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Iijima

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(54) **INK JET HEAD AND PRINTER**

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B41J 2/155 (2006.01)
B41J 2/21 (2006.01)

(52) **U.S. Cl.**
CPC ***B41J 2/1433*** (2013.01); ***B41J 2/14201*** (2013.01); ***B41J 2/155*** (2013.01); ***B41J 2/2146*** (2013.01); *B41J 2002/14419* (2013.01); *B41J 2002/14491* (2013.01); *B41J 2202/19* (2013.01); *B41J 2202/20* (2013.01)

(58) **Field of Classification Search**
CPC B41J 2/1433; B41J 2/14201; B41J 2/14; B41J 2/155
See application file for complete search history.

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(57) **ABSTRACT**

An ink jet head includes a head body, a plurality of pipes, a plurality of flexible substrates, a reference plate, a plate base, a plurality of in-covers, and a plurality of side covers. Each of the in-covers includes an inner surface having a first mating surface in contact with the plate base, and an outer surface having a second mating surface in contact with the driving circuits. Each of the side covers includes an inner surface that is thermally coupled to a respective one of the plurality of in-covers and has a third mating surface in contact with the second mating surface section of the respective one of the plurality of in-covers, and an outer surface fastened to the print wiring substrate.

20 Claims, 10 Drawing Sheets

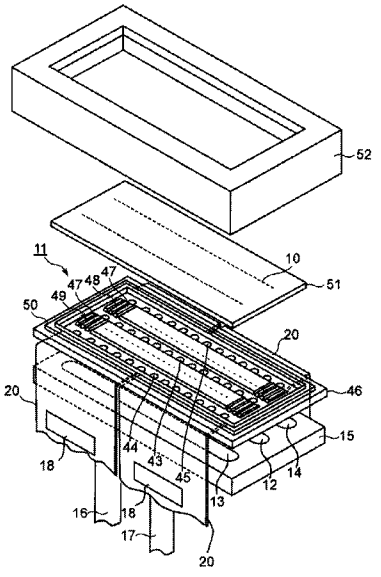

FIG. 1

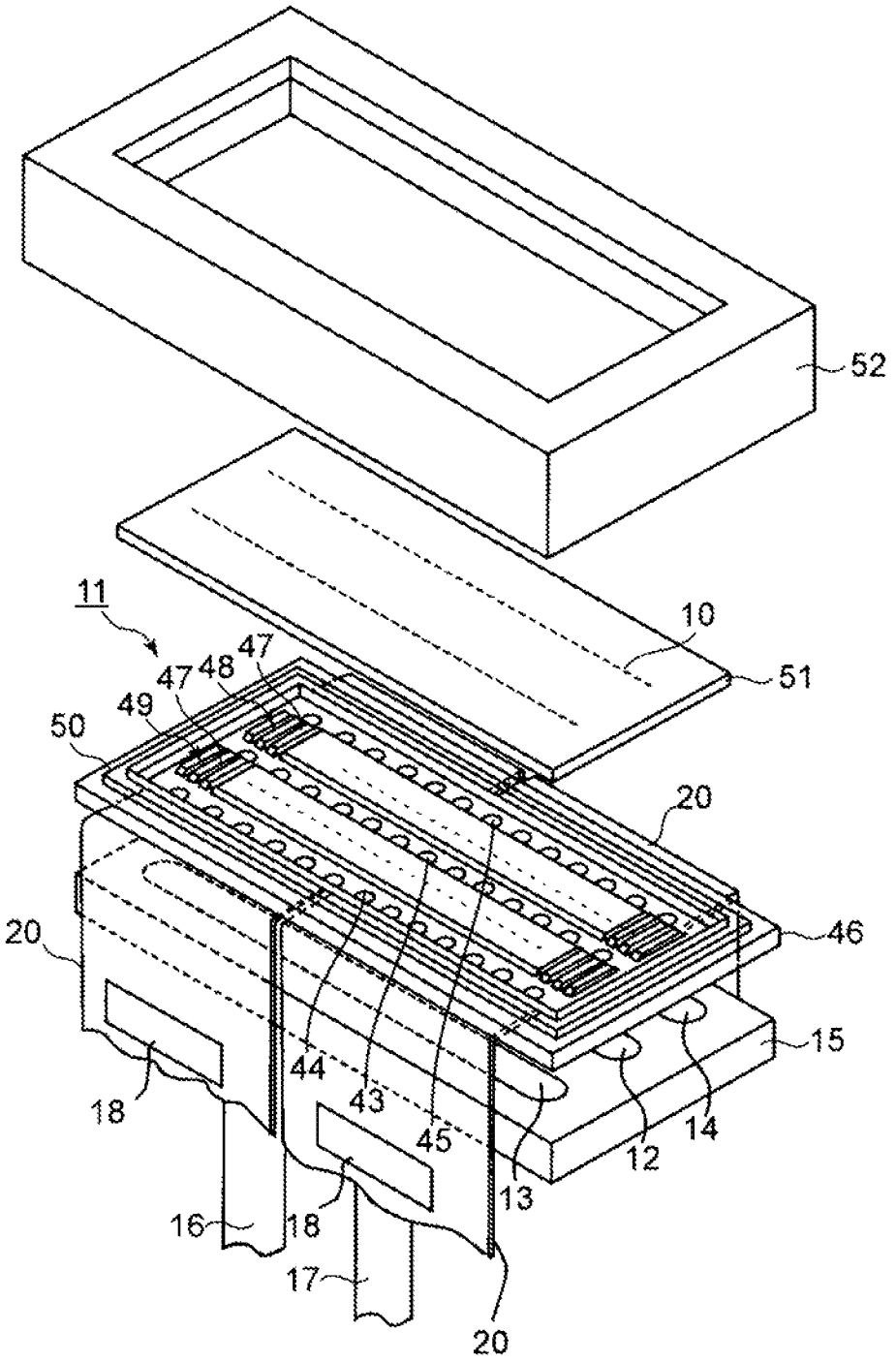
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FIG. 2

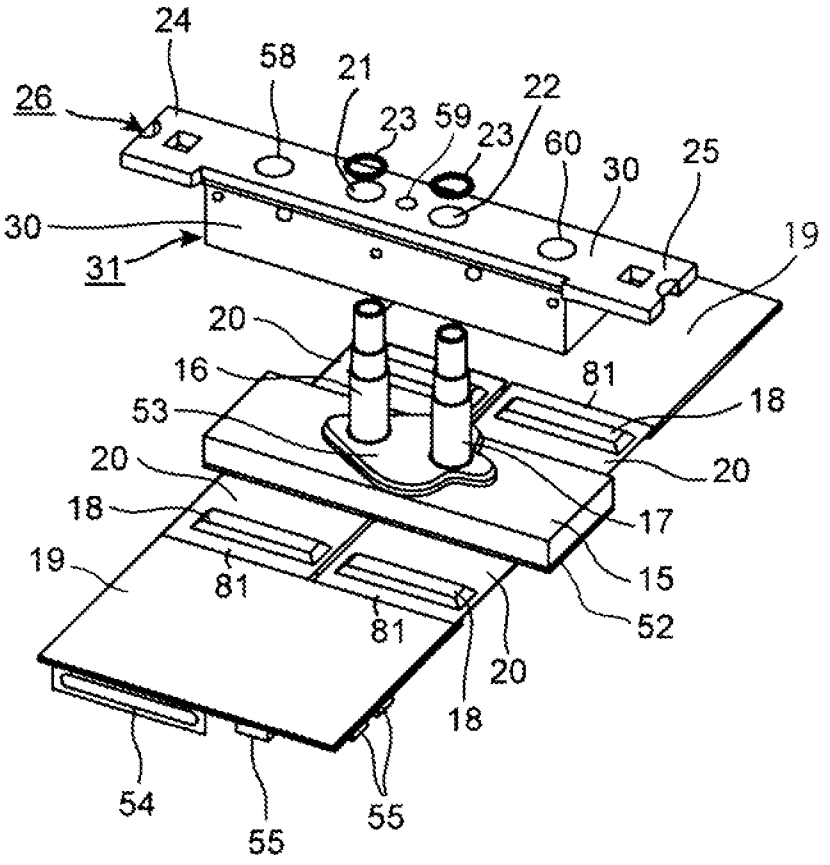
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FIG. 3

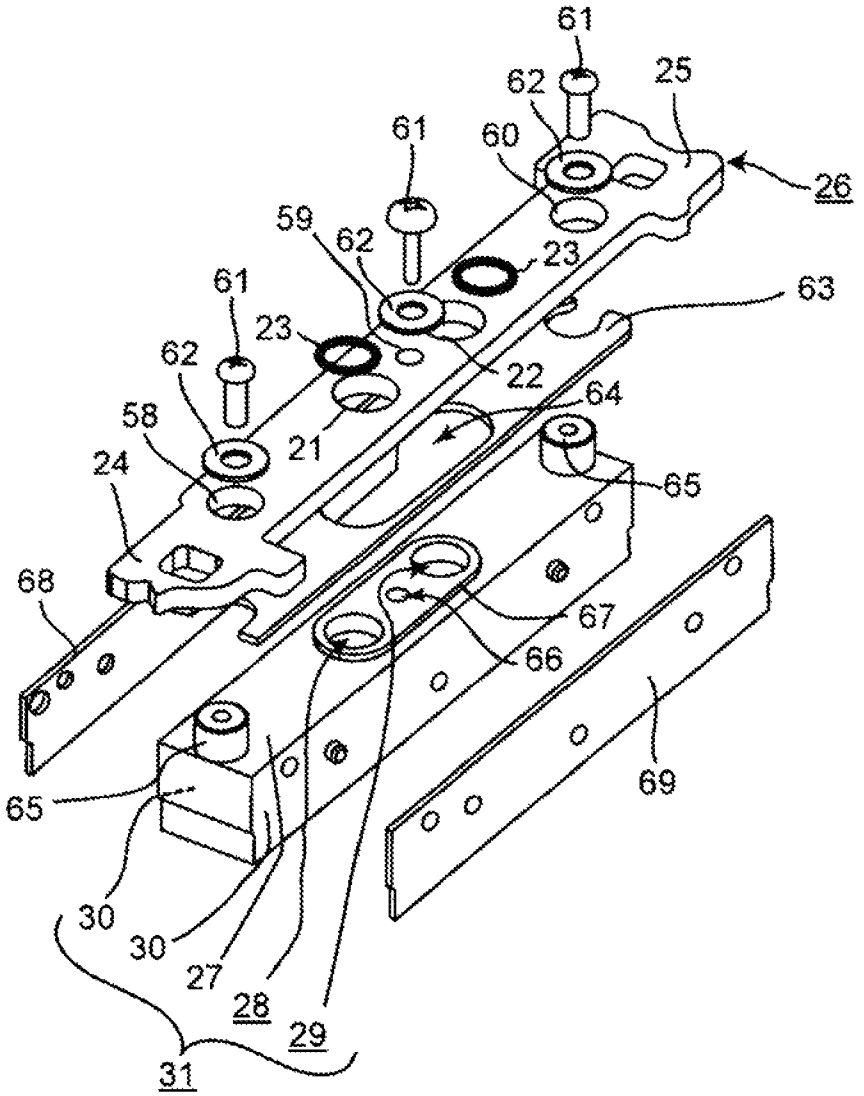
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FIG. 4

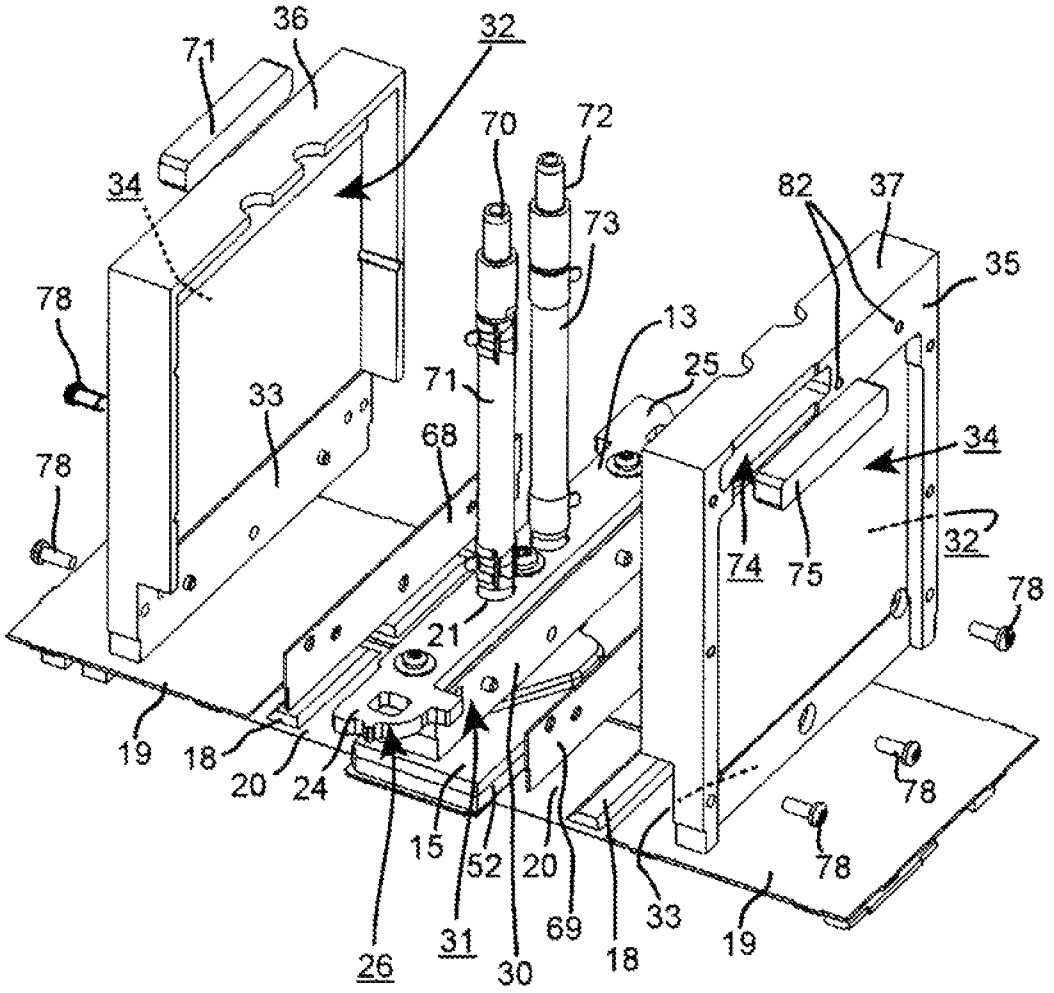
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FIG. 5

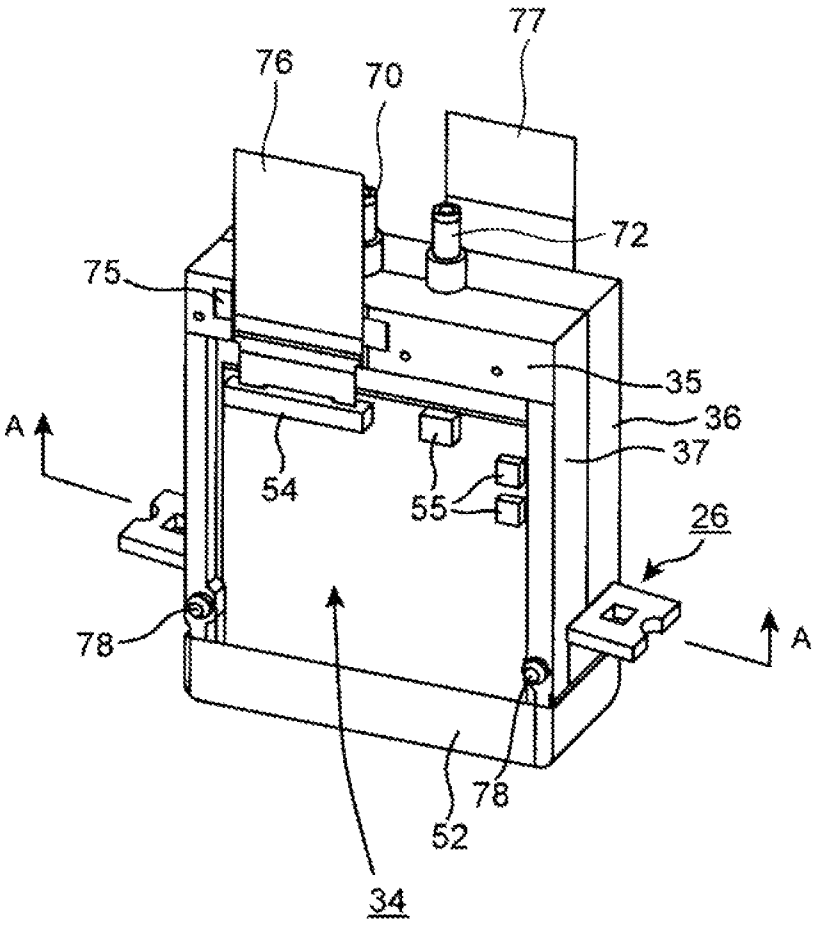

FIG. 6

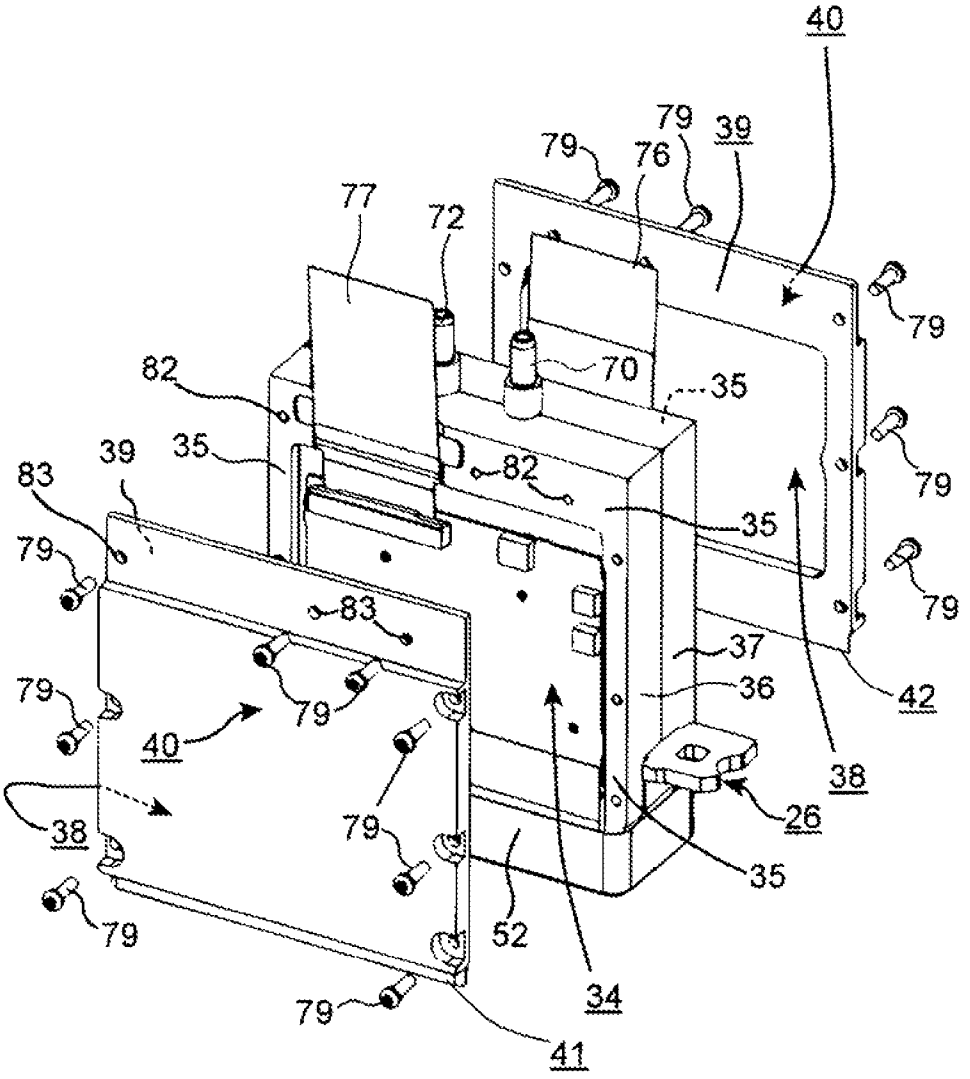
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FIG. 7

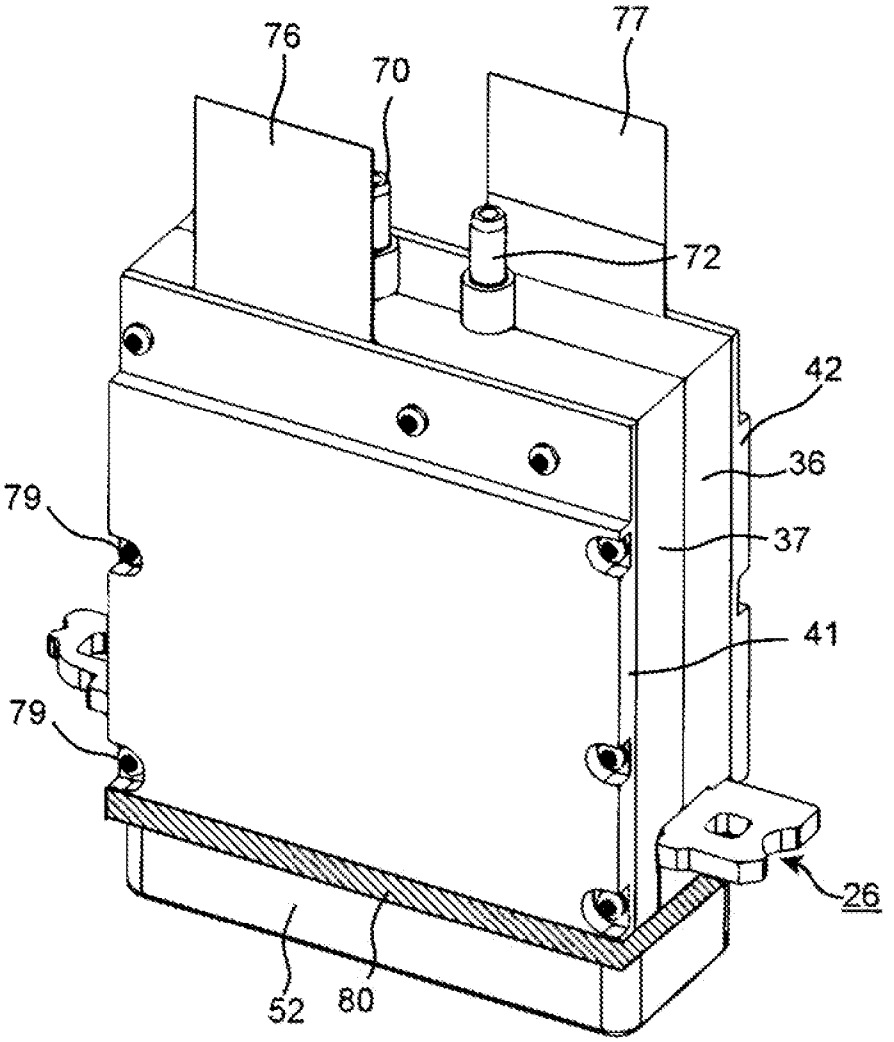


FIG. 8A

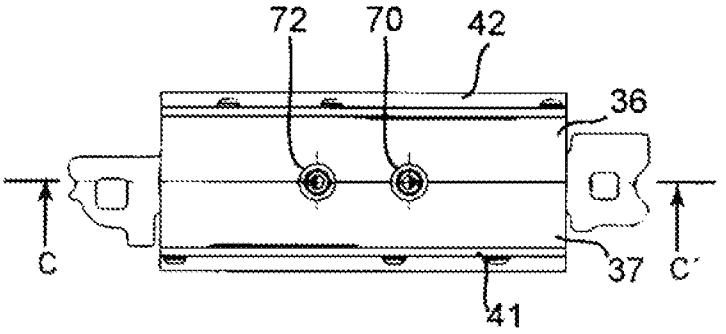


FIG. 8B

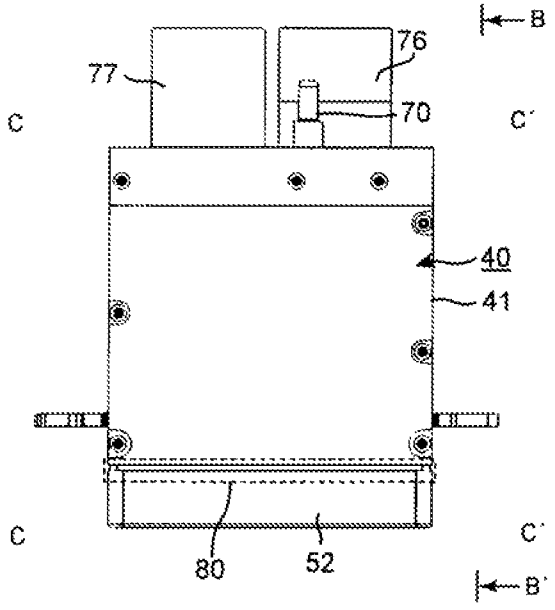


FIG. 8C

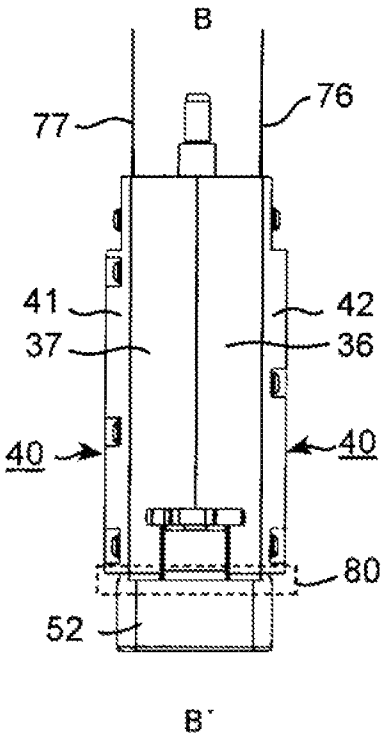


FIG. 9

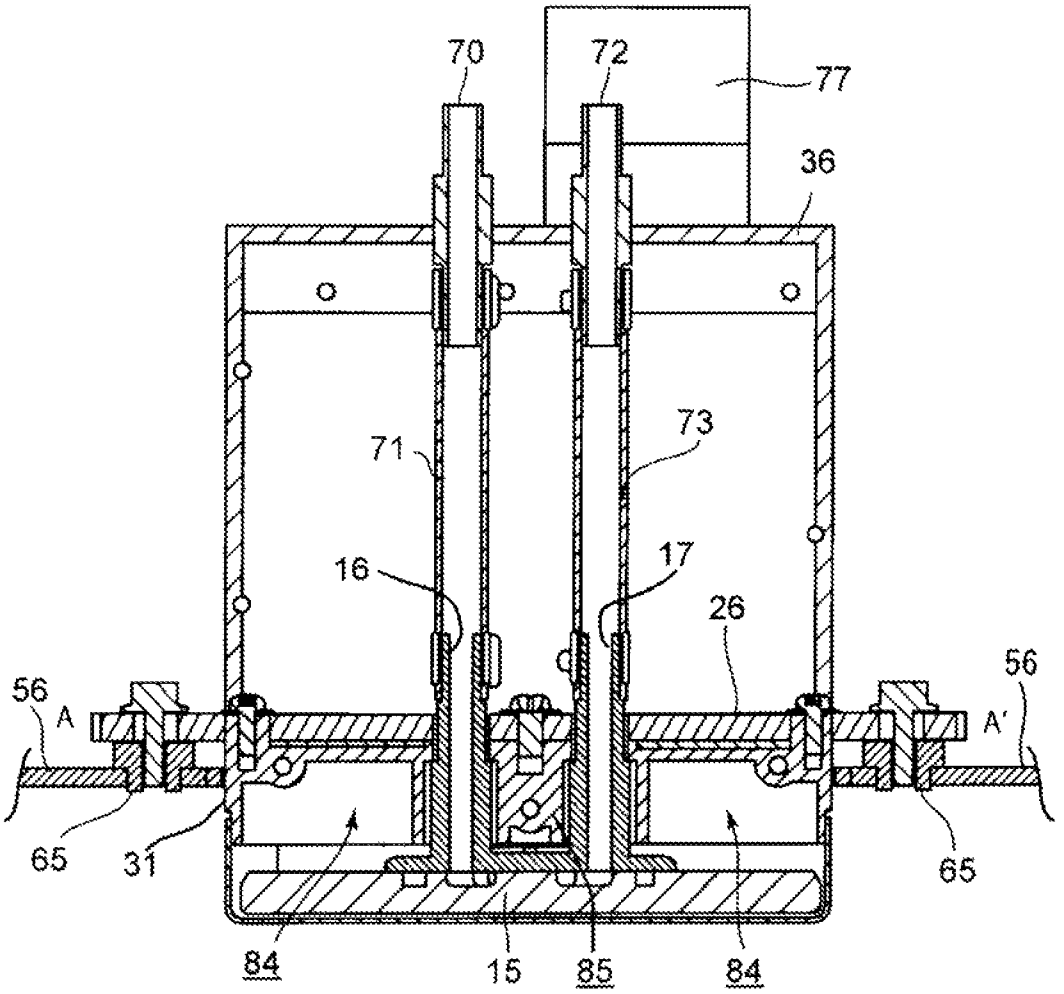
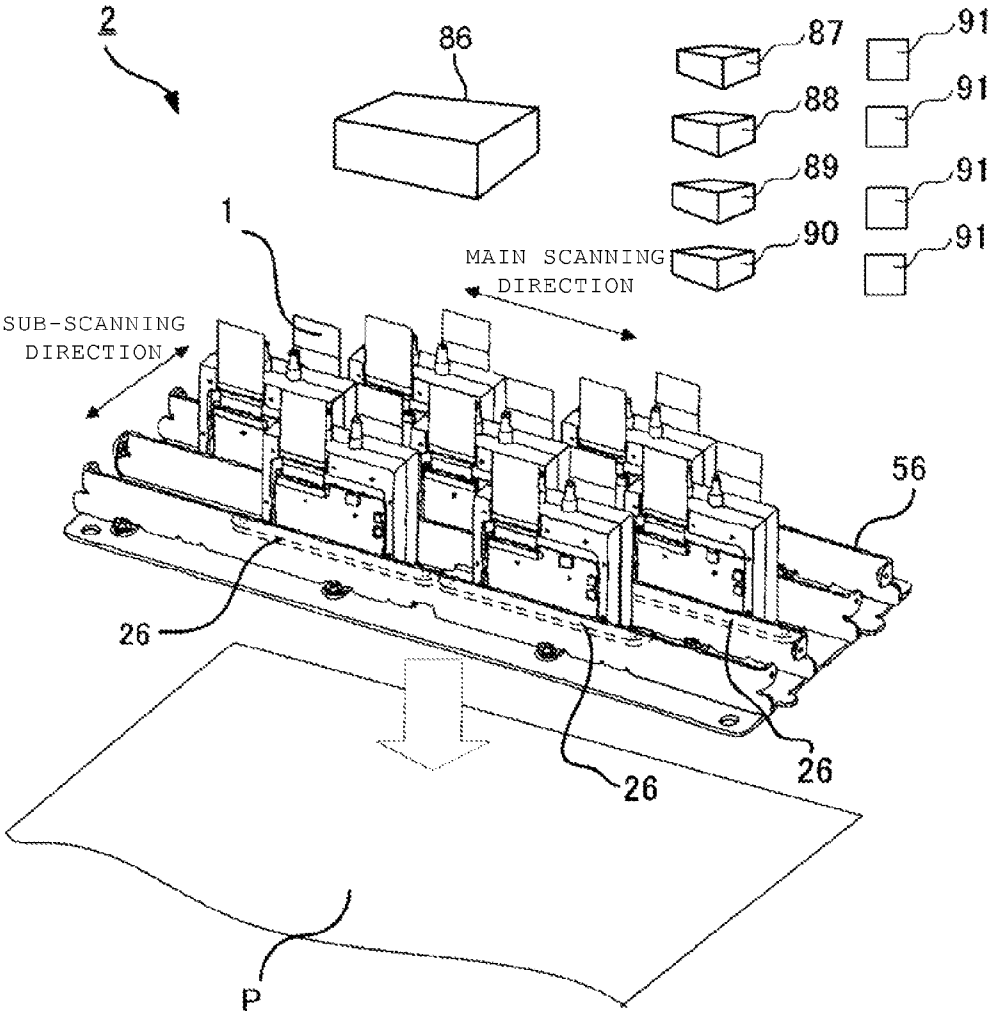


FIG. 10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INK JET HEAD AND PRINTER

CROSS-REFERENCE TO RELATED APPLICATION

This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2014-191242, filed Sep. 19, 2014, the entire contents of which are incorporated herein by reference.

FIELD

Embodiments described herein relate generally to an ink jet head and a printer.

BACKGROUND

A printer body (ink jet printer body) is provided with an ink jet head and ejects ink droplets by pressurizing ink. In the related art, the ink jet head is provided with a driver integrated circuit (IC) for driving ejection, and a cover is provided on an outside of the driver IC, the cover being adapted to release heat from the driver IC as a heat sink. Furthermore, a print wiring substrate on which a peripheral circuit is mounted is provided for driving the driver IC. It is necessary to prevent ink or ink mist leaked or scattered from a boundary surface between components, such as the head body, a mask plate, and the cover, from adhering to the print wiring substrate. Thus, penetration of ink is prevented by performing sealing by pouring a sealing material, such as adhesive, into gaps at the boundary surface between the components.

However, since there are large boundary surfaces between the components dictated by the complex shape of each component, when connecting a pipe of an ink circulation system to an ink tube of the ink jet head, ink may be spilled from the pipe. The spilled ink enters an inside of the cover and adheres to the print wiring substrate.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded perspective view of an ink jet head according to one embodiment.

FIG. **2** is a partially exploded perspective view of the ink jet head according to one embodiment.

FIG. **3** is an exploded perspective view before the ink jet head according to one embodiment is fastened.

FIG. **4** is an exploded perspective view illustrating a reference plate, a plate base, and a plurality of in-covers of the ink jet head according to one embodiment as a body.

FIG. **5** is a perspective view of a state where side covers of the ink jet head according to one embodiment are removed.

FIG. **6** is an exploded perspective view illustrating a positional relationship between the in-covers and the side covers of the ink jet head according to one embodiment.

FIG. **7** is a perspective view after the ink jet head according to one embodiment is fastened.

FIGS. **8**A to **8**C are three-plane views of the ink jet head according to one embodiment.

FIG. **9** is a vertical sectional view of the ink jet head according to one embodiment.

FIG. **10** is a partial perspective view of a printer according to one embodiment.

DETAILED DESCRIPTION

Embodiments provide an ink jet head and a printer in which ink is prevented from entering an inside of a cover and from adhering to a print wiring substrate.

In general, according to one embodiment, an ink jet head includes: a head body having a plurality of ejection ports for ink; a plurality of pipes disposed in a manifold, the manifold configured to supply ink to the head body and discharge ink in a longitudinal direction of an axis of the plurality of pipes intersecting the head body; a plurality of flexible substrates including flexible bodies bent in the longitudinal direction of the axis of the plurality of pipes and driving circuits for the head body, the plurality of flexible substrates being connected to a print wiring substrate; a reference plate disposed between the plurality of flexible substrates and including: a through port for each of the plurality of pipes, a sealing material disposed along an outer periphery of the respective pipe for each through port, and end portions disposed outside each through port in an arrangement direction of the plurality of pipes; a plate base including an upper surface against which the manifold and the head body are positioned with respect to the reference plate, and a through hole for each through port opened to the upper surface; a plurality of in-covers, each of the plurality of in-covers including inner surface having a first mating surface in contact with the plate base, and an outer surface having a second mating surface in contact with the driving circuits; and a plurality of side covers respective disposed alongside the plurality of in-covers, each of the plurality of side covers having an inner surface that is thermally coupled to a respective one of the plurality of in-covers, and has a third mating surface in contact with the second mating surface of a respective one of the plurality of in-covers, and an outer surface fastened to the print wiring substrate.

According to another embodiment, a printer includes: the ink jet head according to any one of the embodiments described herein; and an ink tank of the ink jet head.

Hereinafter, the ink jet head according to the embodiment will be described with reference to FIGS. **1** to **10**. Moreover, the same reference numerals are given to the same portions in each view and duplicated description will be omitted.

One Embodiment

FIG. **1** is an exploded perspective view of the ink jet head according to one embodiment. The ink jet head according to the embodiment includes a head body **11** provided with a plurality of ejection ports **10** of ink, a manifold **15** having a supply path **12** of ink to the head body **11** and discharge paths **13** and **14** for ink, and connection pipes **16** and **17** (pipes) that are provided in the manifold **15** in a longitudinal direction of a cylinder that is arranged orthogonal to the head body **11** and respectively communicate with the supply path **12**, and the discharge paths **13** and **14** of ink.

FIG. **2** is a partial exploded perspective view of the ink jet head according to one embodiment and illustrates the example in FIG. **1** by being upside down. Elements in FIG. **2** that are the same or similar to those described above are designated with identical reference numerals. Each ink jet head according to the embodiment includes four flexible substrates **20** each having a film (flexible body) that is bent from a development posture orthogonal to the longitudinal direction of the cylinder of the connection pipes **16** and **17** to a bending posture in the longitudinal direction of the cylinder. Each flexible substrate **20** includes a driver IC **18** (driving circuit) of the head body **11** on the film, and connection terminals **81** to a print wiring substrate **19**. The ink jet head according to the embodiment further includes a reference plate (DATUM-PLATE) **26** that is provided between the flexible substrates **20**. The reference plate **26** includes through ports **21** and **22** for each of the connection

pipes **16** and **17**, a sealing material **23** disposed along an outer periphery of the connection pipe for each of the through ports **21** and **22**, and both end portions **24** and **25** that are positioned outside each of the through ports **21** and **22** in an arrangement direction of the connection pipes. The end portions **24** and **25** are fixed to a structure body on the printer body side.

FIG. **3** is an exploded perspective view before the ink jet head according to one embodiment is fastened. The ink jet head according to the embodiment includes a plate base (DATUM-PLATE-BLOCK) **31** that has an upper surface **27** for positioning and fixing the head body **11** and the manifold **15** to the reference plate **26**, through holes **28** and **29** for the through ports **21** and **22** opened to the upper surface **27**, and a pair of flat side surfaces **30** coming into contact with the driver IC **18** by the bending posture of the flexible substrate **20**.

FIG. **4** is an exploded perspective view illustrating the reference plate **26**, the plate base **31**, and in-covers **36** and **37** of the ink jet head according to one embodiment as a body. FIG. **5** is a perspective view of an assembly after the assembly in FIG. **4** is covered by the in-covers **36** and **37**, and a perspective view illustrating a state where side covers **41** and **42** are removed from a finished product. Elements in FIG. **4** that are the same or similar to those described above are designated with identical reference numerals. The inkjet head includes two in-covers **36** and **37** that respectively have an inner surface **32** (see FIG. **4**) covering the plate base **31**, a first mating surface section **33** coming into contact with a side surface **30** of the plate base **31** formed on the inner surface **32** side thereof, an outer surface **34** on a side opposite to the inner surface **32**, and a second mating surface section **35** formed on the outer surface **34** side thereof. The inner surface **32** is a surface facing the reference plate **26** and the plate base **31**, and the outer surface **34** is a rear surface with respect to the inner surface **32**. Furthermore, the driver IC **18** (driving circuit) is arranged on (in contact with) the outer surface **34** by the bending posture of the flexible substrate **20**. The second mating surface section **35** includes an upper region on which screw receiving holes **82** of the in-cover **36** are formed and right and left regions that are continuous from the right and left of the upper region on the lower side. The second mating surface section **35** of the in-cover **37** is the same as the example of the in-cover **36**.

FIG. **6** is an exploded perspective view illustrating a positional relationship between the in-covers **36** and **37** and the side covers **41** and **42** of the ink jet head according to one embodiment. Elements in FIG. **6** that are the same or similar to those described above are designated with identical reference numerals. Furthermore, the ink jet head according to the embodiment includes two side covers **41** and **42** respectively have an inner surface **38** that radiates heat with (is thermally coupled to) the in-covers **36** and **37** and faces the outer surface **34**, a third mating surface section **39** that comes into surface contact with the second mating surface section **35** on the inner surface **38** side, and a surface section **40** that is fastened to the print wiring substrate **19**. The inner surface **38** of the side cover **41** is a surface facing the in-cover **36**, and the inner surface **38** of the side cover **42** is a surface facing the in-cover **37**. The third mating surface section **39** is a surface region excluding a center of the side covers **41** and **42**. The in-covers **36** and **37**, and the side covers **41** and **42** are made of aluminum, and a volume of aluminum material is increased with respect to a cover material of the related art, which enhances heat radiation.

The head body **11** (FIG. **1**) includes a base plate **46** having one column of ink supply holes **43** and two columns of ink discharge holes **44** and **45**, piezoelectric bodies **48** and **49** on the base plate **46** having a plurality of grooves **47**, a frame **50** surrounding the piezoelectric bodies **48** and **49**, an orifice plate **51** having the plurality of ejection ports **10** arranged in an arrangement direction of nozzles, and a mask plate **52** covering an entirety of the head body **11**. A conductive film for driving is formed in each groove **47** as an electrode. An edge portion on which the orifice plate **51** is mounted, and another edge portion of which a position is lower than that of the edge portion, are provided in an outer periphery of the frame **50**. The mask plate **52** is mounted on the low edge portion.

The manifold **15** (FIG. **2**) is a coupling section that also serves as a branch section of an ink flow path. The connection pipes (CONNECTION) **16** and **17** are connected to the manifold **15** through a member **53**. The connection pipe **16** is a supply pipe communicating with the supply path **12** of ink and is connected to a tube **71**. The connection pipe **17** is a discharge pipe communicating with the discharge paths **13** and **14** of ink and is connected to a tube **73**

Each of the four flexible substrates **20** includes two sheets of heat-resistant flexible print wiring board (FPC) and, for example, include polyimide wiring film (Tape Carrier Package: TCP). The driver IC (Dr. IC) **18** is packaged in the flexible substrate **20** by a chip on film (COF). One end portion of each flexible substrate **20** is wired to the electrode within the head body **11**. The other end portion of each flexible substrate **20** is connected to the rigid print wiring substrate **19**. The print wiring substrate **19** is a peripheral circuit of the driver IC **18**, electrically transmits and receives a control signal to and from the printer body, and is capable of individually driving the electrodes of the grooves **47**. The print wiring substrate **19** may have a connector **54** to a controller **86** (FIG. **10**) on the printer body, a passive component **55**, and the like. In the example illustrated in FIG. **2**, all four flexible substrates **20**, which are shown in the development state, can be folded at an upper end portion of the base plate **46** and take the bending posture parallel to the longitudinal direction of the cylinder of the connection pipes **16** and **17**.

The reference plate **26** fixes the ink jet head according to the embodiment to a mounting plate **56** (structure body) on the printer body side, for example, as illustrated in FIG. **10** and positions the ink jet head with respect to the printer body. The reference plate **26** in FIG. **3** is configured such that both end portions **24** and **25** thereof are respectively fastened to the iron mounting plate **56** by bolts passing through bolts holes (shapes of both end portions **24** and **25** can vary). The reference plate **26** has strength of a degree not to be subject to deformation, such as deflection and bending, when the reference plate **26** is fastened. The reference plate **26** is formed by a material having a thermal expansion coefficient that is smaller than a thermal expansion coefficient of aluminum and, for example, stainless steel, steel, and the like. A portion between each inner wall of the through ports **21** and **22** and outer periphery surfaces of the connection pipes **16** and **17** is bonded and fixed by the sealing material **23**, such as adhesive. Furthermore, the reference plate **26** is fastened to the plate base **31** between the both end portions **24** and **25** by screws **61** and washers **62** in through holes **58**, **59**, and **60**. The reference plate **26** is fastened to the plate base **31** at a center portion in a longitudinal direction of the plate.

The ink jet head according to the embodiment may be fastened by interposing an elastic sheet **63**, such as a gasket (DATUM-SHEET), between the reference plate **26** and the plate base **31**. Other elastic sheets **68** and **69** may be

provided on both right and left side surfaces of the plate base **31** as heat shielding members.

FIG. **9** is a vertical sectional view of the ink jet head according to the embodiment, which is taken along line AA' in FIG. **5**. Elements in FIG. **9** that are the same or similar to those described above are designated with identical reference numerals. Both right and left ends of the reference plate **26** are fastened to the mounting plate **56** by bolts. As illustrated in FIGS. **3** and **9**, the plate base **31** is a molded block that is formed by a material having a low thermal conductivity. For the plate base **31**, a hollow plastic molded article is used to minimize heat transfer. In an example, the plate base **31** has thinned spaces **84** that are respectively provided on the right and left, and a screw receiving section **85** that is provided at a center portion between the thinned spaces **84**. Furthermore, as illustrated in FIG. **3**, studs **65** that also serve as spacers are erected on both sides in the longitudinal direction of the plate on the upper surface of the plate base **31**. The studs **65** pass through the through holes **58** and **60** of the reference plate **26** and are locked by the screws **61** and the washers **62**. Since the reference plate **26** is not fastened to the plate base **31** without being pressed down, an escape space against heating is provided in the reference plate **26**. Prevention of exit of the reference plate **26** to the upper portion, prevention of deformation, and prevention of rotation of the reference plate **26** are achieved by preventing or minimizing thermal expansion of the reference plate **26**. Furthermore, a spacer **67** is provided at a center portion in the longitudinal direction of the plate on the upper surface of the plate base **31**, and the spacer **67** is provided with openings for a screw receiving hole **66** and the through holes **28** and **29**. The screw **61** mates with the screw receiving hole **66** from above through the opening **64** of the elastic sheet **63**.

Furthermore, the in-covers **36** and **37** in FIG. **4** are aluminum molded bodies and surround each of a supply pipe **70**, the tube **71**, a discharge pipe **72**, and the tube **73** inside themselves by being closely fixed to each other. Each screw **78** mates with both right and left side surfaces **30** of the plate base **31**, closely fixing the in-covers **36** and **37** to each other. The left in-cover **36** faces the plate base **31**, and the first mating surface section **33** on a lower side on the inner surface **32** comes into surface contact with the side surface **30** of the plate base **31**. The right in-cover **37** also has substantially the same shape as that of the in-cover **36**. The in-covers **36** and **37** are fixed to each other, whereby the in-covers **36** and **37** prevent leakage of ink and scattering of ink, receive heating from the driver IC **18**, and may radiate heat as the heat sink. A groove **74** passing through the in-covers **36** and **37** may be formed at an upper portion of each inner surface **32** of the in-covers **36** and **37**. An elastic body (SEAL-RUBBER-FFC) **75** may be provided in the groove **74**.

As illustrated in FIG. **5**, a flat cable **76** is connected to an end portion on a side opposite to the flexible substrate **20** through the connector **54** in one print wiring substrate **19**. The elastic body **75** is provided in the second mating surface section **35** of the in-cover **36** as a protective material for protecting the flat cable **76** from exposure to ink. Adhesive may be used in the protective material. The elastic body **75** is mounted at a height of a fitting portion between the flat cable **76** and the connector **54**. The flat cable **76** is used for signal wiring to receive and transmit a signal from and to a controller **86** on the printer body side. A flat cable **77** is similar to the example of the flat cable **76**.

FIG. **7** is a perspective view after the ink jet head according to one embodiment is fastened and illustrates an example after component elements in FIG. **6** are assembled. Elements in FIG. **7** that are the same or similar to those described above are designated with identical reference numerals. As illustrated in FIGS. **6** and **7**, the third mating surface section **39** of the side cover **41** is a mating surface with the second mating surface section **35** of the in-cover **36**, the second mating surface section **35** and the third mating surface section **39** are closely fixed to each other, whereby leakage of ink and scattering of ink from the inside to the outside of the in-covers **36** and **37** are prevented. The side cover **41** is closely fixed to the in-cover **36** by screwing each screw **79** into the corresponding screw receiving hole **82** of the in-cover **36** through the corresponding receiving hole **83** of the side cover **41**. The inner surface **38** of the side cover **41** faces the print wiring substrate **19** erecting on the outer surface **34** of the in-cover **36**. In a state where the flexible substrate **20** is bent and erected after the in-covers **36** and **37** come into close contact with each other, each of two driver ICs **18** on the right side comes into close contact with the lower portion of the outer surface **34** of the in-cover **37** and the radiation of heat is also performed on the outer surface **34** side. The side cover **41** performs heat exchange of the generated heat with outside air as the heat sink. The side cover **42** is the same as the example of the side cover **41**.

In the ink jet head in FIG. **7**, a sealing tape **80** is wound.

FIGS. **8**A to **8**C are three plane views of the ink jet head according to one embodiment. FIG. **8**A is a top view of the ink jet head, FIG. **8**B is a front view in FIG. **8**A, and FIG. **8**C is a right side view that is taken by line BB' in FIG. **8**B. Elements in FIGS. **8**A to **8**C that are the same or similar to those described above are designated with identical reference numerals. As indicated by broken lines in FIGS. **8**B and **8**C, the sealing tape **80** is wound along each outer surface **34** of the in-covers **36** and **37** at the boundary surface between the in-covers **36** and **37**, and the mask plate **52**. The sealing tape **80** is tetrafluoride ethylene resin unfired tape (raw tape) for sealing (JIS K 6896) and is made of polytetrafluoroethylene (PTFE). Furthermore, the shield is reinforced by covering the sealing tape **80** with a heat-shrinkable film for falling prevention or a heat-shrinkable tube.

FIG. **10** is a partial perspective view of a printer illustrating a positional relationship when a plurality of ink jet heads according to the embodiment are arranged in the printer body. Elements in FIG. **10** that are the same or similar to those described above are designated with identical reference numerals. A printer **2** is a color printer and includes a plurality of ink jet heads **1** (ink jet head according to the embodiment), ink tanks **87**, **88**, **89**, and **90** of four colors, and each of circulation pumps **91** for each of the ink tanks **87** to **90**. Two or three ink jet heads which are respectively arranged in a main scanning direction are arranged in the printer **2** in a sub-scanning direction. The printer **2** is configured such that the ink jet heads **1** are provided to be arranged in zigzag with respect to a sheet P for each color in the mounting plate **56**. The ink jet heads **1** are arranged such that head center lines of the ink jet heads **1** of a rear column (or front column) match an equally dividing position between head center lines of two ink jet heads **1** of the front column (or rear column).

Next, a method of operation of the ink jet head according to the embodiment having the configuration described above will be described. The ink jet head **1** is configured such that any driver IC **18** generates a pulse voltage signal by a driving signal from the printer body, an electric field is generated, and the side wall of the pressure chamber inside the head body is deformed. Ink is pressurized by expansion and contraction of the volume of the pressure chamber in the

head body **11**, and the head body **11** ejects liquid droplets from the ejection port **10**. When the ink jet head **1** ejects the liquid droplets, heat generated by the driver IC **18** is received by the in-covers **36** and **37**, and the side covers **41** and **42** radiate heat by heat exchange with the outside air.

The ink jet head according to the embodiment has a structure in which the boundary surface for applying sealant or the seal material such as adhesive is minimized to prevent entering of ink on the inside of the head body **11** while performing radiation of heat of the driver IC **18** for driving the head, whereby it is possible to reduce location where the sealing material such as adhesive flows into or is applied. The boundary surface that is the location where the sealing material is applied may have a shape by which a sealing process is easily automated. Since the mating surface section is in a range having a shape surrounded by a straight line, it becomes easy to fit movement of a manufacturing robot and automation advances.

Specifically, the sealing location is reduced and the surface mating portion having a linear shape may be formed by a structure of the following descriptions of (1) to (5).

(1) A top surface of each driver IC **18** faces the manifold **15** side on the flexible substrate **20**. The sealing material **23** is bonded and fixed such that ink does not enter from the boundary surface in which the reference plate **26** comes into contact with cylindrical sections of the connection pipes **16** and **17**.

(2) As illustrated in FIG. **4**, the in-covers **36** and **37** are mounted by mating the cover edges thereof each other in the upper portion and the first mating surface sections **33** thereof being mated in the both side surfaces **30** of the plate base **31** in the lower portion. Since surface mating positions between the first mating surface section **33** and the side surface **30** are present in two locations, leakage of ink is prevented. Furthermore, elastic sheet **69** such as a gasket is inserted between the plate base **31** and the in-covers **36** and **37**. Thus, effects of preventing ink from entering the inside of the cover and from adhering to the print wiring substrate **19** are enhanced.

(3) As illustrated in FIG. **5**, in a state where the in-covers **36** and **37** are mounted, the flexible substrate **20** is bent and the driver IC **18** comes into contact with the in-covers **36** and **37**. The flexible substrate **20**, the print wiring substrate **19**, and the flat cables **76** and **77** are respectively accommodated in the in-covers **36** and **37**. Leakage of ink or scattering of ink is prevented by surface mating between the sealing material **23**, the first mating surface section **33**, and the side surface **30**.

(4) As illustrated in FIG. **6**, the side covers **41** and **42** are mounted such that each second mating surface section **35** on the outside of the in-covers **36** and **37** sufficiently comes into close contact with the corresponding third mating surface section **39** on the inside of the side covers **41** and **42** without a gap. Entering of ink inside the cover is prevented by removing the boundary surface by overlapping the flat surface and the flat surface. As illustrated in FIG. **4**, since the elastic body **75** is mounted on the groove **74** on the surface of the in-covers **36** and **37** facing the flat cables **76** and **77**, it is possible to seal the flat cable **77** by the in-cover **36**, the side cover **41**, and the elastic body **75** by mounting the side cover **41** on the in-cover **36**. The flat cable **76** is similar to the example of the flat cable **77**.

(5) The sealing tape **80** is wound on the boundary surface of the in-cover **36**, the side cover **41**, and the mask plate **52**. As falling prevention of the sealing tape **80**, sealing or the shield effect is enhanced by covering the sealing tape **80** with a heat shrinkable film or a heat shrinkable tube.

As described above, according to the ink jet head and the printer according to the embodiment, it is possible to prevent ink from entering the inside of the cover and from adhering to the print wiring substrate **19**.

When mounting the ink jet head according to the embodiment on the printer body, ink does not enter the inside of the cover and ink does not adhere to the print wiring substrate **19** even when ink is spilled from the connection pipes **16** and **17** when connecting the ink tanks **87** to **90**, the circulation pump **91**, the connection pipes **16** and **17**, and the ink jet head by the ink tube. It is possible to prevent ink from being adhered to the print wiring substrate **19** during initial installation or during maintenance. It is possible to reduce locations where the sealing material flows into the boundary surface portion between components by complex shapes of the components. A process of the sealing material flowing through is not necessary and automation of manufacturing is achieved. That is, it is possible to automate a portion of the manufacturing process of a product by the robot. Furthermore, in the ink jet head according to the embodiment, it is possible to stop leakage of ink while radiating heat generated inside the ink jet head without providing an enclosure. Furthermore, in the ink jet head according to the embodiment, it is possible to relieve component dimension precision in each portion between the side covers **41** and **42**, the mating section between the side covers **41** and **42**, and the reference plate **26**, and the mating section between the plate base **31** and the side covers **41** and **42**. Even when twisting or distortion occurs in mating between the components due to cooling after each component is expanded by driving heat, according to the ink jet head according to the embodiment, it is possible to reliably prevent the leakage of ink or scattering of ink. It is possible to automate a process of winding of the sealing tape **80** around the outer peripheral portions of the side covers **41** and **42** many times. In the ink jet head according to the embodiment, since a top cover for covering the connection pipe **16** and the connection pipe **17** is not mounted, it may be not required to consider precision of a component mating portion when using the top cover.

Furthermore, the ink jet head according to the embodiment has a structure in which each of the driver IC **18**, the print wiring substrate **19**, and the like are individually accommodated by the in-covers **36** and **37**, in which the side covers **41** and **42** of aluminum material having good thermal conductivity, in which the ink jet head of the ink circulation type which has two columns of the pressure chamber, and in which the driver IC **18** for driving and the print wiring substrate **19** are connected to each column. Since the in-covers **36** and **37**, and the side covers **41** and **42**, may be manufactured by securing the big volume of the aluminum material, in the ink jet head according to the embodiment, it is possible to increase the surface area and the volume of the in-covers **36** and **37**, and the side covers **41** and **42**, and improve radiation of heat by the accommodation structure made of aluminum.

Furthermore, the mating surface between the in-cover **36** and the side cover **41** is a plane, and the mating surface between the in-cover **37** and the side cover **42** is a plane, and surface contact is provided therebetween. The mating surface between the plate base **31** and one in-cover **36** is a plane, the mating surface between the plate base **31** and the other in-cover **37** is a plane, and surface contact is provided therebetween. The inkjet head is fixed, the reference plate **26** for positioning and the cylindrical sections of the connection pipes **16** and **17** are bonded and fixed such that the ink does not enter from the boundary surface. It is possible to prevent

ink from entering the inside of the head body **11** by providing the structure described above.

Furthermore, the structure is provided in which ink is prevented from entering the inside of the head body **11** by sealing only between the boundary surfaces of the in-covers **36** and **37**, the side covers **41** and **42**, and the mask plate **52**, and by the surface contact regarding the side covers **41** and **42**, the in-covers **36** and **37**, and the plate base **31**. Thus, it is possible to reduce sealing locations and greatly simplify manufacturing processes during manufacturing of the ink jet head.

Furthermore, even a case where a gap occurs in the mating surface between the in-covers **36** and **37**, even when ink enters the manifold **15** side from above, sealing is performed between the reference plate **26** and the connection pipes **16** and **17** in the lower portion. Thus, ink does not enter into the electrode section and the electrical portions of the head body **11**, and entering of ink that requires replacement of the head body **11** is prevented.

In addition, connection pipes are provided in longitudinal direction of the cylinder orthogonal to the head body **11**, but may be intersecting the head body **11** with being inclined. The elastic sheet (DATUM-SHEET-UPPER) **63** and the elastic sheets **68** and **69** are provided for preventing ink from entering between the reference plate **26** and the plate base **31** illustrated in FIG. **3**, whereby it is possible to improve the effect of prevention of leakage of ink. It is also possible to prevent entering of ink by the surface contact between the lower surface of the reference plate **26** and the upper surface **27** of the plate base **31** without inserting the elastic sheet **63**. Fins may be formed in the in-covers **36** and **37**, and the side covers **41** and **42**.

The both side surfaces **30** of the plate base **31**, the first mating surface section **33**, the second mating surface section **35**, and the third mating surface section **39** are flat, but may not be a flat surface. Shapes of the mating portions of a pair of mating surface are configured such that one surface may be shaped to conform with the other surface.

Although the elastic body **75** is provided in the groove **74**, the elastic body **75** may be provided in accordance with the positions of the flat cables **76** and **77** without providing the groove **74**.

The printer according to the embodiment may be a printer of a POS terminal that is used in point of sales (POS) cash register. For example, the printer may be connected to the POS terminal having a sale registering section, an accounting calculation section, and a drawer as a receipt printer. The printer according to the embodiment may be also used in a label printer or a bar code printer.

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 inventions. 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 spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

What is claimed is:

1. An ink jet head, comprising:

a head body having a plurality of ejection ports for ink;

a plurality of pipes disposed in a manifold, the manifold configured to supply ink to the head body and discharge ink in an axial direction of the plurality of pipes;

a plurality of flexible substrates including flexible bodies bent in the axial direction of the plurality of pipes and driving circuits for the head body, the plurality of flexible substrates being connected to a print wiring substrate;

a reference plate disposed between the plurality of flexible substrates and including: a through port for each of the plurality of pipes, a sealing material disposed along an outer periphery of the respective pipe for each through port, and end portions disposed outside each through port in an arrangement direction of the plurality of pipes;

a plate base including an upper surface against which the manifold and the head body are positioned with respect to the reference plate, and a through hole for each through port opened to the upper surface;

a plurality of in-covers, each of the in-covers including an inner surface having a first mating surface in contact with the plate base and an outer surface having a second mating surface in contact with the driving circuits; and

a plurality of side covers respectively disposed alongside the plurality of in-covers, each of the plurality of side covers having an inner surface that is thermally coupled to a respective one of the plurality of in-covers and has a third mating surface in contact with the second mating surface of a respective one of the plurality of in-covers, and an outer surface fastened to the print wiring substrate.

2. The ink jet head according to claim **1**, further comprising:

a mask plate covering the head body; and

an unfired tape of tetrafluoride ethylene resin wound in a boundary surface between the plurality of in-covers and the mask plate along each first outer surface of the plurality of in-covers.

3. The ink jet head according to claim **1**,

wherein the print wiring substrate is connected to a flat cable on a side opposite to an end portion where the print wiring substrate is connected to the plurality of flexible substrates, and

wherein each second mating surface of the plurality of in-covers has a protective material disposed thereon to protect the flat cable from exposure to ink.

4. The ink jet head according to claim **1**,

wherein the plate base includes a pair of side surfaces in contact with the driving circuits.

5. The ink jet head according to claim **1**, wherein the third mating surface of each of the plurality of side covers is disposed around a periphery thereof.

6. The inkjet head according to claim **1**, wherein the head body comprises:

a base plate having a plurality of piezoelectric bodies disposed thereon and a frame surrounding the piezoelectric bodies.

7. The ink jet head according to claim **6**, wherein the head body further comprises:

an orifice plate, disposed on the frame, having the plurality of ejection ports.

8. The ink jet head according to claim **6**, wherein the base plate includes a column of ink supply holes and a plurality of columns of ink discharge holes.

9. The inkjet head according to claim **6**, wherein the piezoelectric bodies include a plurality of grooves, and a conductive film is disposed in each of the plurality of grooves.

10. The inkjet head according to claim 9, wherein the plurality of flexible substrates is wired to electrodes formed by the conductive film in the head body.

11. A printer, comprising:

an ink tank; and

an ink jet head including

a head body having a plurality of ejection ports for ink;

a plurality of pipes disposed in a manifold, the manifold configured to supply ink to the head body and discharge ink in an axial direction of the plurality of pipes;

a plurality of flexible substrates including flexible bodies bent in the axial direction of the plurality of pipes and driving circuits for the head body, the plurality of flexible substrates being connected to a print wiring substrate;

a reference plate disposed between the plurality of flexible substrates and including: a through port for each of the plurality of pipes, a sealing material disposed along an outer periphery of the respective pipe for each through port, and end portions disposed outside each through port in an arrangement direction of the plurality of pipes;

a plate base including an upper surface against which the manifold and the head body are positioned with respect to the reference plate, and a through hole for each through port opened to the upper surface;

a plurality of in-covers, each of the in-covers including an inner surface having a first mating surface in contact with the plate base and an outer surface having a second mating surface in contact with the driving circuits; and

a plurality of side covers respectively disposed alongside the plurality of in-covers, each of the plurality of side covers having an inner surface that is thermally coupled to a respective one of the plurality of in-covers and has a third mating surface in contact with the second mating surface of a respective one of the plurality of in-covers, and an outer surface fastened to the print wiring substrate.

12. The printer according to claim 11, further comprising:

a mask plate covering the head body; and

an unfired tape of tetrafluoride ethylene resin wound in a boundary surface between the plurality of in-covers and the mask plate along each first outer surface of the plurality of in-covers.

13. The printer according to claim 11,

wherein the print wiring substrate is connected to a flat cable on a side opposite to an end portion where the print wiring substrate is connected to the plurality of flexible substrates, and

wherein each second mating surface of the plurality of in-covers has a protective material disposed thereon to protect the flat cable from exposure to ink.

14. The printer according to claim 11,

wherein the plate base includes a pair of side surfaces in contact with the driving circuits.

15. The printer according to claim 11, wherein the third mating surface of each of the plurality of side covers is disposed around a periphery thereof.

16. The printer according to claim 11, wherein the head body comprises:

a base plate having a plurality of piezoelectric bodies disposed thereon and a frame surrounding the piezoelectric bodies.

17. The printer according to claim 16, wherein the head body further comprises:

an orifice plate, disposed on the frame, having the plurality of ejection ports.

18. The printer according to claim 16, wherein the base plate includes a column of ink supply holes and a plurality of columns of ink discharge holes.

19. The printer according to claim 16, wherein the piezoelectric bodies include a plurality of grooves, and a conductive film is disposed in each of the plurality of grooves.

20. The printer according to claim 19, wherein the plurality of flexible substrates is wired to electrodes formed by the conductive film in the head body.

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