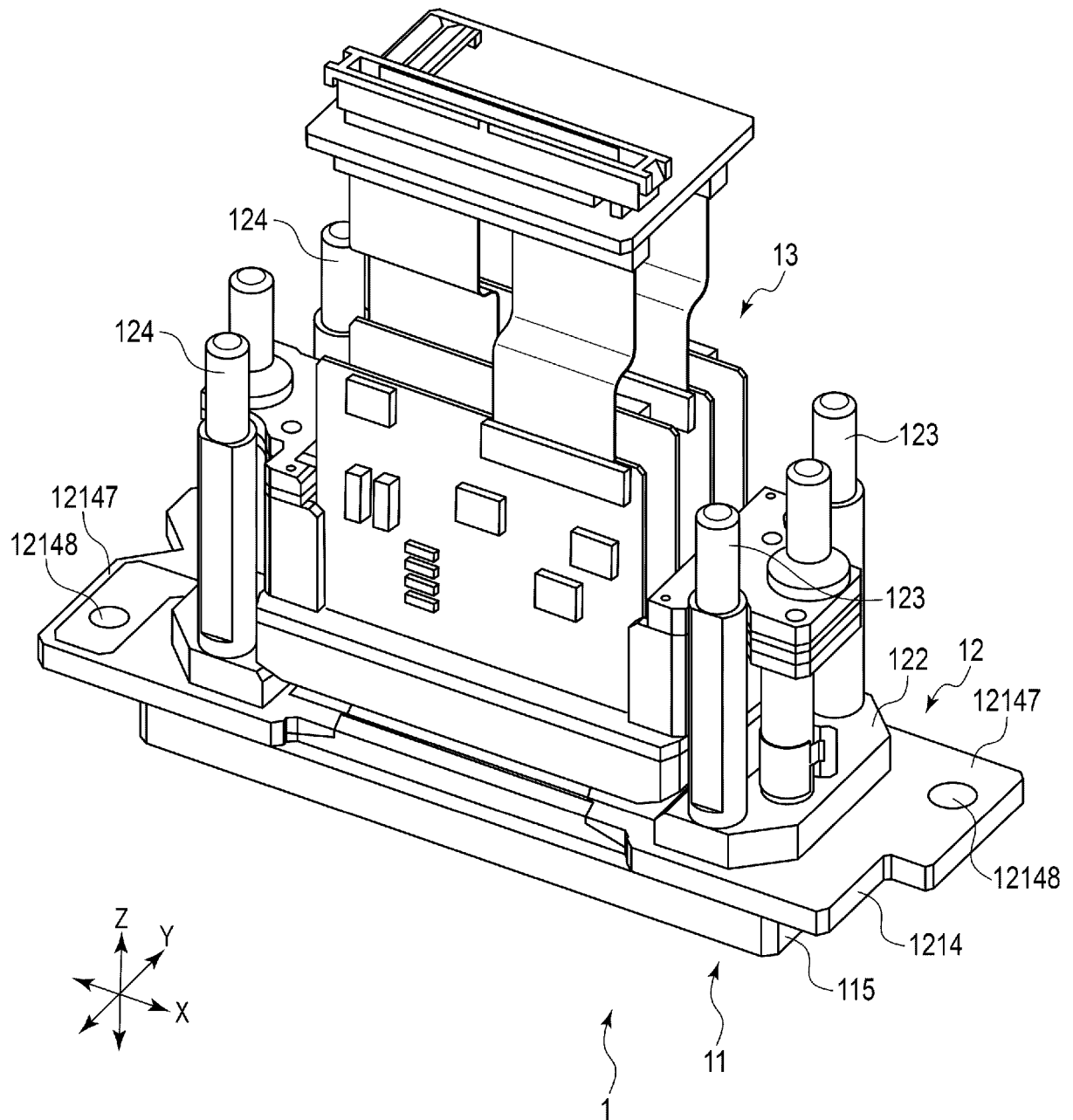


FIG. 2

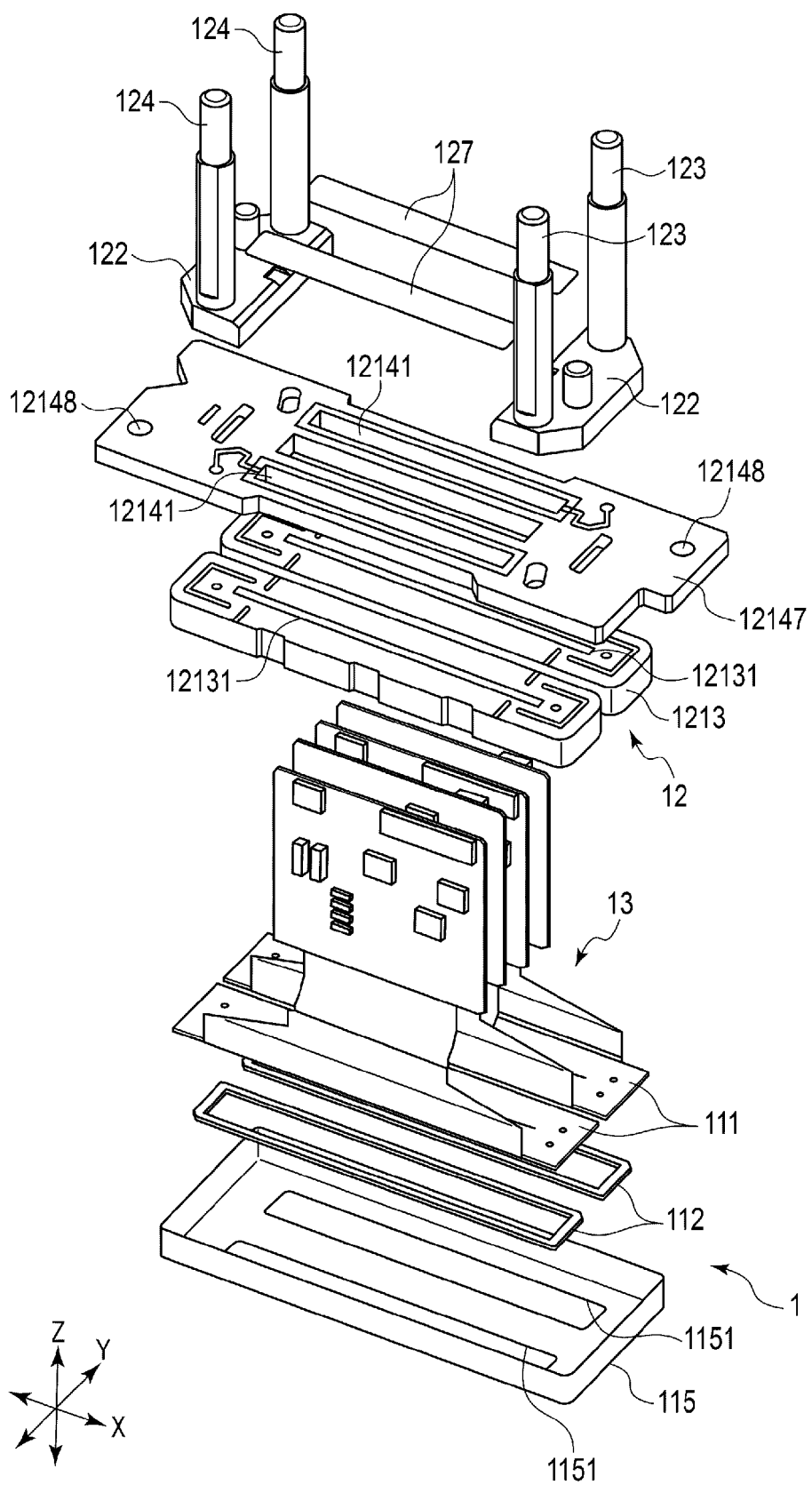


FIG. 3

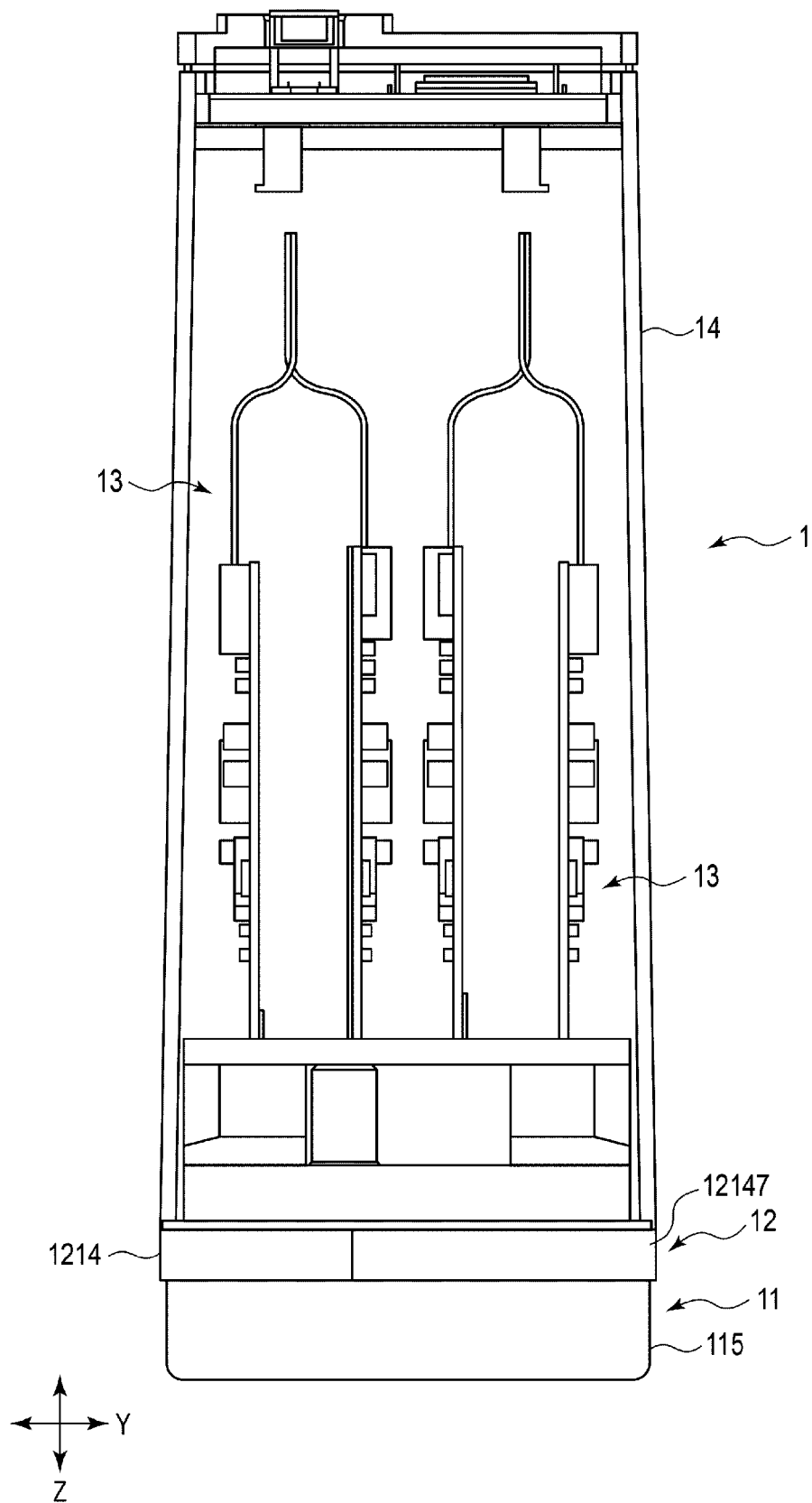


FIG. 4

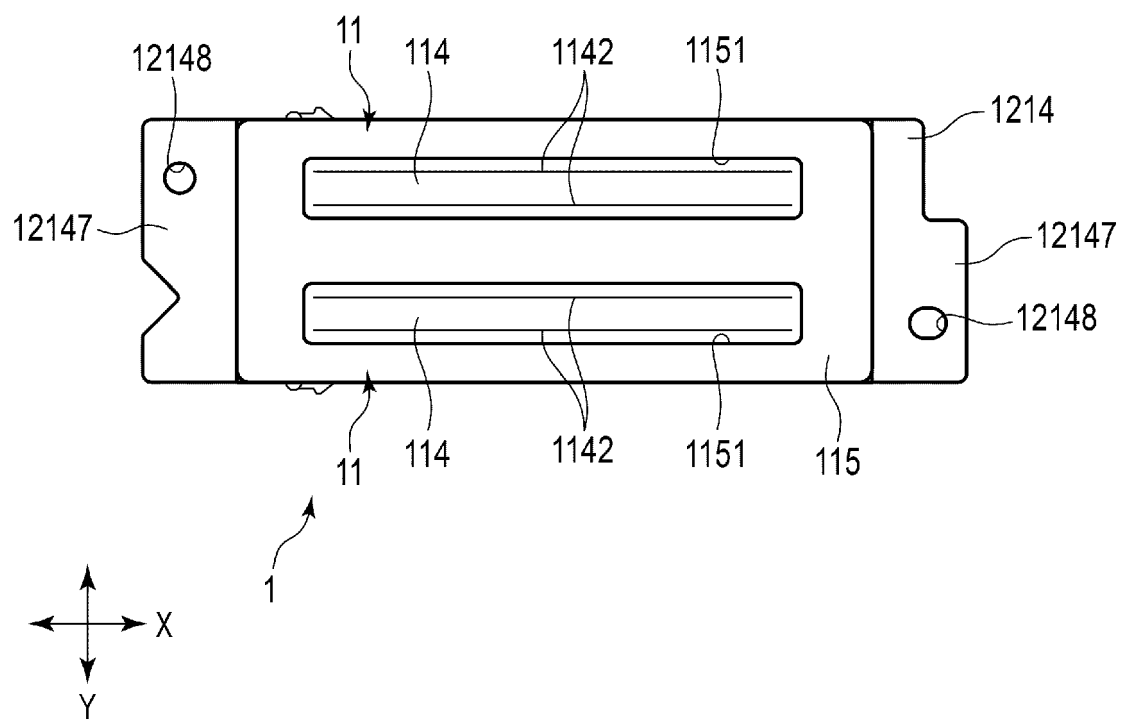


FIG. 5

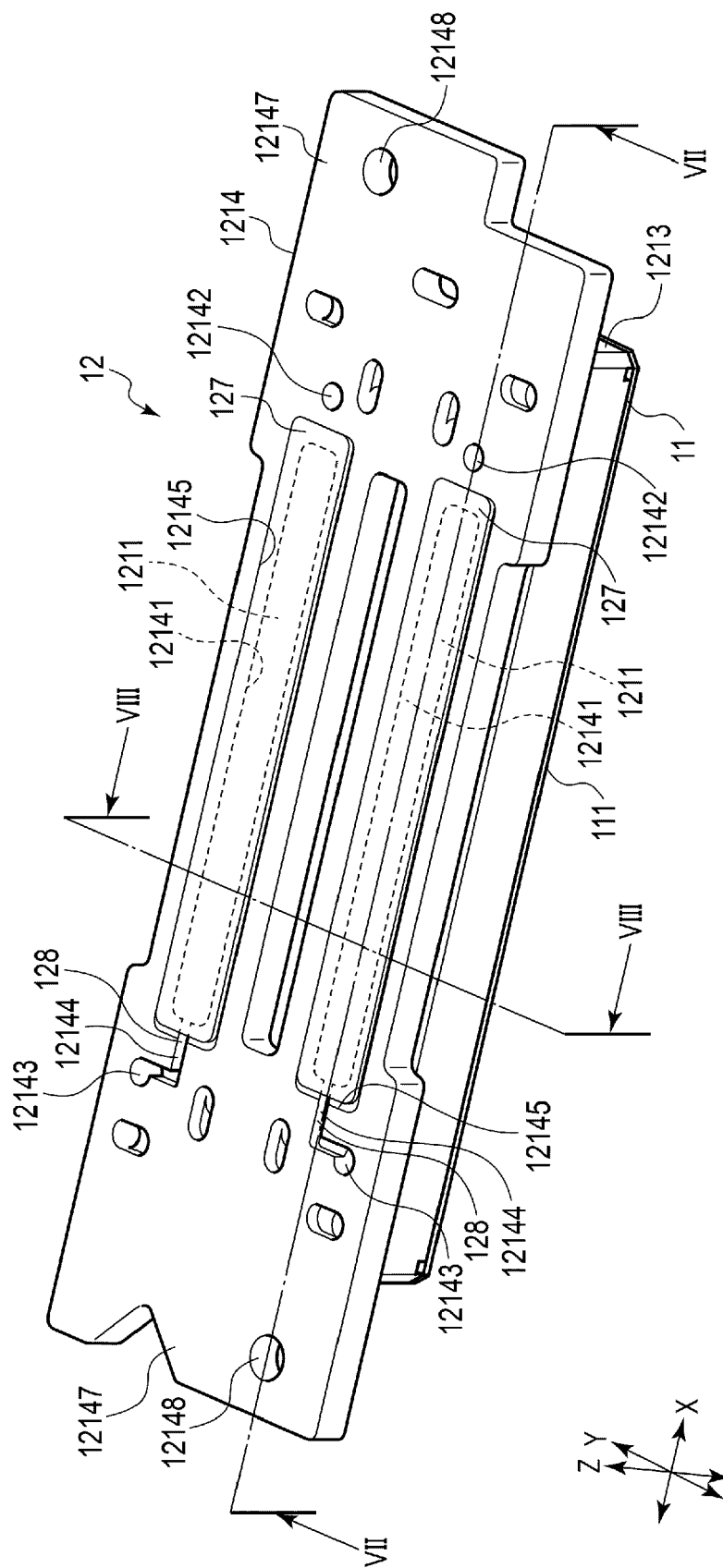


FIG. 6

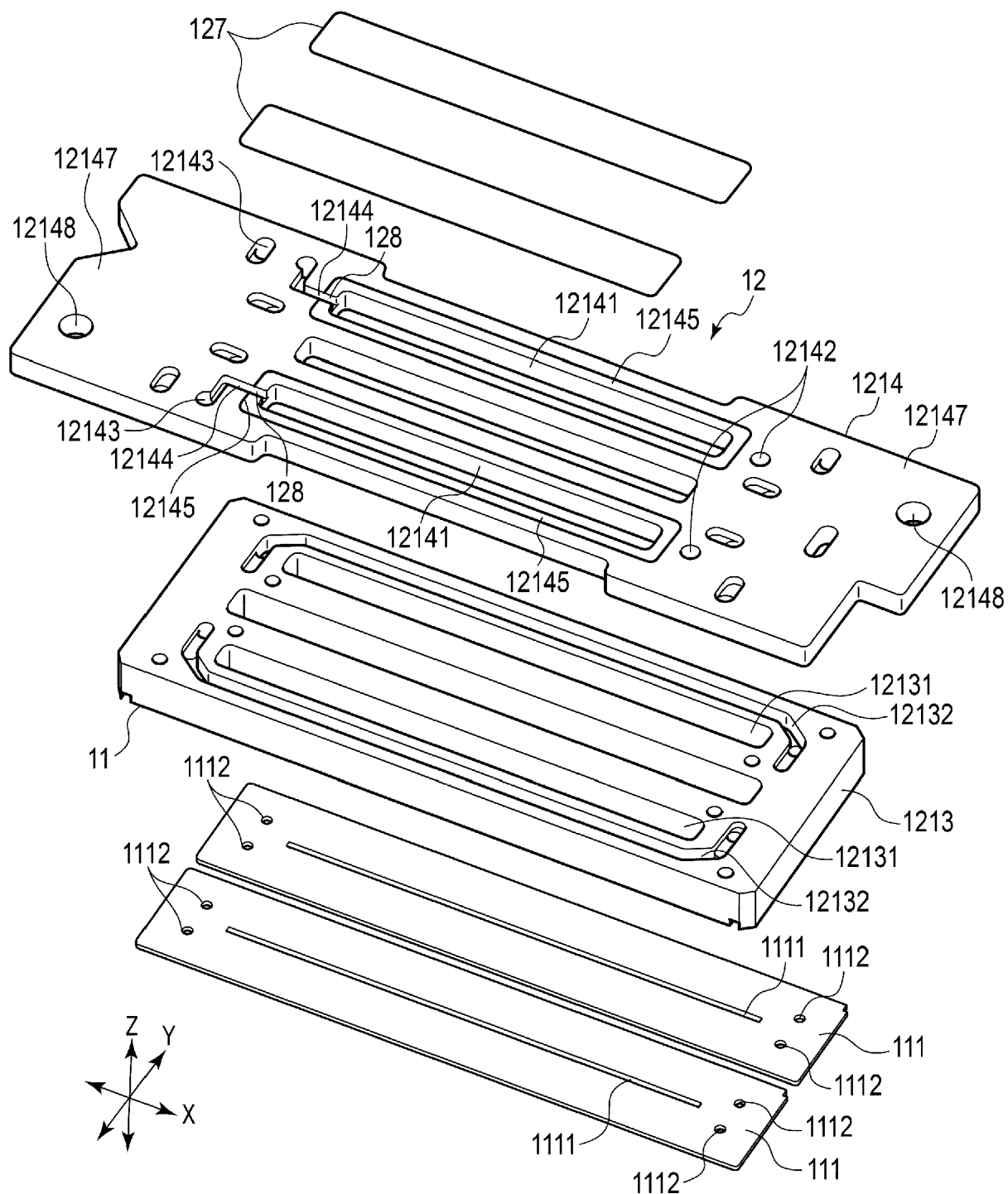


FIG. 7

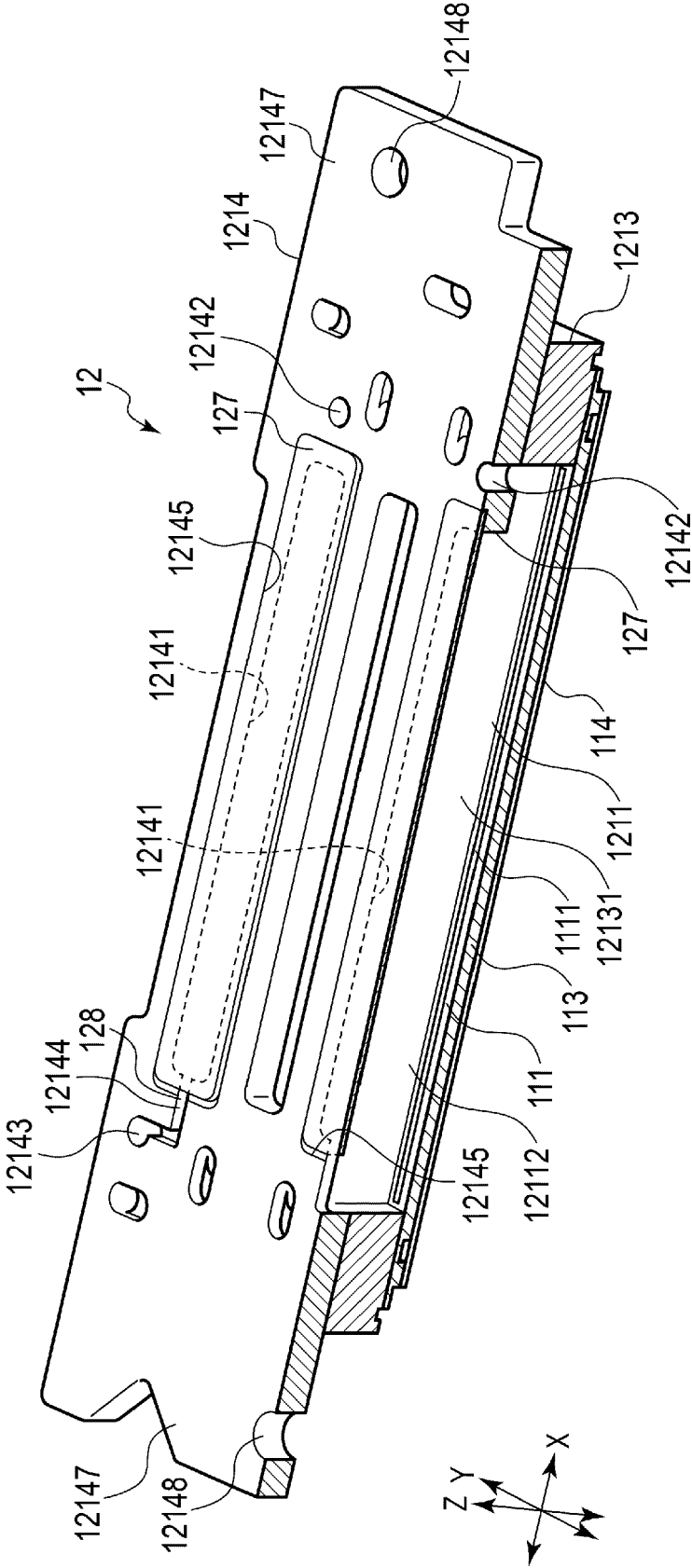


FIG. 8

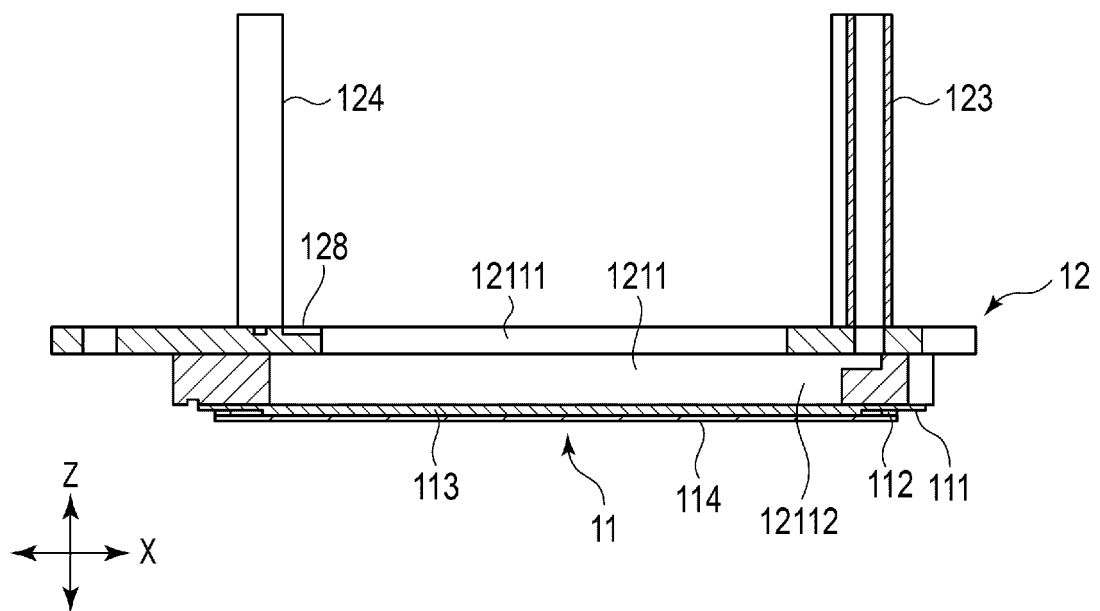


FIG. 9

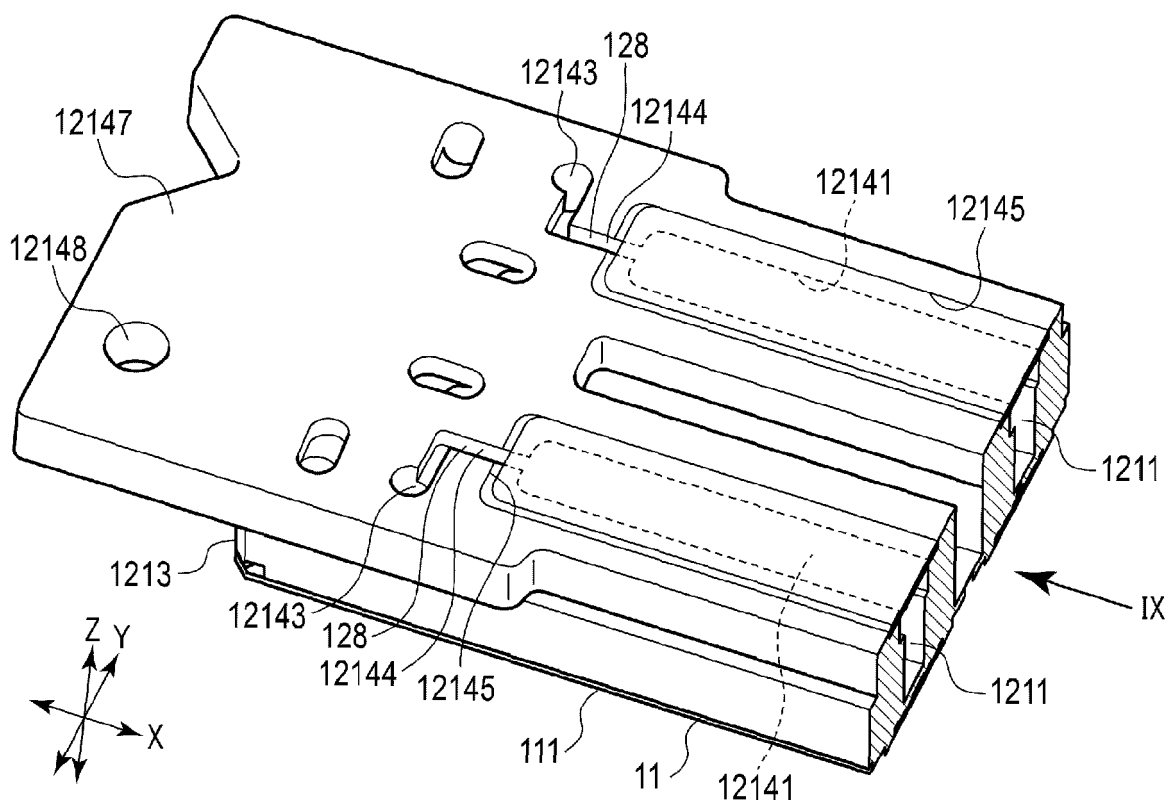


FIG. 10

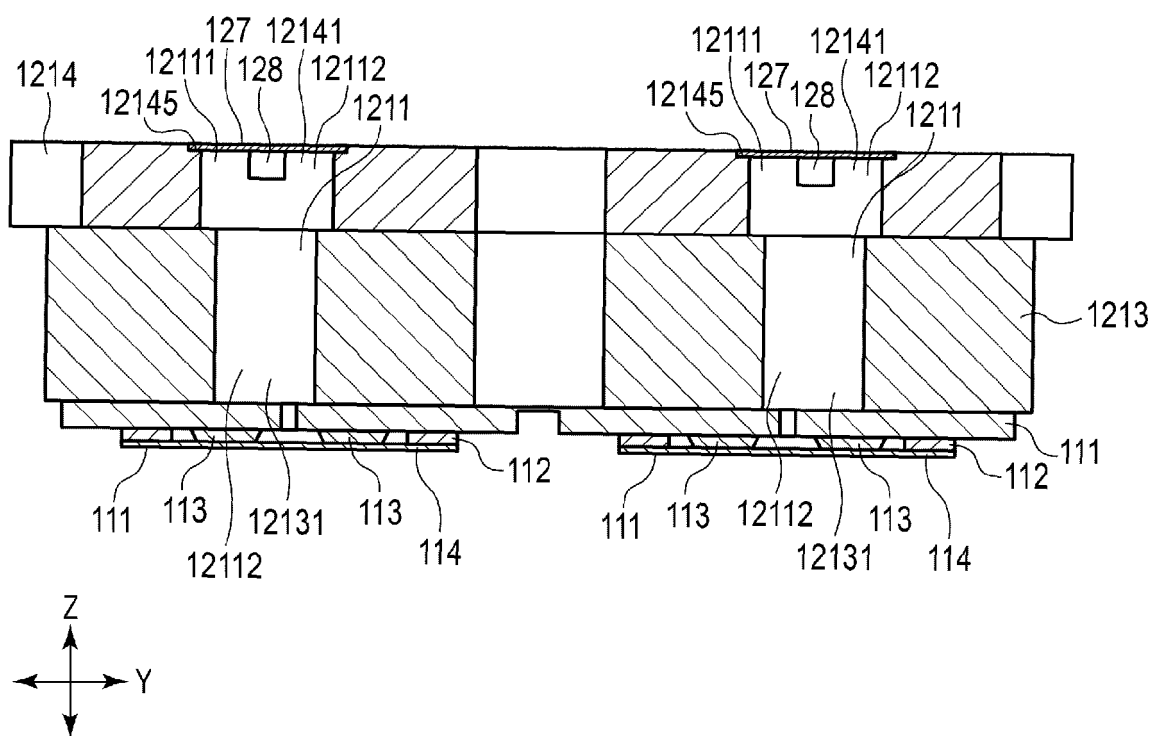


FIG. 11

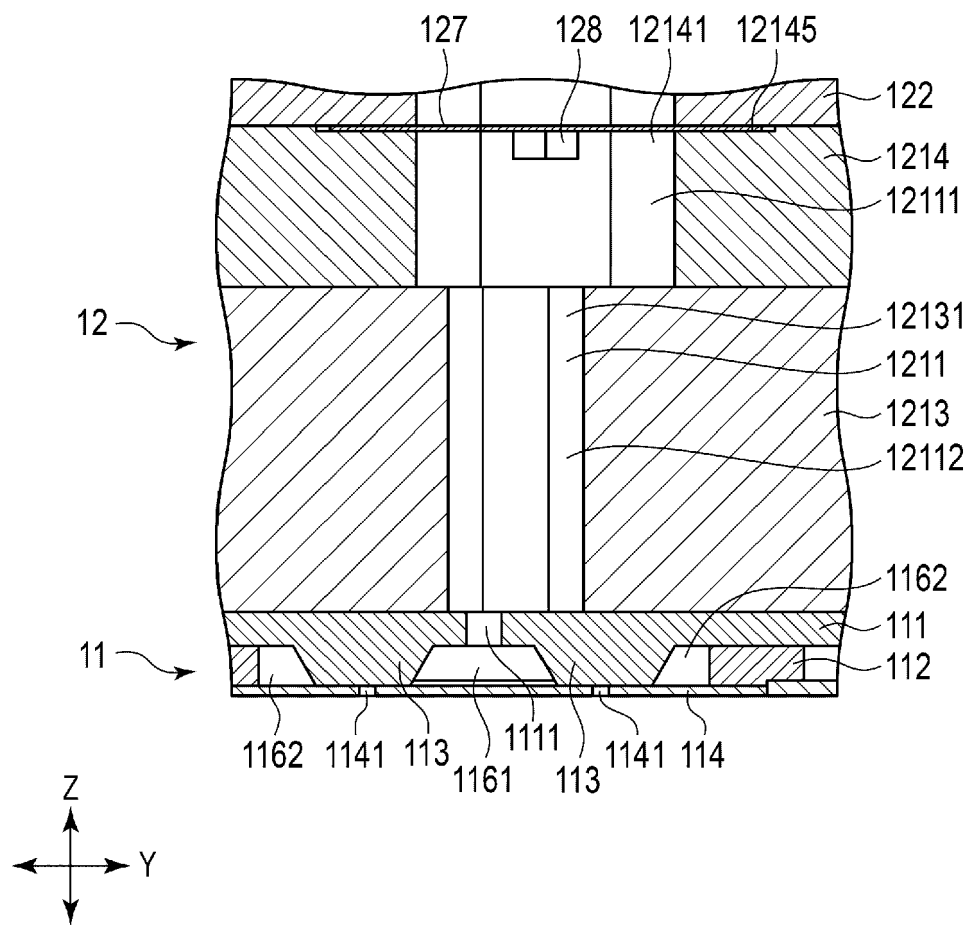


FIG. 12

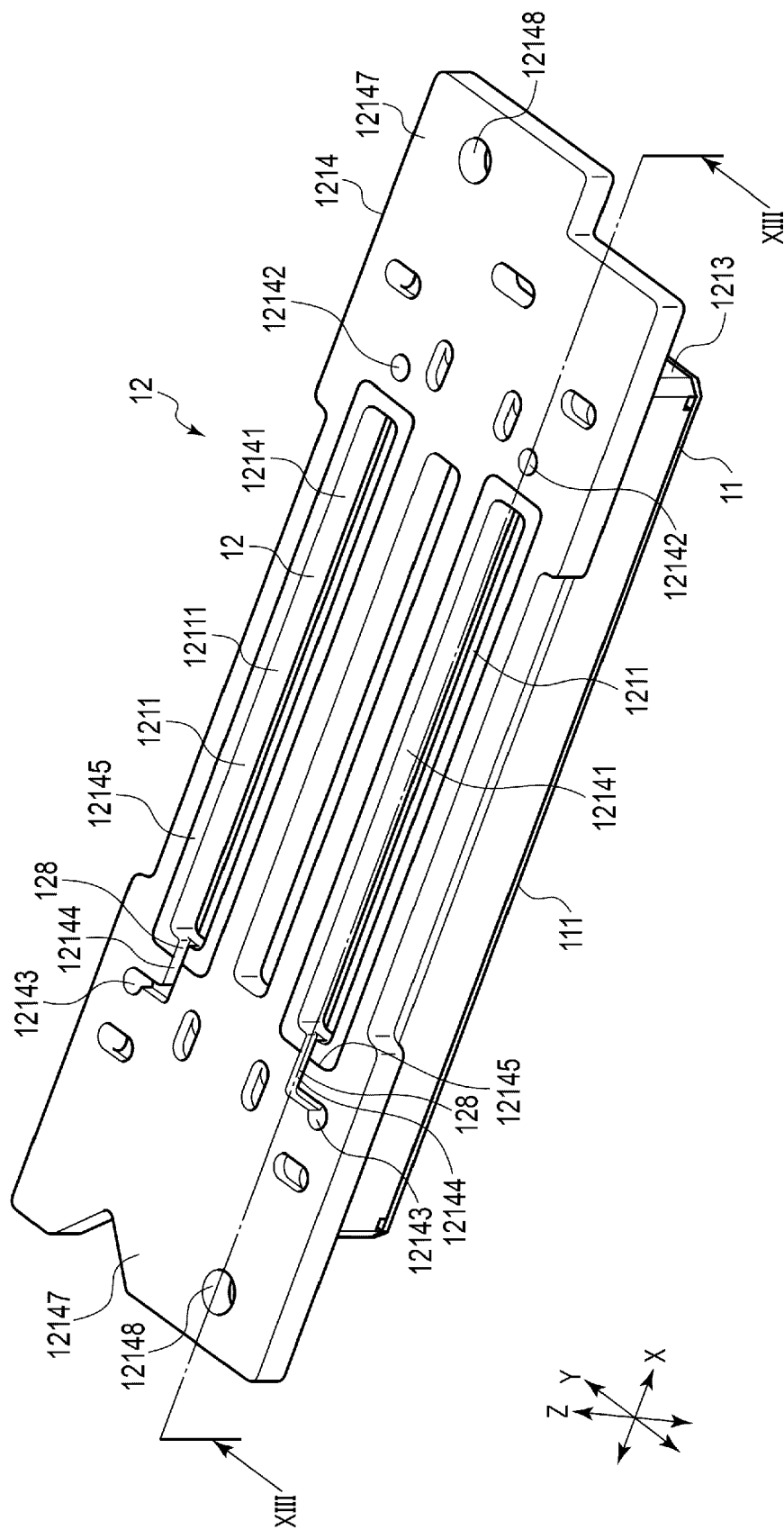


FIG. 13

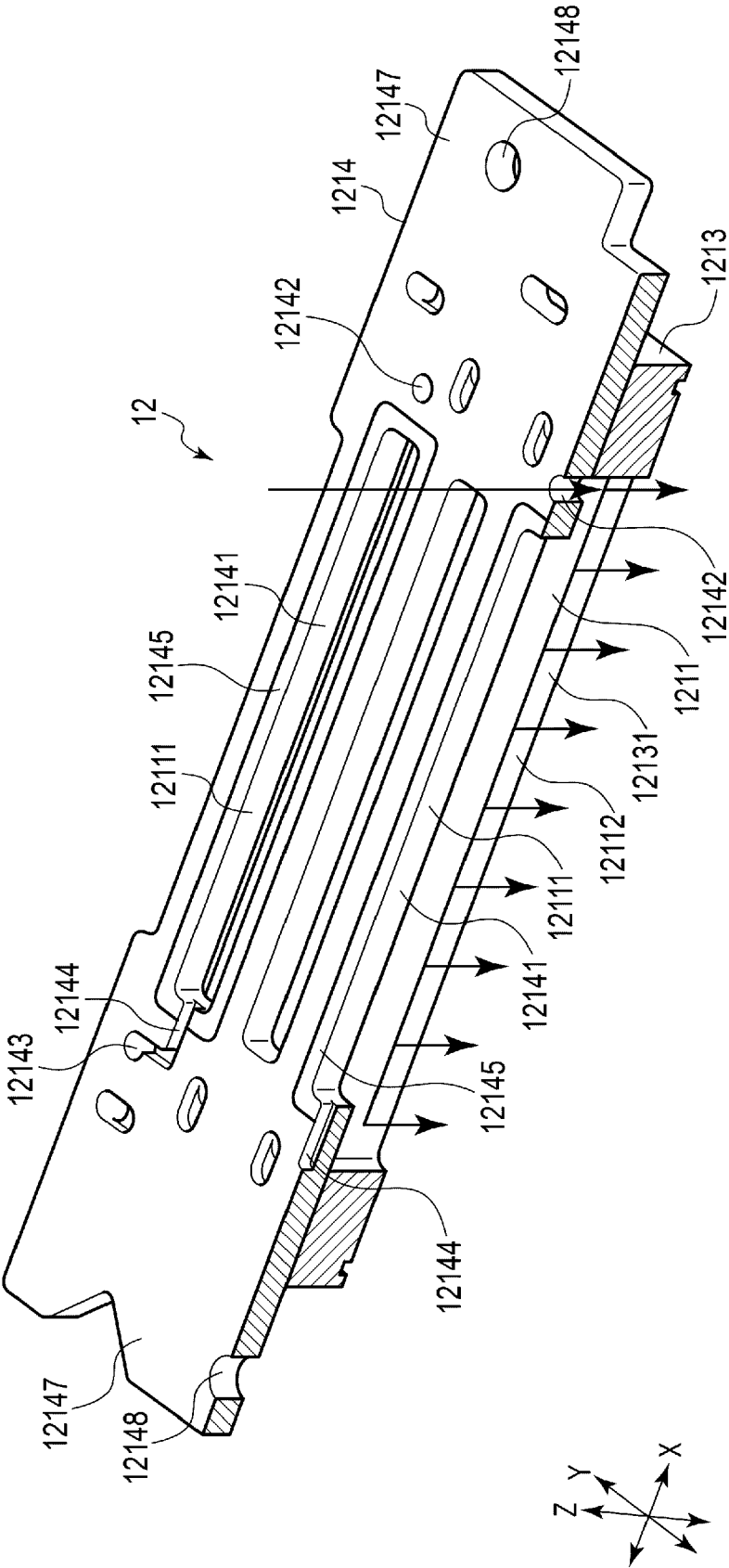


FIG. 14

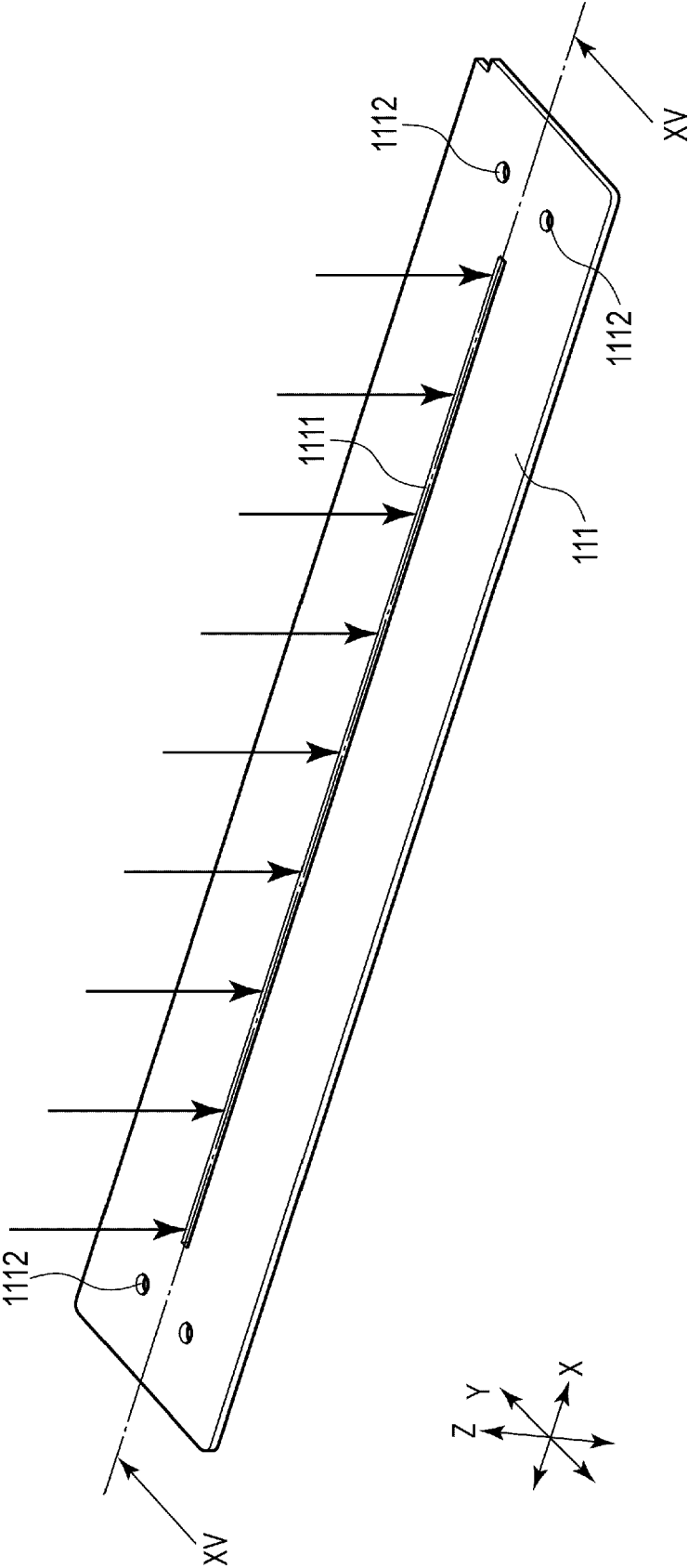


FIG. 15

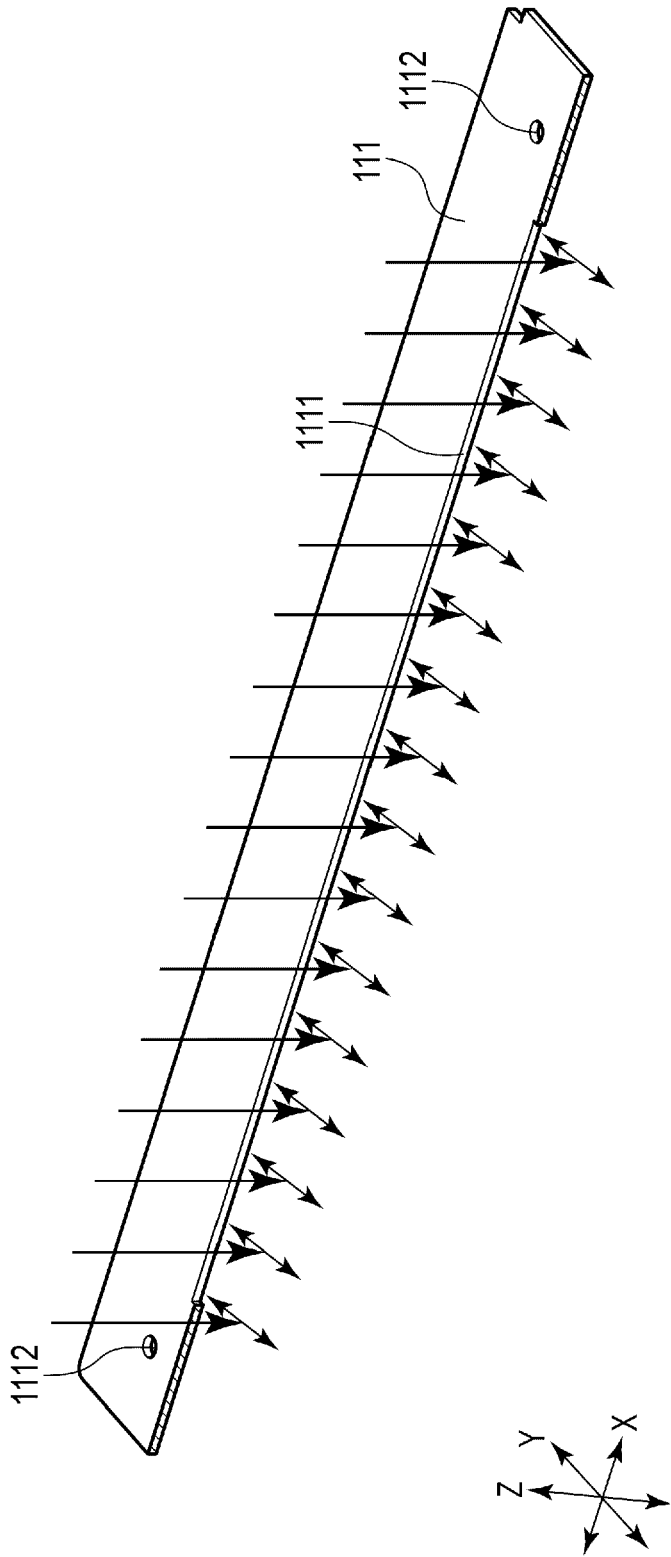


FIG. 16

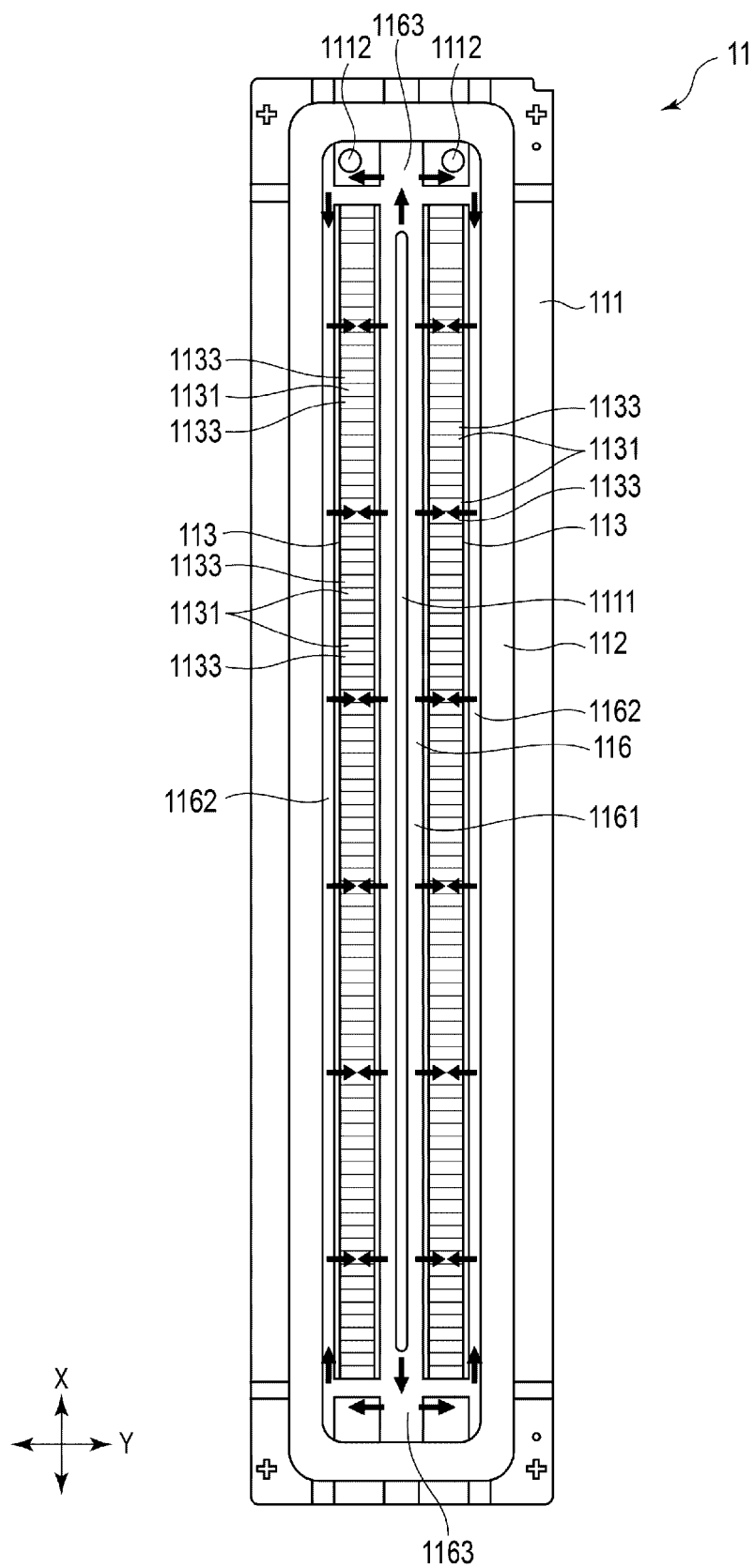


FIG. 17

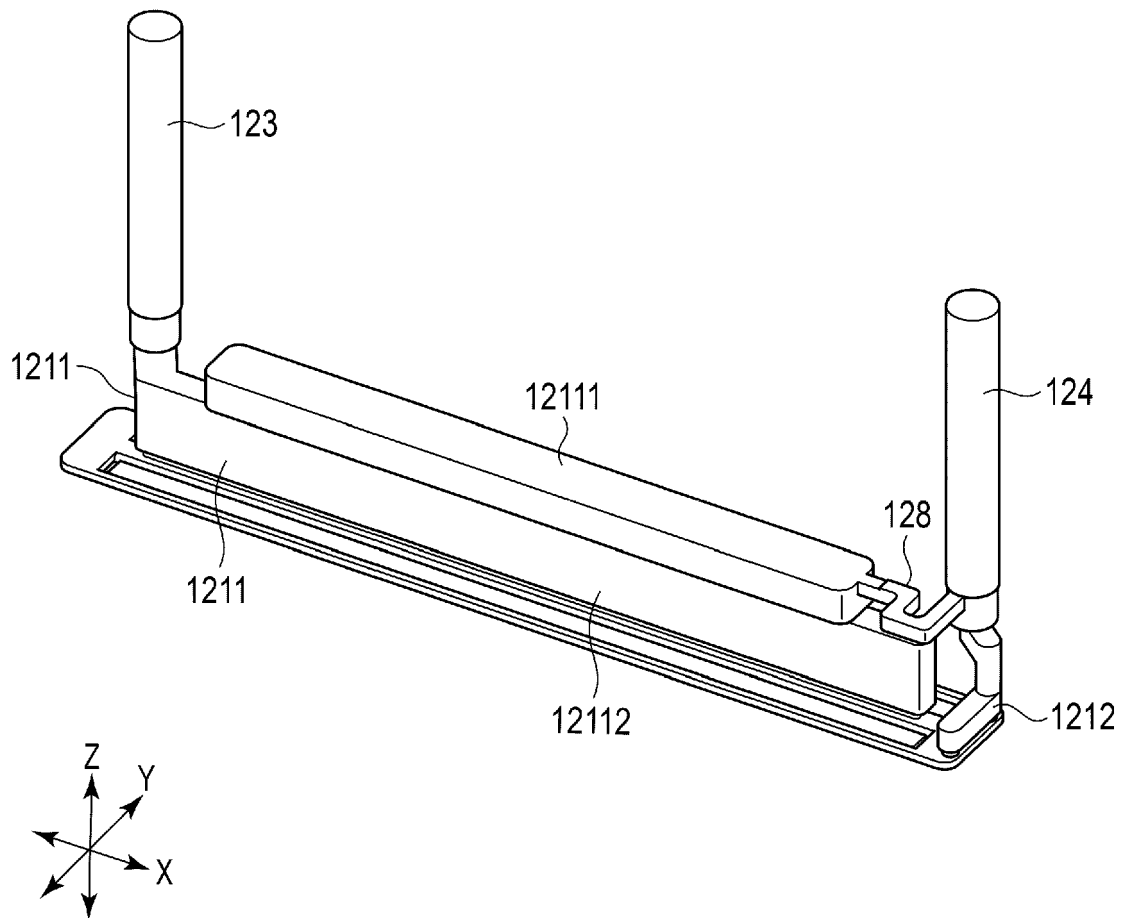


FIG. 18

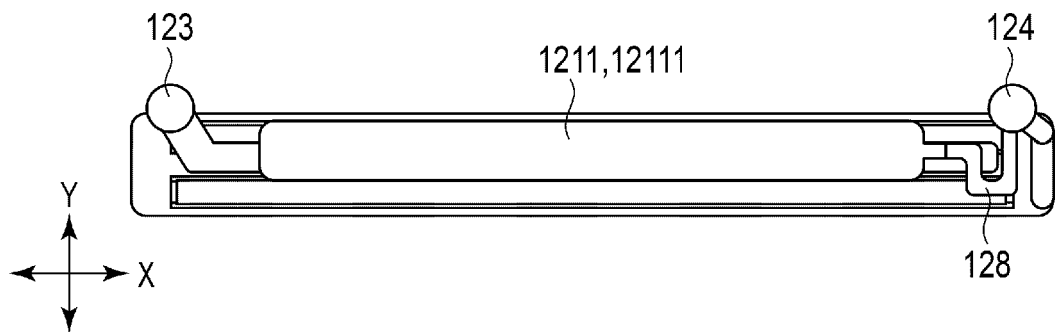


FIG. 19

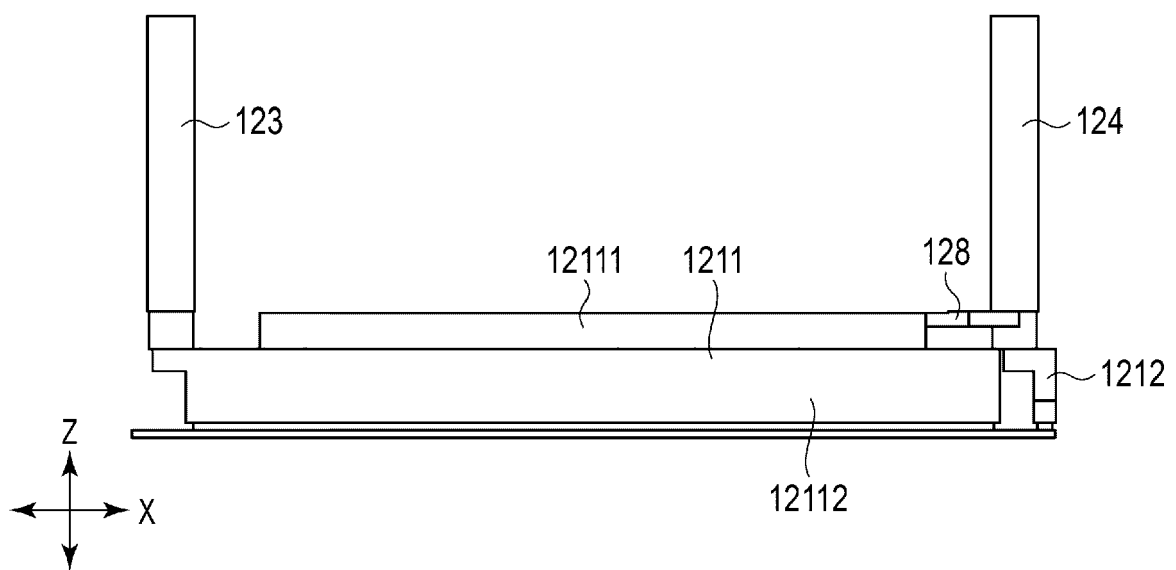


FIG. 20

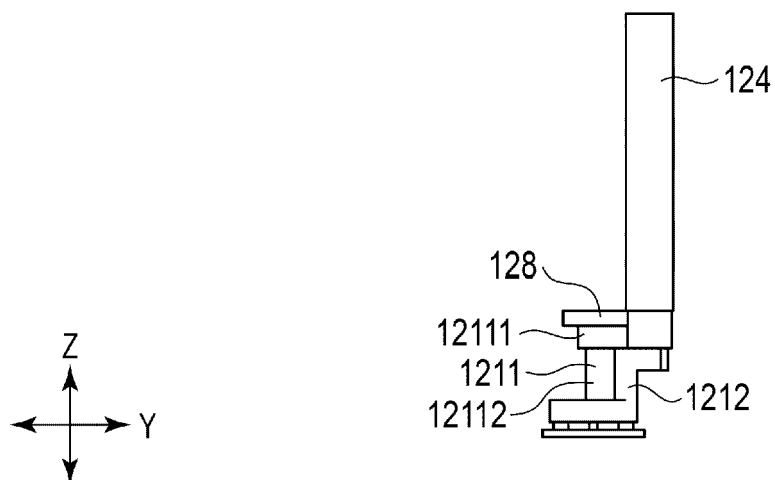
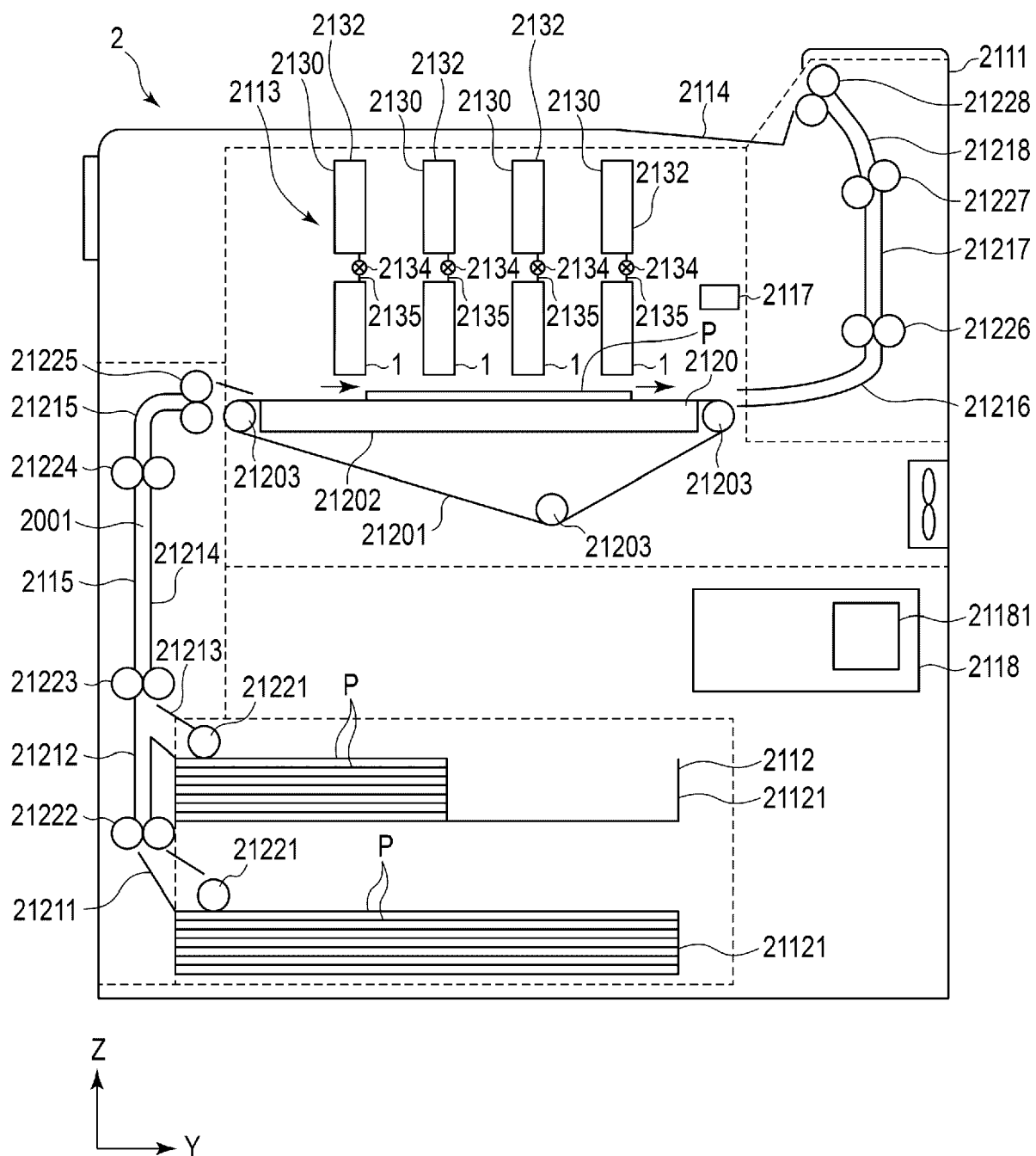


FIG. 21





EUROPEAN SEARCH REPORT

Application Number

EP 22 17 7337

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2009/015640 A1 (NISHIDA HIDEAKI [JP] ET AL) 15 January 2009 (2009-01-15) * figures 3,7,9,10 *	1-3, 5-11,13	INV. B41J2/14
X	US 2018/147845 A1 (IIJIMA TOMOMI [JP] ET AL) 31 May 2018 (2018-05-31) * figure 2 *	1-4,6, 10,12,13	
X	JP 2008 230152 A (TOSHIBA TEC KK) 2 October 2008 (2008-10-02) * figures 7,8 *	1,2,13	
X	JP 2016 055545 A (SII PRINTEK INC) 21 April 2016 (2016-04-21) * figures 3,6,10 *	1,13	
A	JP 2015 071259 A (TOSHIBA CORP; TOSHIBA TEC KK) 16 April 2015 (2015-04-16) * figure 3 *	1	
A	JP 2007 168097 A (TOSHIBA TEC KK) 5 July 2007 (2007-07-05) * figure 7 *	1	TECHNICAL FIELDS SEARCHED (IPC) B41J
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 25 October 2022	Examiner Bardet, Maude
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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