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**(54) Inkjet head and method for producing inkjet head**

Tintenstrahlkopf und Verfahren zur Herstellung des Tintenstrahlkopfs

Tête à jet d'encre et procédé de production de tête à jet d'encre

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**Description**

## TECHNICAL FIELD

5 **[0001]** The present invention relates to an inkjet head and a method for producing inkjet head and particularly relates to the inkjet head that is facilitated in alignment of a lead-out electrode formed on a rear face of a head chip with an FPC (flexible printed circuit) and is high in reliability of electric connection between the lead-out electrode and the FPC and the method for producing the inkjet head.

## 10 BACKGROUND

**[0002]** As a shear mode type inkjet head, the inkjet head of the type having a hexahedral head chip including a straight-shaped channel ranging from a front face to a rear face of the head chip is known. Such an inkjet head is of the type that a partition wall between adjacent channels configures a driving wall including a piezoelectric element, the driving wall is subjected to shearing deformation by applying a predetermined voltage to driving electrodes formed on the both faces of the driving wall to afford a pressure for ejection to ink in each channel.

**[0003]** Since in such an inkjet head, the driving electrode faces inside the channel, a proposal that the lead-out electrode that has been electrically connected with the driving electrode is formed on the rear face of the head chip so as to electrically connect the head chip with a drive circuit by the FPC (the flexible printed circuit) by utilizing the lead-out electrode is made. However, there exists such a disadvantage that as the number of channel rows is increased, it becomes more difficult to electrically lead out each lead-out electrode in a channel row particularly located on an inner side to the outside of the head chip by the FPC.

**[0004]** Therefore, Japanese Patent Application Laid-Open No. 2011-183574 proposes a technology of affixing the FPC to a surface of a platy lead-out member and adhering the lead-out member with the FPC affixed to the rear face of the head chip such that the lead-out electrode formed on the rear face of the head chip is electrically connected directly with the FPC so as to lead out the FPC in a rearward direction of the head chip by the lead-out member.

**[0005]** In addition, PCT International Publication No. WO2011/074412 proposes a technology of forming a groove in the rear face of the head chip along a channel row, arranging an end of the lead-out electrode on a side face in the groove and electrically connecting the FPC directly with the lead-out electrode in the groove by inserting one end of the FPC into the groove so as to lead out the other end of the FPC in the rearward direction of the head chip. The back-face side of the FPC in the groove is filled with a foaming resin material and pressing force working in a direction that the FPC comes into electric connection with the lead-out electrode is applied to the FPC by foaming the foaming resin material, thereby attaining certainty of electric connection.

**[0006]** According to the above-mentioned technologies, it is possible to electrically connect the FPC also directly with the lead-out electrode in the channel row located on the inner side even when the number of channel rows of the head chip is increased. In addition, since the FPC is led out in the rearward direction of the head chip, lateral protrusion is suppressed and this fact is advantageous also in promoting miniaturization of the inkjet head.

## PRIOR ART DOCUMENTS

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## PATENT DOCUMENTS

**[0007]**

45 PATENT DOCUMENT 1: JP-A-2011-183574  
PATENT DOCUMENT 2: WO2011/074412

**[0008]** US 2007/030316 A1 deals with an inkjet head having a head chip, including driving walls composed of a piezoelectric element and channels arranged alongside alternatively, an outlet port and an inlet port provided on front and rear surfaces respectively for each channel, and a driving electrode to apply a drive voltage to a driving wall formed inside the channel, wherein the head chip jets ink in a channel from a nozzle by causing shear deformation to the driving wall by applying voltage to the electrode.

## SUMMARY OF THE INVENTION

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**[0009]** However, when electrically connecting the FPC to the lead-out electrode on the rear face of the head chip, it is necessary to use the lead-out member as a separate component and to form the groove in the rear face of the head chip. Therefore, the cost is increased with an increase in number of components and an increase in number of working

processes caused by grooving. In addition, since it is difficult to perform alignment while directly observing a connection part between the lead-out electrode and the FPC (a wiring provided on the FPC) in the both technologies, the disadvantage, still remains to be solved in order to improve reliability of electric connection between the lead-out electrode and the FPC.

5 [0010] In addition, each of the above-mentioned technologies has a configuration that the lead-out member and the foaming resin material are present in the rear of the electric connection part where the lead-out electrode is electrically connected with the wiring on the FPC. Since the FPC is firmly fixed to the lead-out member and the foaming resin material, a load is liable to impose on a firmly fixed face due to a difference in thermal expansion coefficient between the both and it may sometimes lead to delamination of the FPC.

10 [0011] Therefore, one subject of the present invention is to provide an inkjet head that is facilitated in alignment of the lead-out electrode with the FPC, is high in reliability of electric connection between the lead-out electrode and the FPC and is free from load exertion on the FPC while making use of advantages of the inkjet head adapted to electrically connect the FPC with the lead-out electrode formed on the rear face of the head chip.

15 [0012] In addition, another subject of the present invention is to provide a method for producing the inkjet head that is facilitated in alignment of the lead-out electrode with the FPC, is high in reliability of electric connection between the lead-out electrode and the FPC and is free from load exertion on the FPC while making use of advantages of the inkjet head adapted to electrically connect the FPC with the lead-out electrode formed on the rear face of the head chip.

[0013] Other subjects of the present invention will be apparent from the following description.

20 [0014] Accordingly, there is provided an inkjet head as set out in independent claim 1 and a method for producing an inkjet head as set out in independent claim 13. Advantageous developments are defined in the dependent claims.

#### EFFECT OF THE INVENTION

25 [0015] According to an embodiment of the present invention, it is possible to provide the inkjet head that is facilitated in alignment of the lead-out electrode with the FPC, is high in reliability of electric connection between the lead-out electrode and the FPC and is free from load exertion on the FPC while making use of advantages of the inkjet head adapted to electrically connect the FPC with the lead-out electrode formed on the rear face of the head chip.

30 [0016] In addition, according to an embodiment of the present invention, it is possible to provide the method for producing the inkjet head that is facilitated in alignment of the lead-out electrode with the FPC, is high in reliability of electric connection between the lead-out electrode and the FPC and is free from load exertion on the FPC while making use of advantages of the inkjet head adapted to electrically connect the FPC with the lead-out electrode formed on the rear face of the head chip.

#### BRIEF DESCRIPTION OF DRAWINGS

35 [0017]

- FIG. 1 is a perspective view illustrating one example of an inkjet head according to an embodiment of the present invention, when viewed from the back-face side of the inkjet head;
- 40 FIG. 2 is an end face diagram illustrating one example of a section along the (ii)-(ii) line in FIG. 1;
- FIG. 3 is a partial back face diagram illustrating one example of a head chip;
- FIG. 4 is a plan view illustrating one example of an FPC in a developed state;
- FIG. 5 is a partial sectional diagram illustrating one example of the FPC;
- 45 FIG. 6 is an end face diagram illustrating one example of a section of an inkjet head including four channel rows according to an embodiment of the present invention;
- FIG. 7 is an end face diagram illustrating one example of a section of an inkjet head including one channel row according to an embodiment of the present invention;
- FIG. 8 is an end face diagram illustrating one example of a section of an inkjet head including three channel rows according to an embodiment of the present invention;
- 50 FIG. 9 is an end face diagram illustrating one example of a section of an inkjet head using an FPC having another configuration according to an embodiment of the present invention;
- FIG. 10 is an end face diagram illustrating one example of a section of an inkjet head including four channel rows according to an embodiment of the present invention;
- 55 FIG. 11 is a partial back face diagram illustrating one example of a head chip of the inkjet head illustrated in FIG. 10;
- FIG. 12A is a diagram illustrating one example of a method for producing inkjet head;
- FIG. 12B is a diagram illustrating one example of the method for producing inkjet head;
- FIG. 13 is a diagram illustrating one example of the method for producing inkjet head;
- FIG. 14 is a diagram illustrating one example of the method for producing inkjet head;

FIG. 15 is a diagram illustrating one example of the method for producing inkjet head;  
 FIG. 16 is a diagram illustrating one example of the method for producing inkjet head;  
 FIG. 17 is a diagram illustrating one example of the method for producing inkjet head; and  
 FIG. 18 is a diagram illustrating one example of the method for producing inkjet head.

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## DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0018]** In the following, preferred embodiments of the present invention will be described in detail using the accompanying drawings.

10 **[0019]** FIG. 1 illustrates one example of an inkjet head according to an embodiment of the present invention, that is, a perspective view of the inkjet head when viewed from the back-face side. FIG. 2 is an end face diagram illustrating one example of a section along the (ii)-(ii) line in FIG. 1. FIG. 3 is a partial back face diagram illustrating one example of a head chip. FIG. 4 is a plan view illustrating one example of an FPC in a developed state. FIG. 5 is a partial sectional diagram illustrating one example of the FPC.

15 **[0020]** In the drawings, H1 is an inkjet head, 1 is a head chip, 2 is a nozzle plate to be bonded to a front face 1a of the head chip 1, 3 is an FPC (flexible printed circuit) to be bonded to a rear face 1b of the head chip, and 4 is a common flow path member that supplies ink to the head chip 1.

20 **[0021]** The head chip 1 is configured by a hexahedron that includes two channel rows of rows A and B. Here, the upper channel row is defined as the row A and the lower channel row is defined as the row B in FIG. 2 and FIG. 3. In each channel row, channels 11 and driving walls 12 each partitioning the adjacent two channels 11 and 11 are alternately arranged side by side. The driving wall 12 entirely or partially includes a piezoelectric element.

25 **[0022]** Each channel 11 opens on the front face 1a and the rear face 1b of the head chip 1 in a rectangular shape and is formed straight ranging from the front face 1a to the rear face 1b. As illustrated in FIG. 3, driving electrodes 13 are respectively formed on at least the surfaces of the driving walls 12 in wall faces facing inside the respective channels 11. Although the driving electrode 13 may be formed on at least the surface of the driving wall 12, in the present embodiment, the driving electrodes 13 are formed respectively over the both driving walls 12 and 12 that face inside the channel and each wall face 11a that connects together the driving walls 12 and 12.

30 **[0023]** In the head chip 1, the driving wall 12 that is sandwiched between one pair of driving electrodes 13 and 13 is shear-deformed by applying a drive signal of a predetermined voltage from a not illustrated drive circuit to each driving electrode 13. Thereby, the volume in the channel 11 is changed and hence a pressure change for ejection is afforded to ink supplied into the channel 11, and ink droplets are ejected through nozzles 21 in the nozzle plate 2 that has been bonded to the front face 1a of the head chip 1.

35 **[0024]** Incidentally, in the description of the embodiments of the present invention, in the head chip 1, a face on the side that the nozzles 21 are arranged and the ink is ejected is defined as a "front face" and a face on the opposite side is defined as a "rear face". In addition, a direction going away from the rear face 1b of the head chip 1 is defined as a "rearward direction" and a direction that is parallel with the front face 1a or the rear face 1b of the head chip 1 and goes away from the head chip 1 is defined as a "lateral direction" of the head chip 1.

40 **[0025]** In addition, in the present embodiment, an example of the head chip 1 that all the channels 11 in each channel row are ejection channels that eject the ink droplets through the nozzles 21 is illustrated. However, in the embodiment of the present invention, the head chip may be of the type that each channel row is configured by alternately arranging the ejection channels that eject the ink droplets and dummy channels that do not eject the ink droplets side by side. In the case of the latter head chip, the nozzles 21 are not formed in the nozzle plate 2 at positions corresponding to the dummy channels.

45 **[0026]** In addition, a lead-out electrode 14 is formed on the rear face 1b of the head chip 1 for every channel 11. In FIG. 2 and FIG. 3, 14A denotes the lead-out electrode in the channel row A and 14B denotes the lead-out electrode in the channel row B. One end of each of the lead-out electrodes 14A, 14B is electrically connected with the corresponding driving electrode 13 on a wall face 11a in each channel 11 and the other ends thereof respectively extend toward the center of the rear face 1b of the head chip 1 and stay leaving a space between them and without coming into contact with each other.

50 **[0027]** The FPC 3 is bonded into a region where the lead-out electrodes 14A, 14B are formed on the rear face 1b of the head chip 1. On the FPC 3, wirings 32 respectively corresponding to the lead-out electrodes 14A, 14B are arrayed on one base film 31 formed with a flexible resin film such as polyimide and so forth as illustrated in FIG. 4. In FIG. 2 and FIG. 4, 32A denotes a wiring corresponding to the lead-out electrode 14A and 32B denotes a wiring corresponding to the lead-out electrode 14B.

55 **[0028]** The respective wirings 32A are arranged side by side with a pitch corresponding to that of the lead-out electrodes 14A in the channel row A and the respective wirings 32B are arranged side by side with a pitch corresponding to that of the lead-out electrodes 14B in the channel row B. One ends of the wirings 32A, 32B are arranged leaving a space between them and without coming into contact with each other with a middle part of the FPC 3 interposed and the other

ends thereof are allocated so as to extend toward the opposite ends of the FPC 3. Therefore, there is no possibility that the wirings 32A, 32B corresponding to the respective channel rows may be mutually short-circuited even when the space between the adjacent channels 11 in each channel row is narrowed. In addition, since it is possible to perform work of taking out the driving electrode 13 of each channel 11 in each of the two channel rows to the outside simply by bonding

5 one FPC 3 to the rear face 1b of the head chip 1, it is possible to promote simplification of assembling work.  
[0029] The FPC 3 includes cover lays 33 each formed with a flexible resin film such as polyimide and so forth and disposed so as to sandwich each of the wirings 32A, 32B between each of the cover lays and the base film 31. The cover lay 33 is laminated over a region other than a connection region 34 that functions as an electric connection part between each of the wirings 32A, 32B and each of the lead-out electrodes 14A, 14B and a connection region (not  
10 illustrated) that functions as an electric connection part with a drive circuit. Therefore, one-end terminal parts 32Aa, 32Ba of the respective wirings 32A, 32B are arrayed in the above-mentioned connection region 34 so as to face each other without coming into contact with each other.

[0030] It is preferable that each of the lead-out electrodes 14A, 14B be electrically connected directly with each of the terminal parts 32Aa, 32Ba of the wirings 32A, 32B on the FPC 3 on the rear face 1b of the head chip 1. "Directly" means  
15 that another electric relay member is not interposed between each of the lead-out electrodes 14A, 14B and each of the terminal parts 32Aa, 34Ba of the wirings 32A, 32B on the FPC 3 with the exception of a measure (also a conductive particle is included when an adhesive that contains the conductive particle is used) adapted to mutually adhere the both. Owing to such electric connection of the FPC 3 directly with each of the lead-out electrodes 14A, 14B, the structure is simplified, the number of components is not increased and thus cost reduction becomes possible.

[0031] In addition, an ACP (an anisotropic conductive paste) or an ACF (an anisotropic conductive film) is interposed  
20 between the FPC 3 and the rear face 1b of the head chip 1 as a measure adapted to adhere together the both. It is possible to further improve the reliability of electric connection between the FPC 3 and the head chip 1 by using the ACP and the ACF. In the present embodiment, an example that the ACP (designated by 5) has been used is illustrated.

[0032] The both ends of the FPC 3 are bent in a vertical direction relative to the rear face 1b of the head chip 1 from  
25 the vicinity of the electric connection part between the FPC 3 and each of the lead-out electrodes 14A, 14B and respectively extend in the rear direction of the head chip 1 from between the two channel rows. Thereby, the FPC 3 includes a space S that nothing is present in the rear of the electric connection part (the connection region 34) between the FPC 3 and each of the lead-out electrodes 14A, 14B.

[0033] In addition, the FPC 3 neither closes the inlet of any channel 11 on the rear face 1b of the head chip 1 nor  
30 comes near the rear side of the inlet by extending from between the two channel rows in the rearward direction of the head chip 1. Therefore, labor taken for forming an opening for supplying ink into the channel 11 in the FPC 3 is not necessary. In addition, since protrusion of the FPC 3 in the lateral direction of the head chip 1 is suppressed, it becomes possible to make the inkjet head H1 compact.

[0034] Bent parts 30A, 30B of the FPC 3 are disposed in the vicinity of the electric connection part between the FPC  
35 3 and each of the lead-out electrodes 14A, 14B and in the connection region 34 where the cover lay 33 is not present. The bent parts 30A, 30B are rounded (so as to have R-shaped parts) and the FPC 3 is gently bent by this rounding. Therefore, it is possible to reduce loads imposed on the wirings 32A, 32B when bending the FPC 3 on a part that is not covered with the cover lay 33. Formation of the R-shaped parts is preferable in order to further improve the reliability of electric connection.

[0035] A fillet 5a formed with the adhesive (the ACP 5) is formed over the outer sides of the bent parts 30A, 30B and  
40 the rear face 1b of the head chip 1 by applying a sufficient amount of the ACP 5 between the FPC 3 and the head chip 1. Thereby, since the outer sides of the bent parts 30A, 30B of the FPC 3 are fixed by the fillet 5a, it is possible to increase the adhesion strength of the FPC 3. In addition, since a bent state of each of the bent parts 30A, 30B is maintained, formation of the fillet 5a is preferable from the viewpoint of further improving the reliability of electric connection. In such  
45 situations that the application amount of the ACP 5 is little and the ACF is used in place of the ACP and in other situations, the fillet 5a may be formed by further applying the adhesive such as the ACP, an epoxy-based adhesive and so forth onto the outer sides of the bent parts 30A, 30B by a dispenser and so forth after the FPC 3 has been bonded to the rear face 1b of the head chip 1.

[0036] Copper foil is mainly used for the wirings 32A, 32B of the FPC 3. In addition, as illustrated in FIG. 5, gold plating  
50 322 is directly deposited onto a surface of copper foil 321 on each of the terminal parts 32Aa, 32Ba to be electrically connected with each of the lead-out electrodes 14A, 14B. It becomes possible to further improve the reliability of electric connection by depositing the gold plating 322 onto the surface.

[0037] Incidentally, in general, when such gold plating treatment is to be performed on the surface of the copper foil,  
55 after backing treatment with Ni has been performed on the surface of the copper foil, the gold plating is deposited onto the surface of the Ni layer. However, since the wiring is hardened by performing backing treatment with Ni, such a disadvantage that it becomes difficult to bend the FPC and other disadvantages occur. Direct deposition of the gold plating 322 onto the surface of the copper foil without performing the backing treatment with Ni is preferable in order to further improve the reliability of electric connection between the FPC 3 and each of the lead-out electrodes 14A, 14B

by facilitating bending of the FPC 3.

**[0038]** It is preferable that the copper foil used for the wirings 32A, 32B of the FPC 3 be a rolled copper foil. Since the rolled copper foil is excellent in flexibility and is easily bent, it becomes possible to more readily perform bending on the FPC 3.

**[0039]** The common flow path member 4 is bonded, with the adhesive, to the rear face 1b of the head chip 1 apart from the electric connection part between each of the wirings 32A, 32B of the FPC 3 and each of the lead-out electrodes 14A, 14B. The common flow path member 4 is formed so as to surround the FPC 3 that extends from the rear face 1b of the head chip 1 in the rearward direction and an insertion hole 42 into which the FPC 3 is to be inserted is formed in a central part of the common flow path member 4. Parts located in the rear beyond the bent parts 30A, 30B of the FPC 3 are not fixed to the common flow path member 4.

**[0040]** The FPC 3 extends in the rearward direction of the head chip 1 through the insertion hole 42 in the common flow path member 4. Owing to this, since expansion of the FPC 3 is blocked with the insertion hole 42 even when force acting in a direction of expanding the FPC 3 outward is exerted onto the FPC 3, there is no possibility that the force may affect a connected state of the electric connection part between the FPC 3 and each of the lead-out electrodes 14A, 14B. Formation of the insertion hole 42 is preferable in order to further improve the reliability of electric connection between the FPC 3 and each of the lead-out electrodes 14A, 14B.

**[0041]** An ink flow 41 that communicates with all the channels 11 in the two channel rows of the head chip 1 to enable common supply of the ink to the respective channels 11 is formed in the common flow path member 4. That is, the ink flow path 41 is annularly formed so as to thoroughly surround the FPC 3. In FIG. 1, 41a is an ink inlet and 41b is an ink outlet.

**[0042]** Since the common flow path member 4 is arranged on the outside beyond the FPC 3 that has been bent in the rearward direction of the head chip 1, the FPC 3 is completely isolated from the ink flow path 41 of the common flow path member 4. Thus, there is no possibility of occurrence of troubles (disconnection, corrosion, short-circuit and so forth) caused by direct contact of each of the wirings 32A, 32B on the FPC 3 with the ink and the common flow path member 4 does not obstruct the space S formed in the rear of the electric connection part of the FPC 3 with each lead-out electrode.

**[0043]** The size of the outermost periphery of a surface of the common flow path member 4 to be bonded to the rear face 1b of the head chip 1 is made the same as the size of the outer periphery of the rear face 1b and the common flow path member 4 does not protrude in the lateral direction of the head chip 1. Therefore, it becomes possible to make the inkjet head H1 more compact in conjunction with the fact that the FPC 3 does not protrude in the lateral direction.

**[0044]** Since in the inkjet head H1, each of the wirings 32A, 32B on the FPC 3 is electrically connected directly with each of the lead-out electrodes 14A, 14B formed on the rear face 1b of the head chip 1, the reliability of electric connection is high. Since the FPC 3 includes the space S in the rear of the electric connection part and a member that is separately provided so as to fill the rear of the electric connection part of the FPC 3 such as the existing lead-out member, the foaming resin material and so forth is not present, it is possible to promote cost reduction as much. Moreover, since it does not happen that the load is exerted on the FPC 3 caused by the difference in thermal expansion coefficient between the FPC 3 and the existing lead-out member, the foaming resin material and so forth, it is possible to further improve the reliability of electric connection. The space S formed in the rear of the electric connection part of the FPC 3 is effective also from the viewpoint of improving heat radiation of the head chip 1.

**[0045]** It does not happen that an excessive load which would induce delamination and so forth is imposed on the FPC 3 caused by a difference in thermal expansion coefficient also between the FPC 3 and the common flow path member 4 by not bringing the FPC 3 into firm fixation to the common flow path member 4 as in the present embodiment.

**[0046]** Further, since the separate lead-out member and the foaming resin material are not provided in the rear of the FPC 3 as ever provided, though described later in detail, it is possible to readily perform alignment while observing the FPC 3 from behind the electric connection part of the FPC 3 when aligning each of the wirings 32A, 32B of the FPC 3 with each of the lead-out electrodes 14A, 14B. Therefore, it is possible to further improve the reliability of electric connection in conjunction with the fact that each of the wirings 32A and 32B of the FPC 3 is electrically connected directly with each of the real-out electrodes 14A, 14B.

**[0047]** In addition, according to an embodiment of the present invention, since the common flow path member 4 does not protrude in the lateral direction, it is possible to further increase the number of channel rows readily by laminating the inkjet heads H1 in plural as illustrated in FIG. 6. In this case, it is possible to readily apply the drive signal from the drive circuit also to the lead-out electrodes 14A, 14B in the channel row that is arranged on the inner side by the FPC 3 that extends in the rearward direction of the head chip 1.

**[0048]** Although in the example in FIG. 6, the two inkjet heads H1 are laminated to form an inkjet head H2 that includes four channel rows, it is possible to readily increase the number of channel rows to six rows, eight rows and so forth by further increasing the number of the inkjet heads H1 to be laminated. When the plurality of inkjet heads H1 are laminated to form the inkjet head H2 in this way, it may be configured so as to provide one nozzle plate 2 for the ink jet head H2.

**[0049]** In addition, according to an embodiment of the present invention, it is also possible to configure an inkjet head H3 that includes only one channel row. In this case, as an FPC 3', the FPC having a halved structure formed by cutting

the FPC 3 illustrated in FIG. 4 along the center of the connection region 34 may be used.

**[0050]** Also the FPC 3' in the above-mentioned case is bent from the vicinity of the electric connection part with the lead-out electrode 14, extends toward the rear of the head chip 1 and includes the space S in the rear of the electric connection part. In addition, the common flow path member 4 is bonded so as to cover the inlets of all the channels 11 to a position apart from the electric connection part of the FPC 3' without firmly fixing parts located in the rear beyond the bent part 30 of the FPC 3' and the inkjet head H3 has the same advantageous effects as the inkjet head H1.

**[0051]** Incidentally, in parts to which numerals are assigned on the FPC 3' in FIG. 7, the parts having the same numerals as those assigned to the parts on the FPC 3 in FIG. 2 indicate the same constitutional parts as those on the FPC 3. In addition, in FIG. 7, 32a is a terminal part of the wiring 32.

**[0052]** According to an embodiment of the present invention, it is possible to readily configure an inkjet head H4 including the odd-number (three rows, five rows and so forth) of channel rows by laminating the inkjet head H1 including the even number (two rows, four rows and so forth) of channel rows on the inkjet head H3 including one channel row as illustrated in FIG. 8. The inkjet head H4 so configured may be also configured to be provided with one nozzle plate 2.

**[0053]** Incidentally, when the plurality of inkjet heads are to be laminated as illustrated in FIG. 6 and FIG. 8, one common flow path member may be provided for all the channel rows obtained after the plurality of head chips 1 have been laminated so as to be used in common among the above-mentioned channel rows, not limited to provision of one common flow path member 4 for each of the head chips 1 so laminated.

**[0054]** In addition, when the inkjet head includes two or more channel rows, it is also possible to provide a separate common flow path member for every one channel row regardless of the number of the head chips 1. When the plurality of common flow path members are provided for one inkjet head as mentioned above, it is also possible to eject inks of different colors by one inkjet head, for example, by supplying the inks of different colors for every common flow path member.

**[0055]** FIG. 9 illustrates one example of an inkjet head H5 according to an embodiment of the present invention that an FPC 6 having another configuration is used in place of the FPC 3 of the inkjet head H1. Since the parts with the same numerals as those in FIG. 2 are the same constitutional parts as those in FIG. 2, here, description thereof is omitted by adopting the description on the configuration in FIG. 2.

**[0056]** The FPC 6 is the same as the FPC 3 in the point that a cover lay 63 formed with the flexible resin film made of polyimide and so forth is laminated so as to sandwich wirings 62A, 62B respectively corresponding to the lead-out electrodes 14A, 14B on the rear face 1b of the head chip 1 between it and a base film 61 formed with the flexible resin film made of polyimide and so forth. However, the FPC 6 is different from the FPC 3 in the point that the cover lay 63 is also formed on the connection region with each of the lead-out electrodes 14A, 14B and is arranged so as to face the space S side.

**[0057]** Through-holes 61a, 61a are respectively formed through the base film 61 of the FPC 6 on parts respectively corresponding to the lead-out electrodes 14A, 14B. One-end sides of the wirings 62A, 62B are led out from one face (the face on which the cover lay 63 is to be laminated) to the other face (the face opposite to the lead-out electrodes 14A, 14B) to respectively form terminal parts 62Aa, 62Ba along the surface of the base film 61.

**[0058]** On the FPC 6, each of the terminal parts 62Aa, 62Ba that are arranged on the other face of the base film 61 is electrically connected with each of the corresponding lead-out electrodes 14A, 14B, and is bent in the vicinity of the electric connection part thereof and extends in the rearward direction of the head chip 1. Accordingly, also the FPC does not come near the inlet of any channel 11 and thus does not close the inlet.

**[0059]** In addition, also bent parts 60A, 60B of the FPC 6 may be rounded (may have R-shaped parts) as in the case of the FPC 3 in FIG. 2. However, since the electric connection part including the terminal parts 62Aa, 62Ba and the vicinity thereof are covered with the cover lay 63, such an advantageous effect is obtained that the load caused by bending is hardly imposed on the wirings 62A, 62B by the bent parts 60A, 60B of the FPC 6 with no necessity of provision of the R-shaped parts.

**[0060]** Incidentally, in order to obtain the advantageous effect that the load caused by bending is hardly imposed on the wirings 62A, 62B, the cover lay 63 may not necessarily be formed over the entire surface of the FPC 6 and the cover lay 63 may be formed so as to cover at least the electric connection part including the terminal parts 62Aa, 62Ba and the bent parts 60A, 60B located in the vicinity thereof.

**[0061]** It goes without saying that it is possible to apply the FPC 6 used in the inkjet head H5 also to the inkjet head H3 similarly by forming the FPC 6 into a half-sized configuration that includes only one of the wirings 62A, 62B to be used in place of the FPC 3' including one channel row illustrated in FIG. 7.

**[0062]** According to an embodiment of the present invention, it is also possible to establish electric connection with each of the lead-out electrodes in the three or more channel rows that the inkjet head includes by one FPC 3. FIG. 10 illustrates one example of an inkjet head H6 that the head chip 1 includes four channel rows A to D. FIG. 11 is a partial back-face diagram illustrating one example of the head chip 1 of the inkjet head H6. Since the parts with the same numerals as those in FIG. 2 and FIG. 3 are the same constitutional parts as those in FIG. 2 and FIG. 3, here, description thereof is omitted by adopting the description on the configurations in FIG. 2 and FIG. 3.

[0063] Ends of the lead-out electrode 14B, 14C from the channels 11 in the inner rows B, C extend toward the center of the rear face 1b and stay by leaving a space between them without coming into contact with each other on the rear face 1b of the head chip 1 of the inkjet head H6 as illustrated in FIG. 11. In addition, the lead-out electrode 14A from each channel 11 in the row A is arranged side by side with an end of the lead-out electrode 14B in the row B passing through between the channels 11 in the row B and a lead-out electrode 14D from each channel 11 in the row D is arranged side by side with an end of a lead-out electrode 14C in the row C passing through between the channels 11 in the row C. Therefore, the ends of all the lead-out electrodes 14A to 14D in the four channel rows are arrayed on a central part of the rear face 1b of the head chip 1.

[0064] At that time, wirings corresponding to the lead-out electrodes 14A to 14D may be formed on the FPC 3. Then, it is possible to electrically connect each of all the lead-out electrodes 14A to 14D in the four channel rows with each of the corresponding wirings by one FPC 3 by bonding the FPC 3 to the central part of the rear face 1b of the head chip 1 as illustrated in FIG. 10.

[0065] Incidentally, it goes without saying that the FPC 6 illustrated in FIG. 9 may be used as the FPC for the inkjet head H6.

[0066] Next, a method for producing the inkjet head according to an embodiment of the present invention will be described, by giving the inkjet head H1 that includes the two channel rows by way of example using FIG. 12 to FIG. 18. Incidentally, although the FPC 3 illustrated in FIG. 4 has been used in the inkjet head H1, this method is also applicable when the FPC 6 illustrated in FIG. 9 is to be used.

[0067] First, the channel 11 and the driving wall 12 are formed to be arranged side by side by grinding a plurality of grooves in parallel from an upper surface of a substrate 101 including a piezoelectric element and the driving electrode 13 is formed on the entire of an inner surface of each channel 11. Then, one cover substrate 102 is laminated on the substrate 101 so as to close an upper part of each channel 11, thereby forming one large-sized channel substrate 100 (FIG. 12A).

[0068] Next, two channel substrates 100 that have been formed in a similar manner are prepared and bonded together such that the cover substrate 102 is located on the outer side, thereby producing a large-sized channel substrate 200 including two channel rows (FIG. 12B).

[0069] Then, the head chips 1, 1 and so forth each including the two channel rows are produced by cutting (fully cutting) the large-sized channel substrate 200 along a plurality of cut lines c, c and so forth along a direction orthogonal to a length-wise direction of the channels 11 (FIG. 13). It is possible to adjust a driving length of the channel 11 of each head chip 1 depending on a space between the adjacent ones of the cut lines c, c and so forth.

[0070] Next, the lead-out electrodes 14A, 14B that are provided for every channel 11 and one end of each of which is electrically connected to the driving electrode 13 in each channel 11 as illustrated in FIG. 3 are pattern-formed on the rear face 1b of the head chip 1 that includes the two channel rows (a first step).

[0071] For formation of the lead-out electrodes 14A, 14B, it is possible to adopt a well-known patterning technology of performing exposure/developing treatment using a dry film, formation of a metal film by a vapor deposition method and removal of the dry film after formation of the metal film.

[0072] It is preferable to perform vapor deposition on the rear face 1b of the head chip 1 two times by changing the direction. Specifically, it is preferable to perform vapor deposition from a direction vertical to the rear face 1b, that is, vertically from a direction of 30 degrees each time along a direction that the channel rays are arranged side by side. Thereby, it becomes possible to assure electric connection of each of the lead-out electrode 14A, 14B with the driving electrode 13 in each channel 11.

[0073] In addition, formation of the lead-out electrodes 14A, 14B may be performed by a sputtering method in place of the vapor deposition. The sputtering method is preferable because since the metal particles fly in a random direction, it is possible to form the metal film deep into the channel 22 without changing the direction in particular.

[0074] In addition, it is also possible to form the lead-out electrodes 14A, 14B by an electroless plating method.

[0075] Next, the ACP 5 is applied onto the rear face 1b of the head chip 1 so as to cover the lead-out electrodes 14A, 14B and the connection region 34 of the FPC 3 is superposed on the rear face 1a (FIG. 14).

[0076] On the FPC 3, the wirings 32A, 32B are formed in advance on the base film 31 as illustrated in FIG. 4 and the cover lay 33 is laminated so as to sandwich each of the wirings 32A, 32B between the cover lay 33 and the base film 31. The cover lay 33 is not formed on the connection region 34 and the terminal parts 32Aa, 32Ba of the wirings 32A, 32B are exposed onto the connection region 34. The FPC 3 is arranged and superposed on the rear face 1b of the head chip 1 such that the terminal parts 32Aa, 32Ba face the rear face 1b of the head chip 1.

[0077] After the FPC 3 has been superposed on the rear face 1b of the head chip 1, alignment of each of the lead-out electrodes 14A, 14B with each of the wirings 32A, 32B provided on the FPC 3 is performed by observing the FPC 3 from behind the head chip 1 (a second step, FIG. 15).

[0078] In FIG. 15, 300 is a camera used to observe the FPC 3 from behind the head chip 1 upon alignment. According to an embodiment of the present invention, since the lead-out member and the foaming resin material that have been ever used for bonding the FPC 3 to the rear face 1b of the head chip 1 are not used and it is not configured to form the

groove and to insert the FPC into the groove, it is possible to assure a wide space that nothing is present in the rear of the FPC 3 upon alignment and hence it is possible to readily observe the FPC 3 from behind the head chip 1 by using the camera 300 in this way.

**[0079]** The camera 300 is capable of capturing an image of the wirings 32A, 32B in the connection region 34 and the lead-out electrodes 14A, 14B through the base film 31 of the FPC 3 and projects the image so captured onto a not illustrated monitor screen. It is possible for an operator to readily and surely perform alignment of each wiring of the FPC 3 with each lead-out electrode by observing the monitor screen. Thereby, it becomes possible to improve the reliability of electric connection between each of the wirings 32A, 32B of the FPC 3 and each of the lead-out electrodes 14A, 14B.

**[0080]** At the completion of alignment of each wiring of the FPC 3 with each lead-out electrode, each of the wirings 32A, 32B of the FPC 3 and each of the lead-out electrodes 14A, 14B are crimped together (a third step, FIG. 16).

**[0081]** In FIG. 16, 400 is a crimp jig that is preferably used upon crimping. The crimp jig 400 is formed with a platy member whose thickness is thinner than a space between the channel rows of the head chip 1. A leading end of the crimp jig 400 adapted to perform crimping in abutment against the FPC 3 is configured as a flatly formed leading end face 401 and side faces 402, 402 disposed adjacent to the leading end face 401 are configured by faces that are vertical to the rear face 1b of the head chip 1 so as to extend toward the rear of the head chip 1. The crimp jig 400 crimps each of the terminal parts 32Aa, 32Ba of the wirings 32A, 32B onto each of the lead-out electrodes 14A, 14B by pressing the leading end face 401 against the FPC 3 from the back-face side of the connection region 34 of the FPC 3 at a predetermined pressure.

**[0082]** After the FPC 3 has been crimped onto the rear face 1b of the head chip 1 by the crimp jig 400, the both ends of the FPC 3 are bent from the part that is not covered with the cover lay 33 in the vicinity of the electric connection part with each of the lead-out electrodes 14A, 14B so as to extend in the rearward direction of the head chip 1 along the side faces 402, 402 of the crimp jig 400 while maintaining a crimped state (a fourth step).

**[0083]** Both corner parts 401a, 401a of the leading end face 401 of the crimp jig 400 are rounded (so as to have R-shaped parts) by being subjected to rounding processing. Thereby, when bending the FPC 3 along the side faces 402, 402 of the crimp jig 400, it is possible to readily form the R-shaped parts without making the bent parts 30A, 30B (see FIG. 2) of the FPC 3 sharp-angled.

**[0084]** If the ACP 5 between the rear face 1b of the head chip 1 and the FPC 3 is applied in a sufficient amount, it will be possible for the ACP 5 to form the fillets 5a, 5a on the electric connection part by going around and cutting into also the outer sides of the bent parts 30A, 30B of the FPC 3 as illustrated in FIG. 2 upon crimping and bonding using the crimp jig 400. However, when formation of the fillets 5a, 5a is insufficient for reasons of the little amount of the applied ACP 5 and so forth, it is preferable to form the fillets 5a by applying an additional adhesive such as the ACP, an epoxy adhesive and so forth to the outer sides of the bent parts 30A, 30B by using a dispenser 500 and so forth after the FPC 3 has been bent or after the crimp jig has been removed as described later as illustrated in FIG. 17.

**[0085]** After bending of the FPC 3 has been completed and the ACP 5 (the adhesive) has hardened (after bonding has been completed), the crimp jig 400 is removed. Thereby, the space S that nothing is present is formed in the rear of the electric connection part between the FPC 3 and each of the lead-out electrodes 14A, 14B. Therefore, it does not happen that the load is imposed on the FPC 3 caused by the difference in thermal expansion coefficient between the FPC 3 and the lead-out electrode as in the case of using the existing lead-out member and the foaming resin material.

**[0086]** Next, the common flow path member 4 that has been formed in advance into a shape with the insertion hole 42 is bonded to the rear face 1b of the head chip 1 apart from the electric connection part between the FPC 3 and each of the lead-out electrodes 14A, 14B (a fifth step, FIG. 18).

**[0087]** That is, the both ends of the FPC 3 that has been bonded such that the both ends extend in the rearward direction of the head chip 1 are inserted into the insertion hole 42 in the common flow path member 4 and the common flow path member 4 is bonded to the rear face 1b of the head chip 1 with the epoxy-based adhesive and so forth such that the inlets of all the channels 11 in each channel row are covered with the ink flow path 41. The FPC 3 is simply inserted into the insertion hole 42 in the common flow path member 4 and is not firmly fixed to an inner surface of the insertion hole 42, and the space S in the rear of the FPC 3 is not closed.

**[0088]** Although, here, the nozzle plate 2 is configured to be bonded to the front face 1a of the head chip 1 as illustrated in FIG. 18, the nozzle plate 2 may be bonded to the front face 1a after the head chip 1 has been cut apart from the channel substrate 200 and before the FPC 3 is superposed on the head chip 1.

**[0089]** Thus, it is possible to configure the compact inkjet head H1 including the two channel rows that makes it possible to electrically connect the FPC 3 directly to each of the lead-out electrodes 14A, 14B on the rear face 1b of the head chip 1 readily. Since electric connection of the FPC 3 is performed directly to each of the lead-out electrodes 14A, 14B and also alignment of the FPC 3 with each of the lead-out electrodes 14A, 14B is facilitated, it becomes possible to perform highly reliable electric connection.

**[0090]** When the number of channel rows is to be increased, the plurality of the inkjet heads H1 may be laminated. In this case, when the common flow path member is to be used in common among all the channel rows, after the plurality of the head chips 1 each being in a state that the FPC 3 has already been bonded and the common flow path member

4 is not yet bonded have been laminated, one common flow path member that includes the insertion hole into which each FPC 3 is separately inserted and includes therein the ink flow path that is common among all the channel rows may be bonded to the head chip 1.

5 [0091] In addition, it is also possible to form the inkjet head H3 that includes one channel row illustrated in FIG. 7 in the same way by cutting the chip head 1 apart from the channel substrate 100 illustrated in FIG. 12A and bonding the FPC 3' that includes only one wiring 32 to the head chip 1.

[0092] Further, when the head chip 1 of the inkjet head H6 illustrated in FIG. 11 is to be formed, two sets of the head chips 1 in each of which one more substrate 101 has been laminated on a lower surface of the channel substrate 100 illustrated in FIG. 12A such that the channels 11 are oriented in the same direction are prepared and the lead-out electrodes 14A to 14D may be formed on the rear face 1b of the cut apart head chip 1 as illustrated in FIG. 11 after these sets have been bonded such that the cover substrate 102 is located on the outer side.

10 [0093] Although various exemplary embodiments have been shown and described, the invention is not limited to the embodiments shown. Therefore, the scope of the invention is intended to be limited solely by the scope of the claims that follow.

15

EXPLANATIONS OF LETTERS OR NUMERALS

[0094]

20	1:	head chip
	1a:	front face
	1b:	rear face
	11:	channel
	11a:	wall face
25	12:	driving wall
	13:	driving electrode
	14, 14A, 14B, 14C, 14D :	lead-out electrode
	2:	nozzle plate
	21:	nozzle
30	3, 3':	FPC
	30, 30A, 30B:	bent part
	31:	base film
	32, 32A, 32B:	wiring
	32a, 32Aa, 32Ba:	terminal part
35	321:	copper foil
	322:	gold plating
	33:	cover lay
	34:	connection region
	4:	common flow path member
40	41:	ink flow path
	41a:	ink flow inlet
	41b:	ink flow outlet
	42:	insertion hole
	5:	ACP
45	5a:	fillet
	6:	FPC
	60A, 60B:	bent part
	61:	base film
	61a:	through-hole
50	62A, 62B:	wiring
	62Aa, 62Ba:	terminal part
	63:	cover lay
	100:	channel substrate
	101:	substrate
55	102:	cover substrate
	200:	large-sized channel substrate
	300:	camera
	400:	crimp jig

401:	leading end part
401a:	corner part
402:	side face
500:	dispenser
5 H1, H2, H3, H4, H5, H6:	inkjet head
S:	space
C:	cut line

10 **Claims**

1. An inkjet head, comprising:

15 a head chip (1) that includes a channel row in which a driving wall (12) including a piezoelectric element and a channel (11) are alternately arranged side by side and that an outlet and an inlet of the channel are arranged respectively on a front face (1a) and a rear face (1b) and a driving electrode (13) is formed on a wall face (11a) of the driving wall facing inside the channel, wherein  
a lead-out electrode (14, 14A to 14D) that is electrically connected to the driving electrode in the channel is formed on the rear face of the head chip for every channel and a wiring (32, 32A, 32B, 62A, 62B) of an FPC  
20 (3, 3', 6) is electrically connected to the lead-out electrode, and the wiring of the FPC is directly electrically connected to the lead-out electrode so as to thereby allow a direct electric connection part between the lead-out electrode and the wiring to be formed on the rear face of the head chip, and  
the FPC is bent from the vicinity of an electric connection part between the lead-out electrode and the wiring and extends in a rearward direction of the head chip, and includes a space (S) in the rear of the electric connection  
25 part.

2. The inkjet head according to claim 1, wherein

30 a common flow path member (4) that forms an ink flow path (41) that is common among the channels (11) in the channel row is bonded to a part apart from the electric connection part on the rear face (1b) of the head chip (1).

3. The inkjet head according to claim 2, wherein

the FPC (3, 3', 6) is not firmly fixed to the common flow path member (4).

4. The inkjet head according to claim 1, 2 or 3 wherein

35 the channel rows are arranged in plural side by side, and the FPC (3, 3', 6) extends from between the adjacent two channel rows in the rearward direction of the head chip (1).

5. The inkjet head according to claim 4, wherein

40 wirings (32, 32A, 32B, 62A, 62B) that are electrically connected respectively with the lead-out electrodes (14, 14A to 14D) in at least the adjacent two channel rows are formed on the FPC (3, 3', 6).

6. The inkjet head according to claim 5, wherein

45 the wiring (32, 32A, 32B, 62A, 62B) to be electrically connected with the lead-out electrode (14, 14A to 14D) in one of the channel rows and the wiring to be electrically connected with the lead-out electrode in the other of the channel rows are arrayed so as to extend from the electric connection part arranged on the middle of the FPC (3, 3', 6) mutually toward opposite ends of the FPC and the both ends of the FPC respectively extend in the rearward direction of the head chip (1).

7. The inkjet head according to any one of claims 1 to 6, wherein

50 the FPC (3, 3', 6) is provided with a cover lay (33, 63) except the electric connection part and is bent on a part not covered with the cover lay in the vicinity of the electric connection part, and the bent part (30, 30A, 30B, 60A, 60B) is provided with the R-shaped part.

8. The inkjet head according to any one of claims 1 to 7, wherein

55 a surface of a terminal part (32a, 32Aa, 32Ba, 62Aa, 62Ba) of each wiring (32, 32A, 32B, 62A, 62B) on the FPC (3, 3', 6) to be electrically connected with the lead-out electrode (14, 14A to 14D) is gold-plated without performing backing processing with Ni on a surface of copper foil (321).

9. The inkjet head according to claim 8, wherein the copper foil (321) is a rolled copper foil.
- 5 10. The inkjet head according to any one of claims 1 to 6, wherein on the FPC (3, 3', 6), a through-hole (61a) is formed in a base film (31, 61), each wiring (32, 32A, 32B, 62A, 62B) is led out from one surface of the base film to the other surface of the base film through the through-hole and is electrically connected with the lead-out electrode (14, 14A to 14D) on the other surface, and a cover lay (33, 63) is provided on the one surface so as to cover at least the electric connection part and a bent part (30, 30A, 30B, 60A, 60B) in the vicinity of the electric connection part.
- 10 11. The inkjet head according to any one of claims 1 to 10, wherein the FPC (3, 3', 6) is electrically connected with the lead-out electrode (14, 14A to 14D) with an ACF or an ACP (5).
- 15 12. The inkjet head according to any one of claims 1 to 11, wherein a fillet (5a) formed with an adhesive is formed over the outer side of a bent part (30, 30A, 30B, 60A, 60B) of the FPC (3, 3', 6) and the rear face (1b) of the head chip (1).
13. A method for producing an inkjet head, comprising, in this order:
- 20 preparing a head chip (1) that includes a channel row in which a driving wall (12) including a piezoelectric element and a channel (11) are alternately arranged side by side and that an outlet and an inlet of the channel are arranged respectively in a front face (1a) and a rear face (1b) and a driving electrode (13) is formed on a wall face (11a) of the driving wall facing inside the channel, and forming a lead-out electrode (14, 14A to 14D) that is electrically connected with the driving electrode in the channel and is provided for every channel on the rear face of the head chip;
- 25 superposing an FPC (3, 3', 6) on the rear face of the head chip and observing the FPC from behind the head chip, thereby aligning the lead-out electrode with a wiring (32, 32A, 32B, 62A, 62B) provided on the FPC; crimping together and then directly electrically connecting the wiring on the FPC and the lead-out electrode so aligned to each other so as to thereby form a direct electric connection part between the lead-out electrode and the wiring; and
- 30 bending the FPC so as to extend from the vicinity of an electric connection part with the lead-out electrode in a rearward direction of the head chip.
14. The method for producing the inkjet head according to claim 13, further comprising:
- 35 bonding a common flow path member (4) that forms an ink flow path (41) that is common among the channels (11) in the channel row to the rear face (1b) of the head chip (1) apart from the electric connection part, following bending of the FPC (3, 3', 6).
- 40 15. The method for producing the inkjet head according to claim 13 or 14, wherein in crimping together the wiring (32, 32A, 32B, 62A, 62B) and the lead-out wiring, crimping is performed by pressing a leading end face of a crimp jig (400) against the electric connection part from the back-face side of the FPC (3, 3', 6).
16. The method for producing the inkjet head according to claim 15, wherein
- 45 the crimp jig (400) has a side face (402) extending toward the rear of the head chip (1) adjacently to the leading end face, and in bending the FPC (3, 3', 6), after the FPC has been bent so as to extend in the rearward direction of the head chip along the side face of the crimp jig, the crimp jig is removed.
- 50 17. The method for producing the inkjet head according to any one of claims 13 to 16, wherein in aligning the lead-out electrode (14, 14A to 14D) with the wiring (32, 32A, 32B, 62A, 62B), after an ACF or an ACP (5) has been provided on the rear face (1b) of the head chip (1) so as to cover the lead-out electrode, the FPC (3, 3', 6) is superposed on the rear face of the head chip.
- 55 18. The method for producing the inkjet head according to any one of claims 13 to 17, wherein in bending the FPC (3, 3', 6), after the FPC has been bent, a fillet (5a) formed with an adhesive is formed over the outer side of the bent part (30, 30A, 30B, 60A, 60B) and the rear face (1b) of the head chip (1).

**Patentansprüche**

**1. Tintenstrahlkopf, aufweisend:**

5 einen Kopfchip (1), der eine Kanalreihe umfasst, in welcher eine Antriebswand (12) einschließlich eines piezo-  
elektrischen Elements und ein Kanal (11) Seite an Seite alternierend angeordnet sind, und wobei ein Auslass  
und ein Einlass des Kanals jeweils an einer Vorderseite (1a) und einer Rückseite (1b) angeordnet ist und eine  
Antriebselektrode (13) an einer Wandseite (11a) der dem Inneren des Kanals zugewandten Antriebswand  
10 ausgebildet ist, wobei  
eine Anschlusselektrode (14, 14A bis 14D), die mit der Antriebselektrode in dem Kanal elektrisch verbunden  
ist, an der Rückseite des Kopfchips für jeden Kanal ausgebildet ist, und eine Verdrahtung (32, 32A, 32B, 62A,  
62B) einer FPC (3, 3', 6) mit der Anschlusselektrode elektrisch verbunden ist, und die Verdrahtung der FPC  
mit der Anschlusselektrode direkt elektrisch verbunden ist, um dadurch zu ermöglichen, dass ein direkter elek-  
15 trischer Verbindungsabschnitt zwischen der Anschlusselektrode und der Verdrahtung an der Rückseite des  
Kopfchips ausgebildet wird, und  
die FPC von der Umgebung eines elektrischen Verbindungsabschnitts zwischen der Anschlusselektrode und  
der Verdrahtung gebogen ist und sich in einer Rückwärtsrichtung des Kopfchips erstreckt und einen Raum (S)  
in dem hinteren Teil des elektrischen Verbindungsabschnitts umfasst.

20 **2. Tintenstrahlkopf nach Anspruch 1, wobei**  
ein gemeinsames Strömungspfadelement (4), das einen Tintenströmungspfad (41) ausbildet, der den Kanälen (11)  
in der Kanalreihe gemeinsam bereitgestellt ist, an einem Abschnitt, der von dem elektrischen Verbindungsabschnitt  
entfernt ist, an der Rückseite (1b) des Kopfchips (1) gebondet ist.

25 **3. Tintenstrahlkopf nach Anspruch 2, wobei**  
die FPC (3, 3', 6) nicht fest mit dem gemeinsamen Strömungspfadelement (4) fixiert ist.

**4. Tintenstrahlkopf nach Anspruch 1, 2 oder 3, wobei**  
die Kanalreihen in einer Vielzahl Seite an Seite angeordnet sind, und  
30 sich die FPC (3, 3', 6) zwischen den beiden benachbarten Kanalreihen in der Rückwärtsrichtung des Kopfchips (1)  
erstreckt.

**5. Tintenstrahlkopf nach Anspruch 4, wobei**  
Verdrahtungen (32, 32A, 32B, 62A, 62B), die jeweils mit den Anschlusselektroden (14, 14A bis 14D) in zumindest  
35 den beiden benachbarten Kanalreihen elektrisch verbunden sind, auf der FPC (3, 3', 6) ausgebildet sind.

**6. Tintenstrahlkopf nach Anspruch 5, wobei**  
die Verdrahtung (32, 32A, 32B, 62A, 62B), die mit der Anschlusselektrode (14, 14A bis 14D) in einer der Kanalreihen  
elektrisch zu verbinden ist, und die Verdrahtung, die mit der Anschlusselektrode in der anderen der Kanalreihen  
40 elektrisch zu verbinden ist, angeordnet sind, um sich von dem in der Mitte der FPC (3, 3', 6) angeordneten elektrischen  
Verbindungsabschnitt gegenseitig zu gegenüberliegenden Enden der FPC zu erstrecken, und sich die beiden Enden  
der FPC jeweils in die Rückwärtsrichtung des Kopfchips (1) erstrecken.

**7. Tintenstrahlkopf nach einem der Ansprüche 1 bis 6, wobei**  
45 die FPC (3, 3', 6) mit einer Abdeckschicht (33, 63), mit Ausnahme des elektrischen Verbindungsabschnitts, versehen  
ist, und an einem Abschnitt gebogen ist, der nicht mit der Abdeckschicht in der Umgebung des elektrischen Ver-  
bindungsabschnitts abgedeckt ist, und der gebogene Abschnitt (30, 30A, 30B, 60A, 60B) mit dem R-förmigen  
Abschnitt versehen ist.

**8. Tintenstrahlkopf nach einem der Ansprüche 1 bis 7, wobei**  
eine Oberfläche eines Anschlussabschnitts (32a, 32Aa, 32Ba, 62Aa, 62Ba) von jeder Verdrahtung (32, 32A, 32B,  
62A, 62B) auf der FPC (3, 3', 6), die mit der Anschlusselektrode (14, 14A bis 14D) elektrisch zu verbinden ist,  
goldbeschichtet ist, ohne eine Verstärkungsverarbeitung mit Ni auf einer Oberfläche einer Kupferfolie (321) durch-  
50 zuführen.

**9. Tintenstrahlkopf nach Anspruch 8, wobei**  
die Kupferfolie (321) eine gerollte Kupferfolie ist.

10. Tintenstrahlkopf nach einem der Ansprüche 1 bis 6, wobei  
auf der FPC (3, 3', 6) ein Durchgangsloch (61a) in einem Trägerfilm (31, 61) ausgebildet ist, wobei jede Verdrahtung  
(32, 32A, 32B, 62A, 62B) von einer Oberfläche des Trägerfilms zu der anderen Oberfläche des Trägerfilms durch  
das Durchgangsloch herausführt und mit der Anschlusselektrode (14, 14A bis 14D) auf der anderen Oberfläche  
elektrisch verbunden ist, und eine Abdeckschicht (33, 63) auf der einen Oberfläche vorgesehen ist, um zumindest  
den elektrischen Verbindungsabschnitt und einen gebogenen Abschnitt (30, 30A, 30B, 60A, 60B) in der Umgebung  
des elektrischen Verbindungsabschnitts abzudecken.
11. Tintenstrahlkopf nach einem der Ansprüche 1 bis 10, wobei  
die FPC (3, 3', 6) mit der Anschlusselektrode (14, 14A bis 14D) mit einer ACF oder einer ACP (5) elektrisch verbunden  
ist.
12. Tintenstrahlkopf nach einem der Ansprüche 1 bis 11, wobei  
eine Leiste (5a), die mit einem Haftmittel ausgebildet ist, über der äußeren Seite eines gebogenen Abschnitts (30,  
30A, 30B, 60A, 60B) der FPC (3, 3', 6) und der Rückseite (1b) des Kopfchips (1) ausgebildet ist.
13. Verfahren zum Herstellen eines Tintenstrahlkopfes, in dieser Reihenfolge aufweisend:
- Vorbereiten eines Kopfchips (1), der eine Kanalreihe umfasst, in welcher eine Antriebswand (12) einschließlich  
eines piezoelektrischen Elements und ein Kanal (11) Seite an Seite alternierend angeordnet sind, und wobei  
ein Auslass und ein Einlass des Kanals jeweils an einer Vorderseite (1a) und einer Rückseite (1b) angeordnet  
ist und eine Antriebselektrode (13) an einer Wandseite (11a) der dem Inneren des Kanals zugewandten An-  
triebswand ausgebildet ist, und Ausbilden einer Anschlusselektrode (14, 14A bis 14D), die mit der Antriebse-  
lektrode in dem Kanal elektrisch verbunden ist und für jeden Kanal an der Rückseite des Kopfchips vorgesehen  
ist;
- Überlagern einer FPC (3, 3', 6) auf der Rückseite des Kopfchips und Überwachen der FPC hinter dem Kopfchip,  
wodurch die Anschlusselektrode mit einer auf der FPC vorgesehenen Verdrahtung (32, 32A, 32B, 62A, 62B)  
ausgerichtet wird;
- Zusammencrimpen und dann direktes elektrisches Verbinden der Verdrahtung auf der FPC und der Anschlus-  
selektrode, die so zueinander ausgerichtet sind, dass dadurch ein direkter elektrischer Verbindungsabschnitt  
zwischen der Anschlusselektrode und der Verdrahtung ausgebildet wird; und
- Biegen der FPC, damit sie sich aus der Umgebung eines elektrischen Verbindungsabschnitts mit der Anschlus-  
selektrode in einer Rückwärtsrichtung des Kopfchips erstreckt.
14. Verfahren zum Herstellen des Tintenstrahlkopfes nach Anspruch 13, ferner aufweisend:
- Bonden eines gemeinsamen Strömungspfadelements (4), das einen Tintenströmungspfad (41), der den Kanä-  
len (11) in der Kanalreihe gemeinsam bereitgestellt ist, an der Rückseite (1b) des Kopfchips (1) von dem  
elektrischen Verbindungsabschnitt entfernt ausbildet, einem Biegen der FPC (3, 3', 6) folgend.
15. Verfahren zum Herstellen des Tintenstrahlkopfes nach Anspruch 13 oder 14, wobei  
beim Zusammencrimpen der Verdrahtung (32, 32A, 32B, 62A, 62B) und der Anschlussverdrahtung ein Crimpen  
durchgeführt wird, indem eine vordere Endseite einer Crimpvorrichtung (400) gegen den elektrischen Verbindungs-  
abschnitt von der Rückflächenseite der FPC (3, 3', 6) gedrückt wird.
16. Verfahren zum Herstellen des Tintenstrahlkopfes nach Anspruch 15, wobei  
die Crimpvorrichtung (400) eine Seitenfläche (402), die sich zu der Rückseite des Kopfchips (1) erstreckt, neben  
der vorderen Endfläche aufweist, und  
beim Biegen der FPC (3, 3', 6), nachdem die FPC gebogen worden ist, um sich in der Rückwärtsrichtung des  
Kopfchips entlang der Seitenfläche der Crimpvorrichtung zu erstrecken, die Crimpvorrichtung entfernt wird.
17. Verfahren zum Herstellen des Tintenstrahlkopfes nach einem der Ansprüche 13 bis 16, wobei  
beim Ausrichten der Anschlusselektrode (14, 14A bis 14D) mit der Verdrahtung (32, 32A, 32B, 62A, 62B), nachdem  
eine ACF oder eine ACP (5) an der Rückseite (1b) des Kopfchips (1) bereitgestellt worden ist, um die Anschlusse-  
lektrode abzudecken, die FPC (3, 3', 6) auf der Rückseite des Kopfchips überlagert wird.
18. Verfahren zum Herstellen des Tintenstrahlkopfes nach einem der Ansprüche 13 bis 17, wobei  
beim Biegen der FPC (3, 3', 6), nachdem die FPC gebogen worden ist, eine Leiste (5a), die mit einem Haftmittel

ausgebildet ist, über der äußeren Seite des gebogenen Abschnitts (30, 30A, 30B, 60A, 60B) und der Rückseite (1b) des Kopfchips (1) ausgebildet wird.

5 **Revendications**

1. Tête à jet d'encre comprenant :

10 une plaquette (1) de tête qui comprend une rangée de conduits, dans laquelle une paroi (12) de commande comprenant un élément piézoélectrique et un conduit sont disposés en alternance côte à côte et en ce qu'une sortie et une entrée du conduit sont disposées respectivement sur une face (1a) avant et sur une face (1b) arrière et une électrode (13) de commande est formée sur une face (11a) de la paroi de commande faisant face à l'intérieur du conduit, dans laquelle

15 une électrode (14, 14A à 14D) de sortie, qui est reliée électriquement à l'électrode de commande dans le conduit, est formée sur la face arrière de la plaquette de tête pour chaque conduit, et un câblage (32, 32A, 32B, 62A, 62B) d'un FPC (3, 3', 6) est relié électriquement à l'électrode de sortie, et le câblage du FPC est relié électriquement directement à l'électrode de sortie en permettant ainsi de former, sur la face arrière de la plaquette de tête, une partie de connexion électrique directe entre l'électrode de sortie et le câblage et

20 le FPC est courbé à partir du voisinage d'une partie de connexion électrique entre l'électrode de sortie et le câblage et s'étend dans une direction vers l'arrière de la plaquette de tête et comprend un espace (S) dans l'arrière de la partie de connexion électrique.

2. Tête à jet d'encre suivant la revendication 1, dans laquelle

25 un élément (4) commun de trajet de courant, qui forme un trajet (41) de courant d'encre qui est commun entre les conduits (11) de la rangée de conduits, est relié à une partie distincte de la partie de connexion électrique sur la face (1b) arrière de la plaquette (1) de tête.

3. Tête à jet d'encre suivant la revendication 2, dans laquelle

30 le FPC (3, 3', 6) n'est pas fixé solidement à l'élément (4) commun de trajet de courant.

4. Tête à jet d'encre suivant les revendications 1, 2 ou 3, dans laquelle

35 les rangées de conduit sont disposées en une pluralité côte à côte et le FPC (3, 3', 6) s'étend à partir d'entre deux rangées de conduits voisines dans la direction vers l'arrière de la plaquette (1) de tête.

5. Tête à jet d'encre suivant la revendication 4, dans laquelle

des câblages (32, 32A, 32B, 62A, 62B), qui sont reliés électriquement respectivement aux électrodes (14, 14A à 14D) de sortie, dans au moins les deux rangées de conduits voisines, sont formés sur le FPC (3, 3', 6).

6. Tête à jet d'encre suivant la revendication 5, dans laquelle

40 le câblage (32, 32A, 32B, 62A, 62B) à relier électriquement à l'électrode (14, 14A à 14D) de sortie dans l'une des rangées de conduits, et le câblage à relier électriquement à l'électrode de sortie dans l'autre des rangées de conduits, sont mis de manière à s'étendre de la partie de connexion électrique disposée sur le milieu du FPC (3, 3', 6) mutuellement vers des extrémités opposées du FPC et, les deux extrémités du FPC s'étendent respectivement  
45 dans la direction vers l'arrière de la plaquette (1) de tête.

7. Tête à jet d'encre suivant l'une quelconque des revendications 1 à 6, dans laquelle

50 le FPC (3, 3', 6) est pourvu d'une couche (33, 63) de recouvrement, à l'exception de la partie de connexion électrique, et est courbé sur une partie non recouverte par la couche de recouvrement au voisinage de la partie de connexion électrique et la partie (30, 30A, 30B, 60A, 60B) courbée est pourvue d'une partie en forme de R.

8. Tête à jet d'encre suivant l'une quelconque des revendication 1 à 7, dans laquelle

55 une surface d'une partie (32a, 32Aa, 32Ba, 62Aa, 62Ba) terminale de chaque câblage (32, 32A, 32B, 62A, 62B) sur le FPC (3, 3', 6) à relier électriquement à l'électrode (14, 14A à 14D) de sortie est plaquée d'or sans effectuer un traitement de renforcement par du Ni sur une surface de feuille (321) de cuivre.

9. Tête à jet d'encre suivant la revendication 8, dans laquelle

la feuille (321) de cuivre est une feuille de cuivre laminé.

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10. Tête à jet d'encre suivant l'une quelconque des revendications 1 à 6, dans laquelle sur le FPC (3, 3', 6), un trou (61a) traversant est formé dans une pellicule (31, 61) de base, chaque câblage (32, 32A, 32B, 62A, 62B) est sorti d'une surface de la pellicule de base vers l'autre surface de la pellicule de base en passant dans le trou traversant et est relié électriquement à l'électrode (14, 14A à 14D) de sortie sur l'autre surface et une couche (33, 63) de recouvrement est prévue sur la une surface de manière à recouvrir au moins la partie de connexion électrique, et une partie (30, 30A, 30B, 60A, 60B) courbée au voisinage de la partie de connexion électrique.
  11. Tête à jet d'encre suivant l'une quelconque des revendications 1 à 10, dans laquelle le FPC (3, 3', 6) est relié électriquement à l'électrode (14, 14A à 14D) de sortie par un ACF ou par un ACP (5).
  12. Tête à jet d'encre suivant l'une quelconque des revendications 1 à 11, dans laquelle un bandeau (5a) formé d'un adhésif est formé du côté extérieur d'une partie (30, 30A, 30B, 60A, 60B) courbée du FPC (3, 3', 6) et de la face (1b) arrière de la plaquette (1) de tête.
  13. Procédé de fabrication d'une tête à jet d'encre, comprenant dans cet ordre :
 

préparer une plaquette (1) de tête, qui comprend une rangée de conduits, dans laquelle une paroi (12) de commande comprenant un élément piézoélectrique et un conduit (11) sont disposés en alternance côte à côte et en ce qu'une sortie et une entrée du conduit sont disposées respectivement dans une face (1a) avant et dans une face (1b) arrière et une électrode (13) de commande est formée sur une face (11a) de la paroi d'entraînement faisant face à l'intérieur du conduit, et former une électrode (14, 14A à 14D) de sortie, qui est reliée électriquement à l'électrode de commande dans le conduit et est prévue pour chaque conduit sur la face arrière de la plaquette de tête ;

superposer un FPC (3, 3', 6) sur la face arrière de la plaquette de tête et observer le FPC par l'arrière la plaquette de tête en alignant ainsi l'électrode de sortie avec un câblage (32, 32A, 32B, 62A, 62B) prévu sur le FPC ; sertir ensemble, puis relier électriquement directement le câblage sur le FPC et l'électrode de sortie, en les alignant l'un avec l'autre, en formant ainsi une partie de connexion électrique directe entre l'électrode de sortie et le câblage et

courber le FPC de manière à ce qu'il s'étende du voisinage d'une partie de connexion électrique avec l'électrode de sortie dans une direction vers l'arrière de la plaquette de tête.
  14. Procédé de fabrication d'une tête à jet d'encre suivant la revendication 13, comprenant en outre :
 

relier un élément (4) commun de trajet de courant, qui forme un trajet (41) de courant d'angle qui est commun entre les conduits (11) de la rangée de conduits, à la face (1b) arrière de la plaquette (1) de tête, mis à part à partir de la partie de liaison électrique, suivi d'une courbure du FPC (3, 3', 6).
  15. Procédé de fabrication d'une tête à jet d'encre suivant les revendications 13 ou 14, dans lequel dans le sertissage ensemble du câblage (32, 32A, 32B, 62A, 62B) et du câblage de sortie, le sertissage est effectué en pressant une face d'extrémité d'attaque d'un gabarit (400) de sertissage contre la partie de connexion électrique, à partir du côté de la face arrière du FPC (3, 3', 6).
  16. Procédé de fabrication d'une tête à jet d'encre suivant la revendication 15, dans lequel le gabarit (400) de sertissage a une face (402) latérale s'étendant vers l'arrière de la plaquette (1) de tête d'une manière voisine à la face d'extrémité d'attaque, et dans la courbure du FPC (3, 3', 6), après que le FPC a été courbé de manière à s'étendre dans la direction vers l'arrière de la plaquette de tête le long de la face latérale du gabarit de sertissage, on enlève le gabarit de sertissage.
  17. Procédé de fabrication d'une tête à jet d'encre suivant l'une quelconque des revendications 13 à 16, dans lequel dans l'alignement de l'électrode (14, 14A à 14D) de sortie avec le câblage (32, 32A, 32B, 62A, 62B), après qu'un ACF ou un ACP (5) a été mis sur la face (1b) arrière de la plaquette (1) de tête de manière à recouvrir l'électrode de sortie, on superpose le FPC (3, 3', 6) sur la face arrière de la plaquette de tête.
  18. Procédé de fabrication d'une tête à jet d'encre suivant l'une quelconque des revendications 13 à 17, dans lequel dans la courbure du FPC (3, 3', 6), après que le FPC a été courbé, on forme un bandeau (5a) formé d'un adhésif sur le côté extérieur de la partie (30, 30A, 30B, 60A, 60B) courbée et sur la face (1b) arrière de la plaquette (1) de tête.

FIG. 1

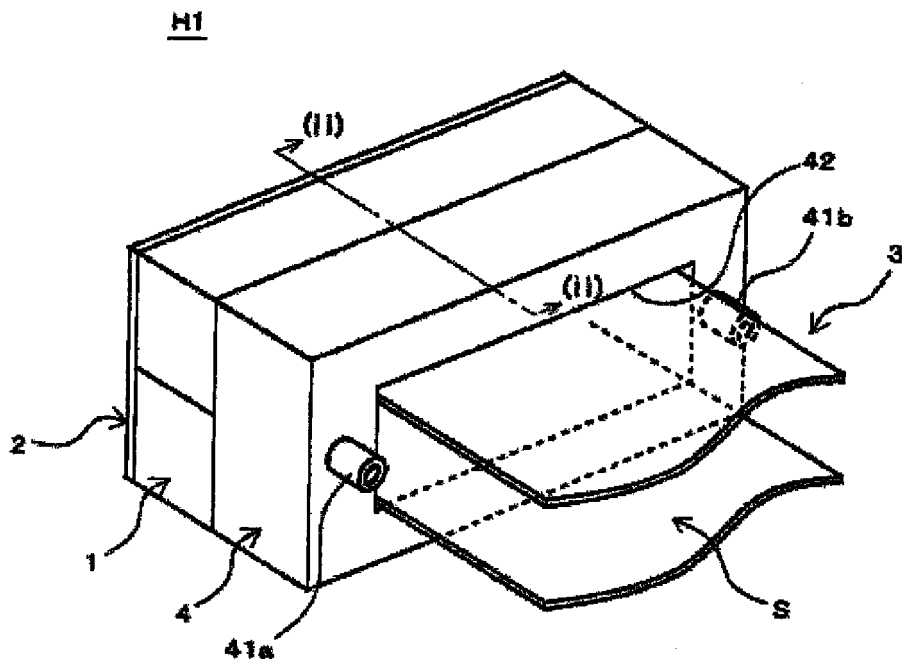


FIG. 2

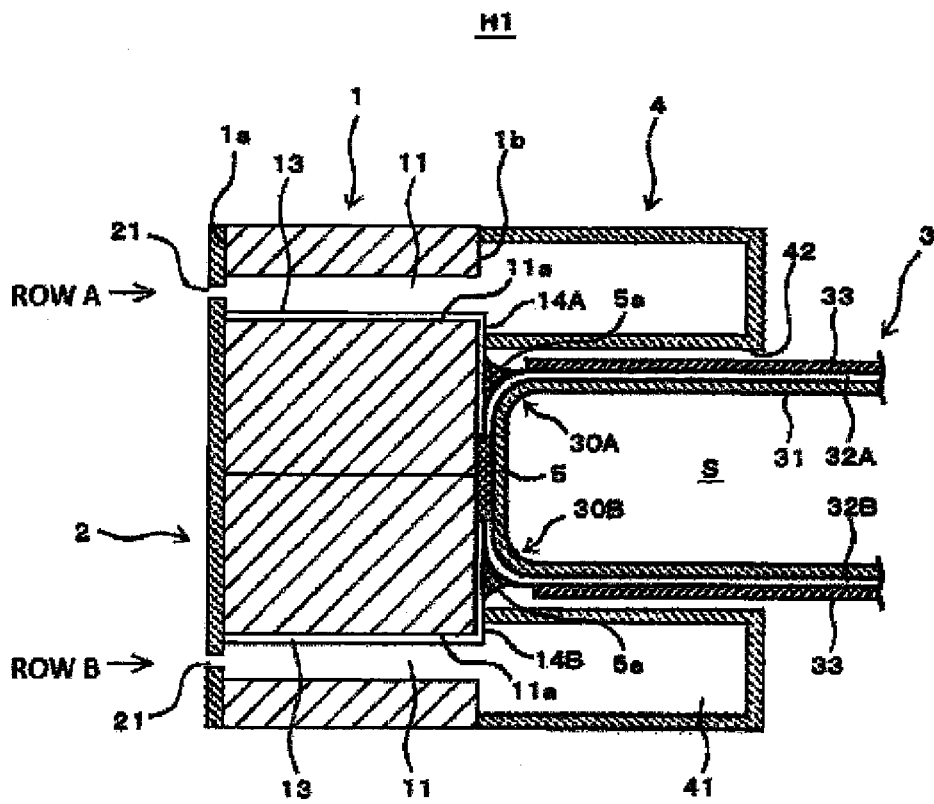


FIG. 3

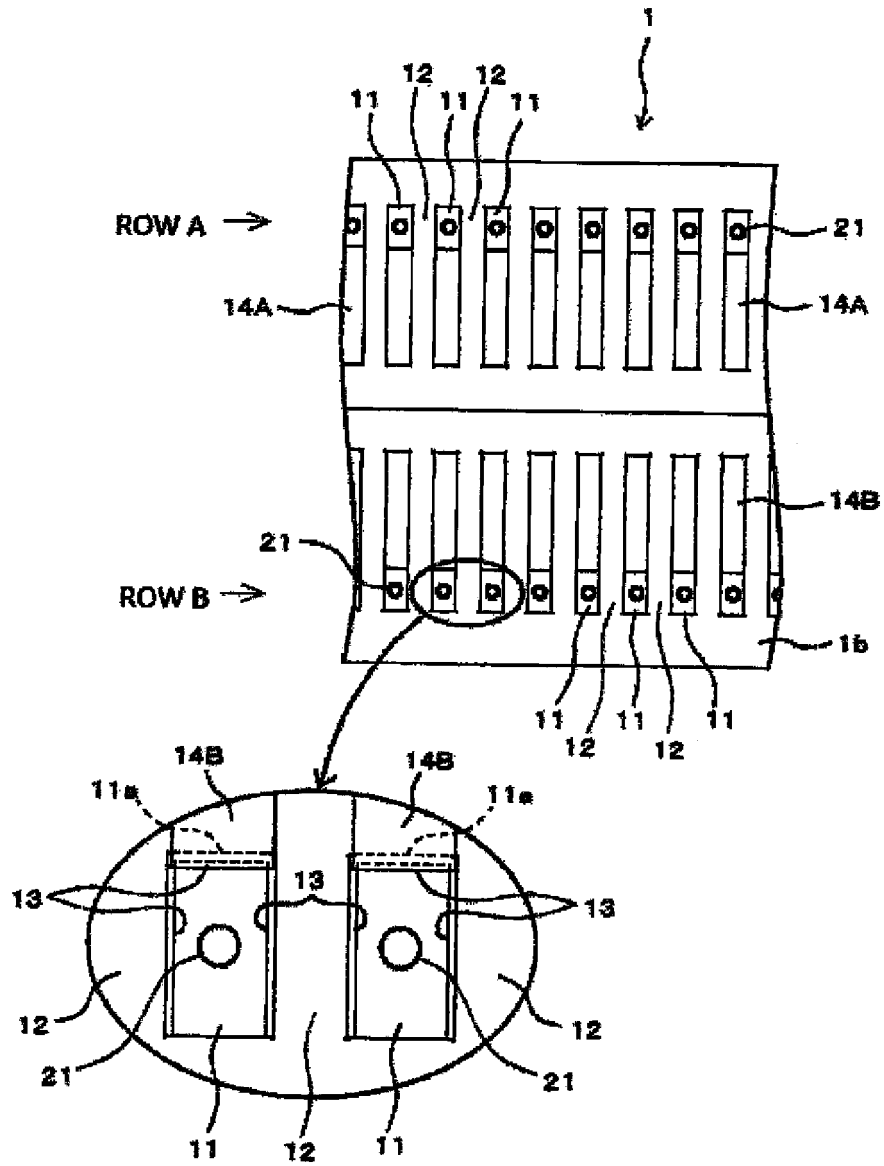


FIG. 4

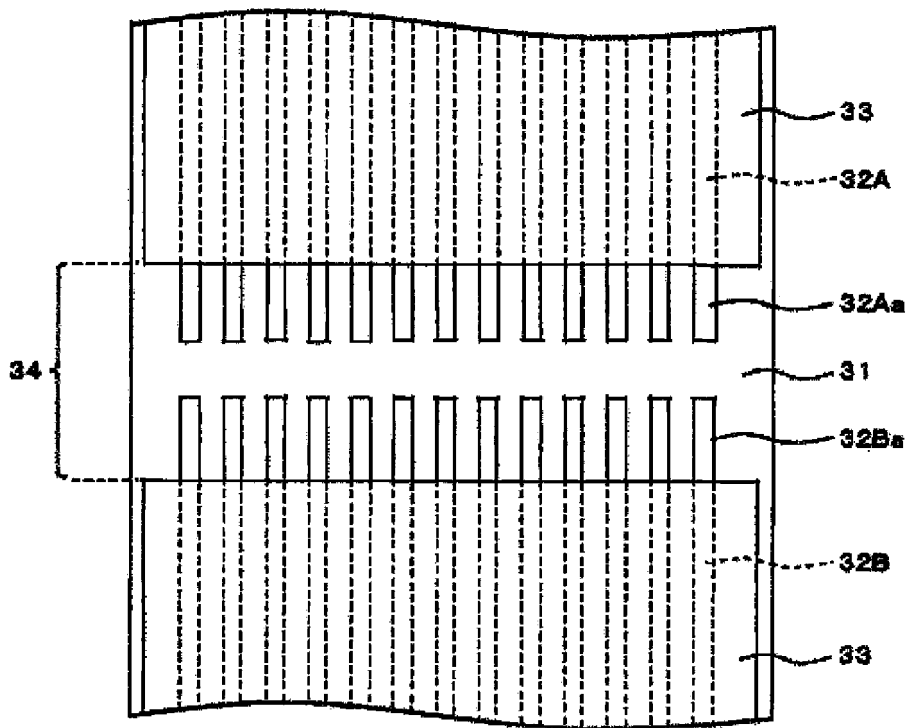


FIG. 5

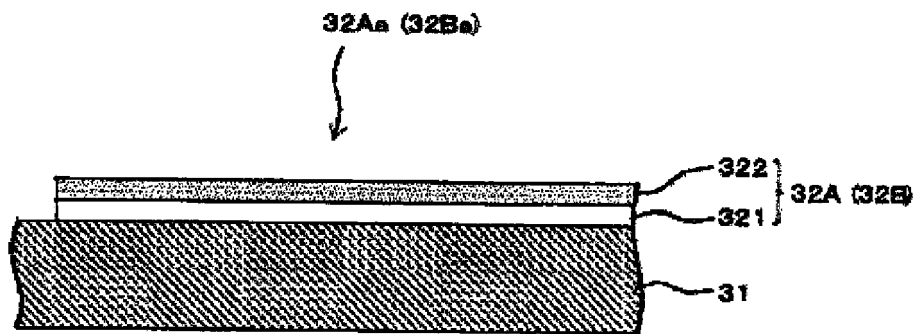


FIG. 6

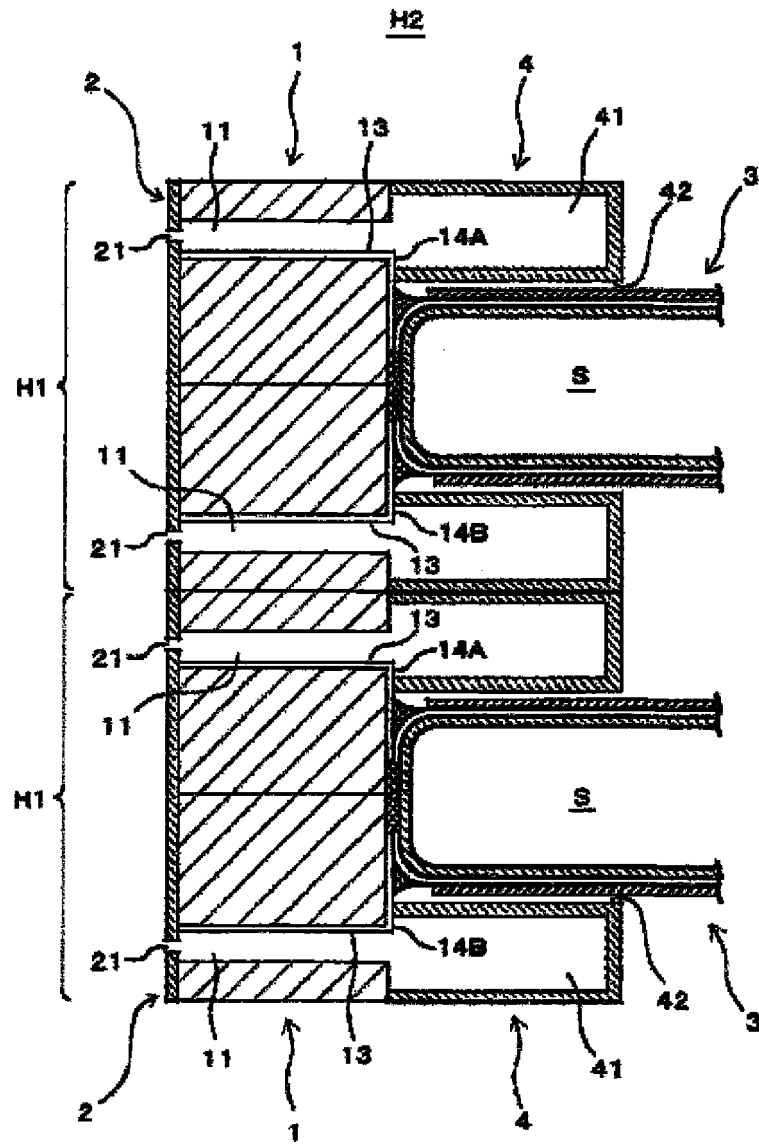




FIG. 8

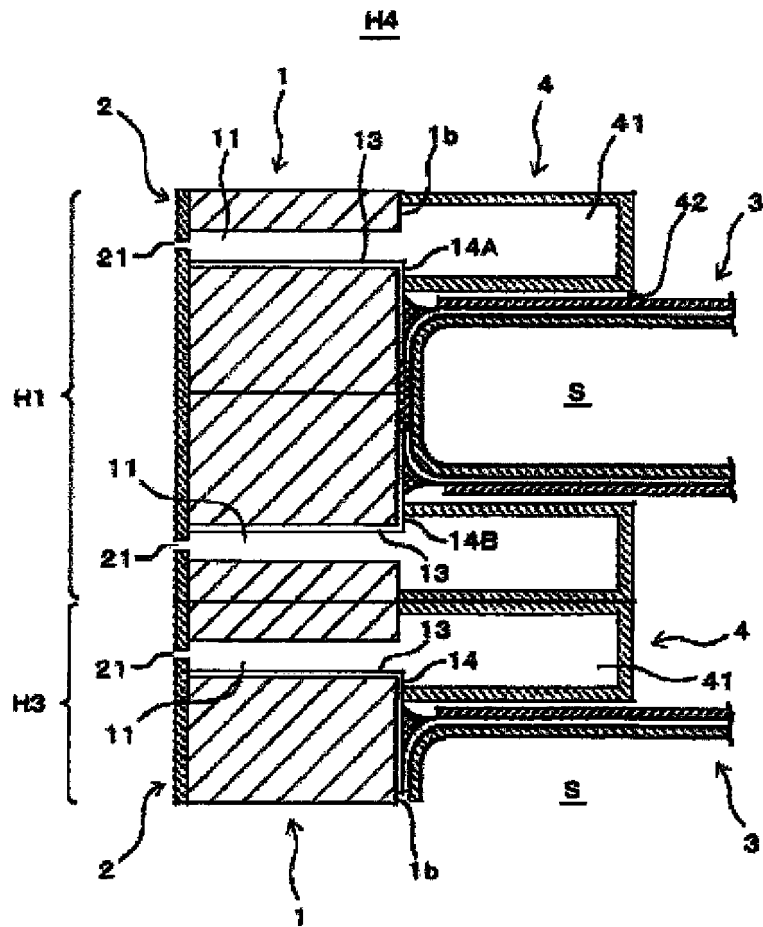


FIG. 9

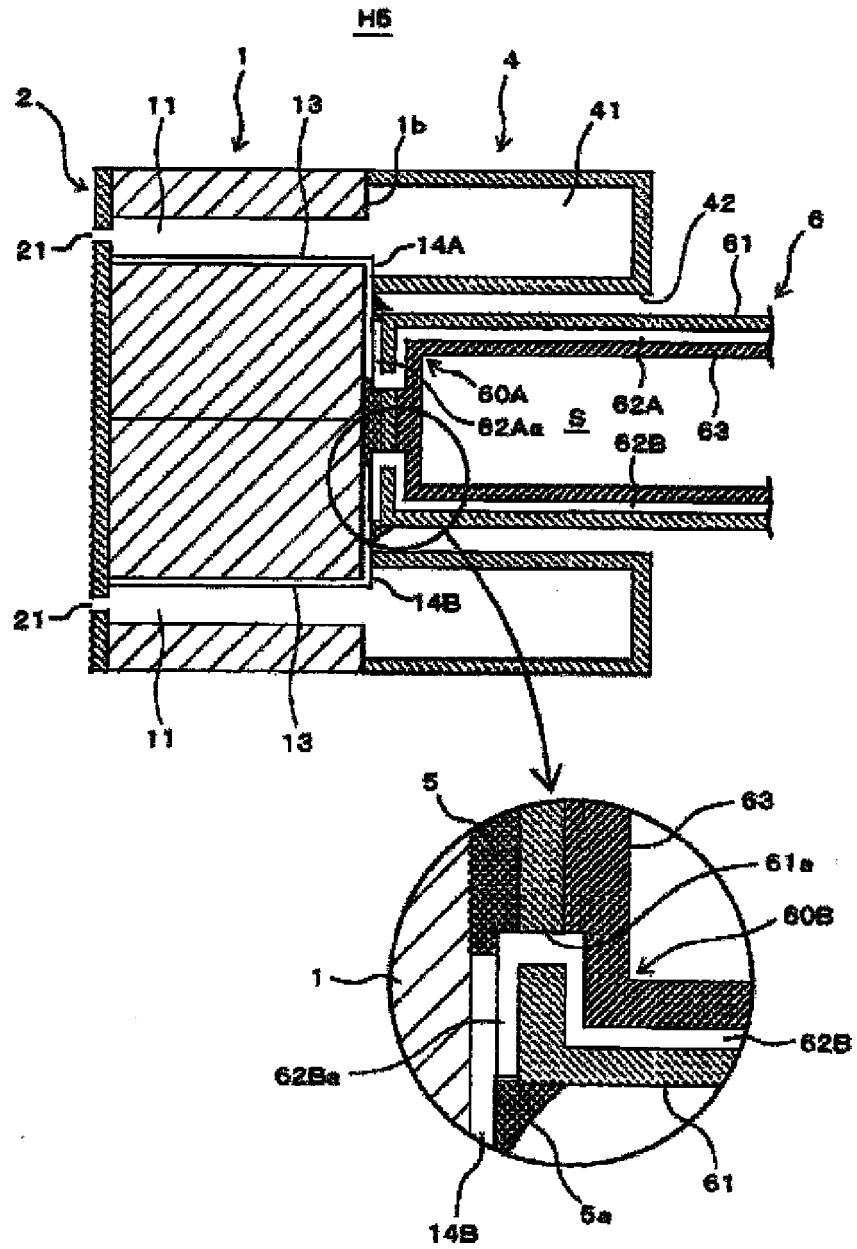


FIG. 10

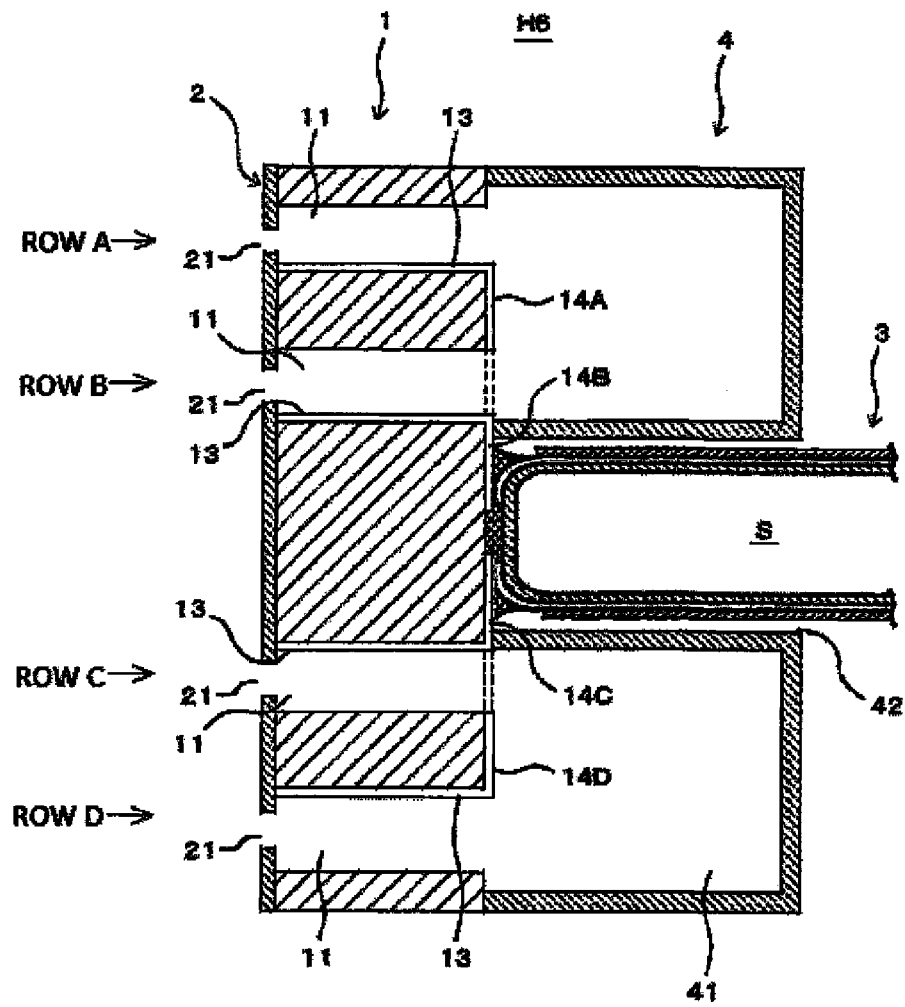


FIG. 11

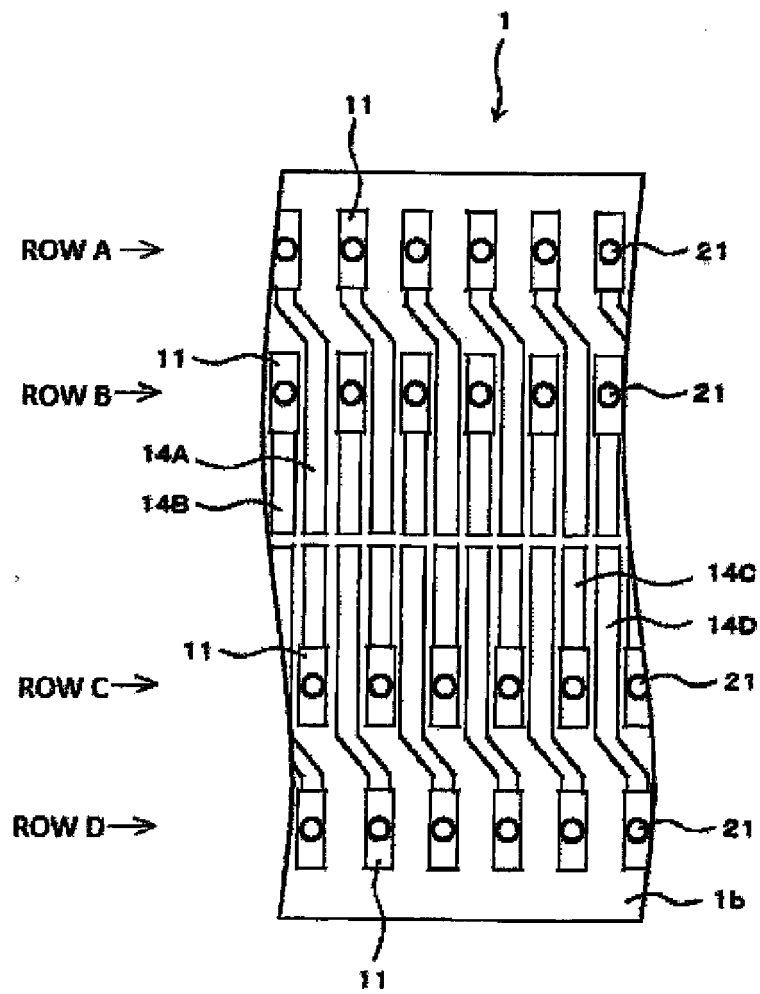


FIG. 12

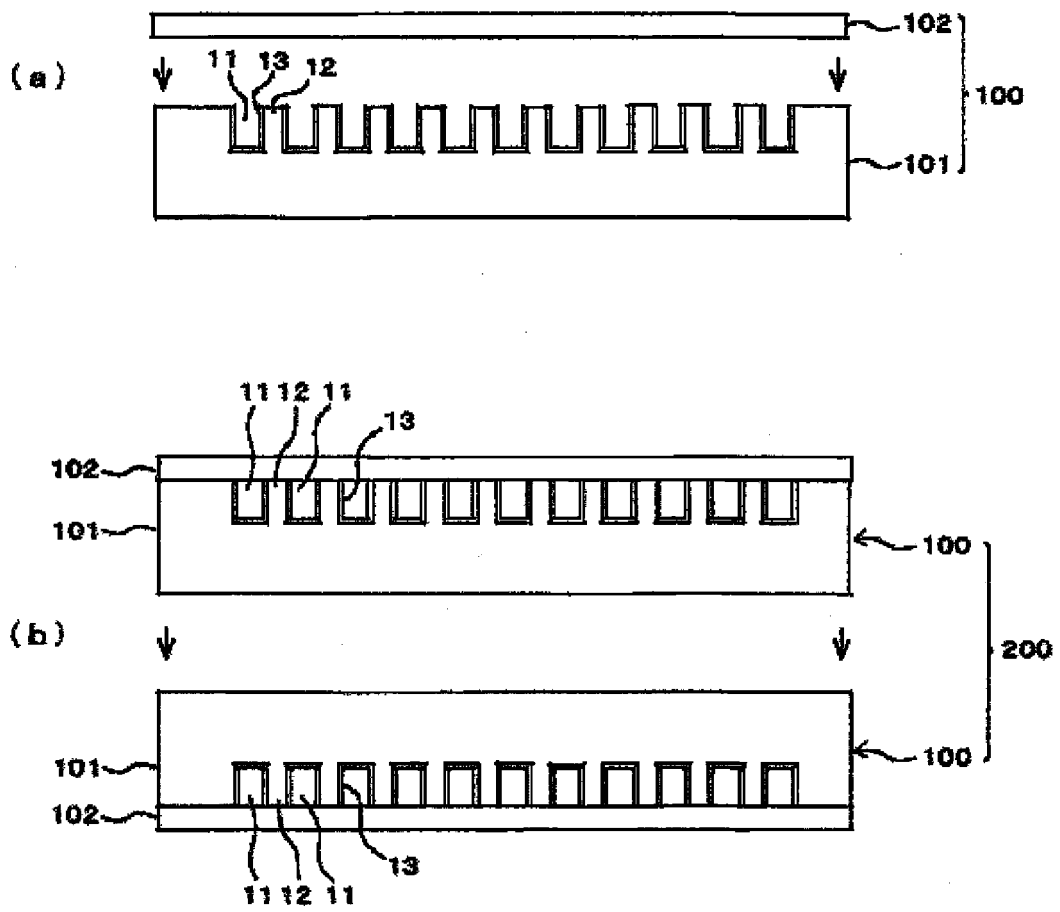


FIG. 13

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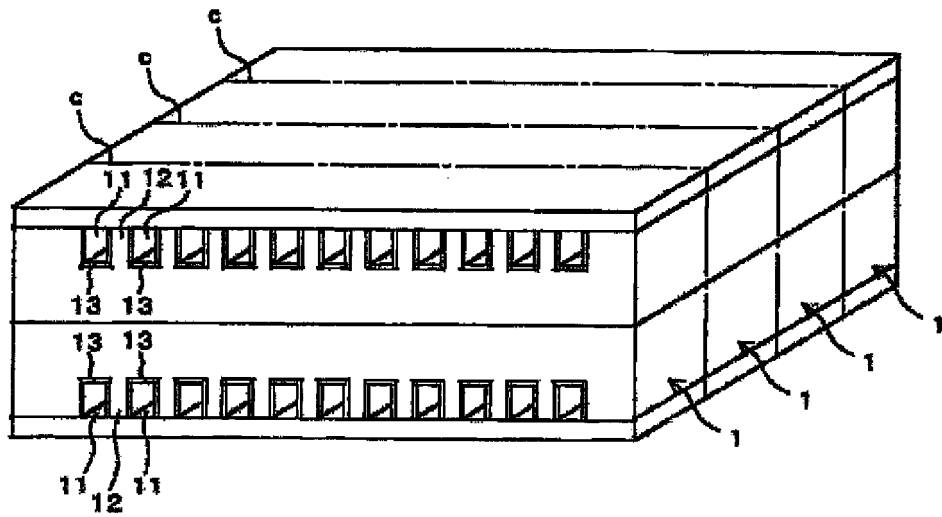


FIG. 14

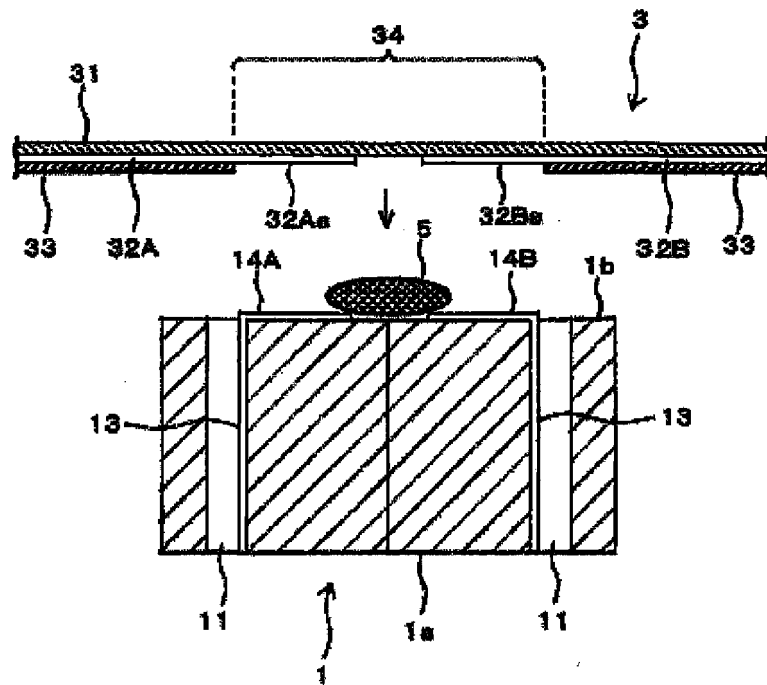


FIG. 15

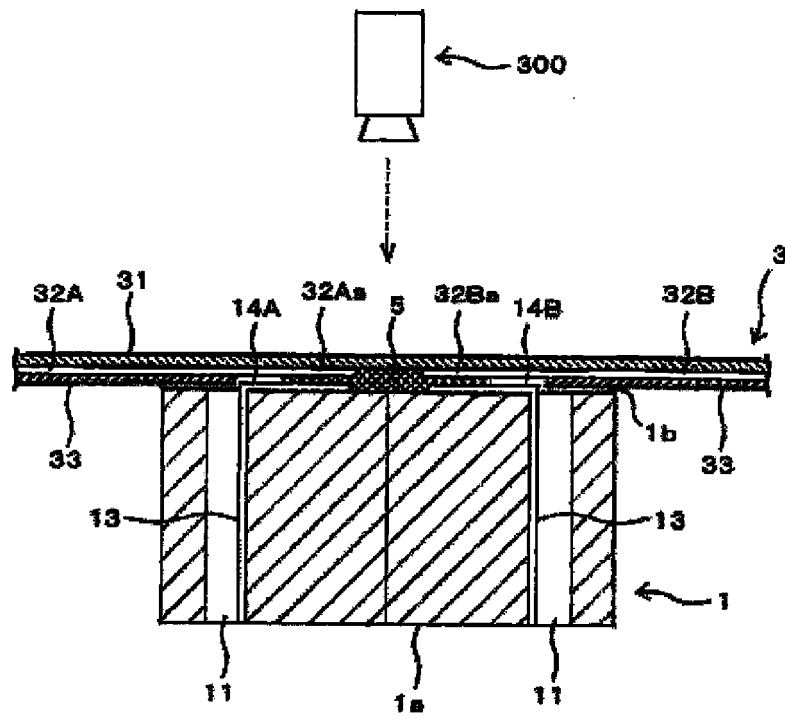


FIG. 16

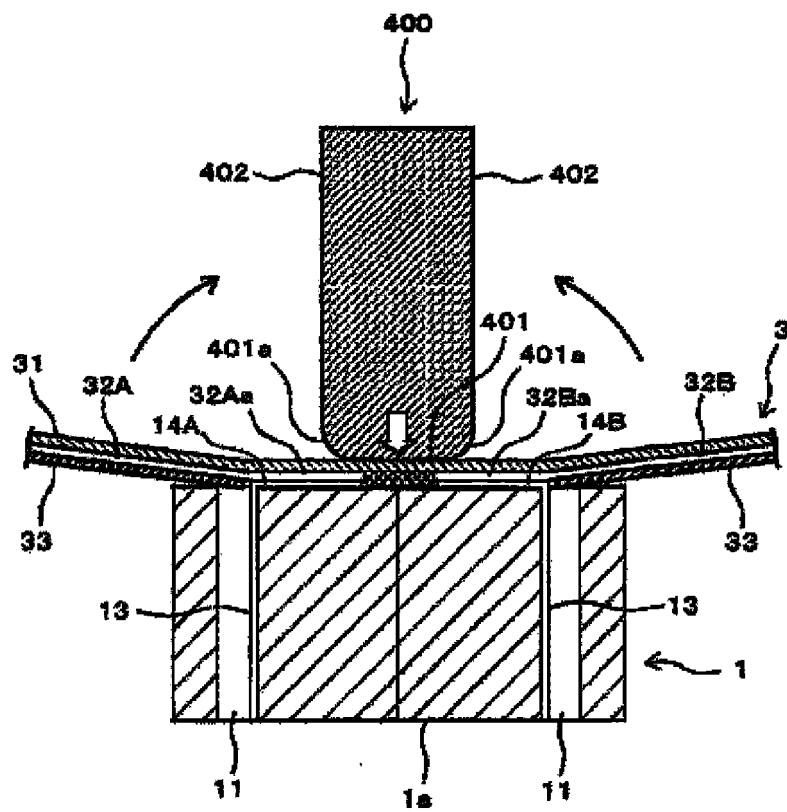


FIG. 17

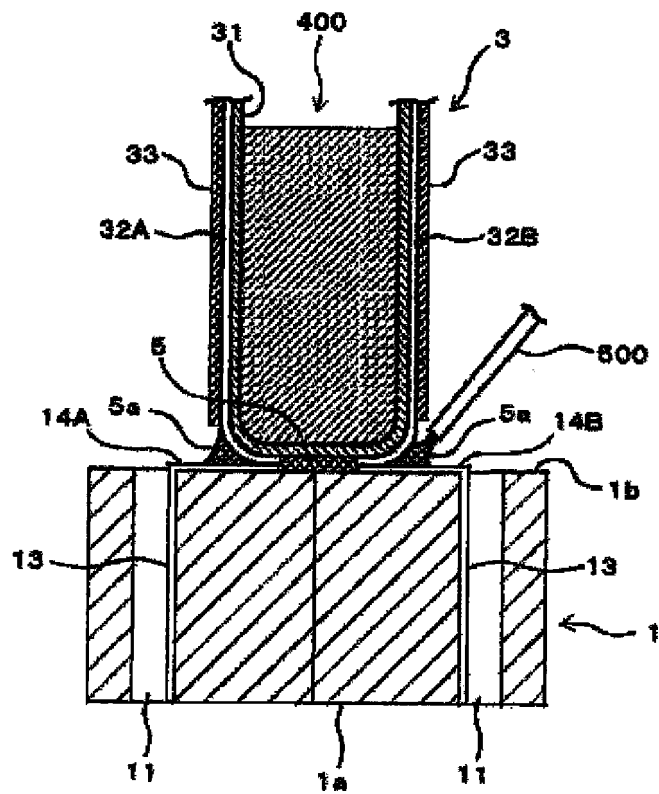
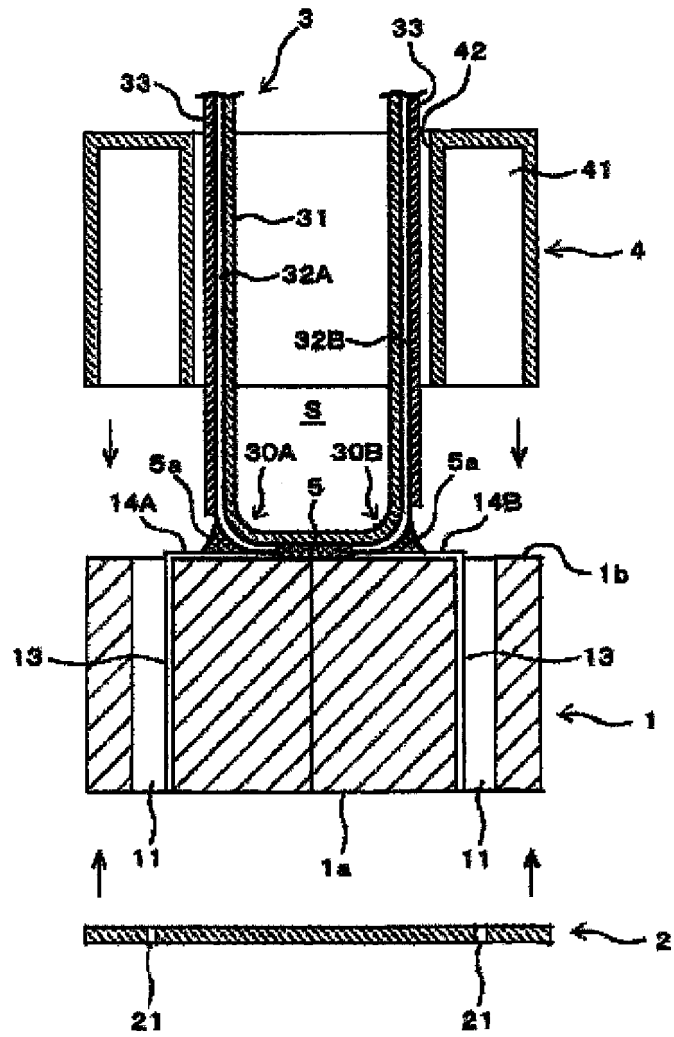


FIG. 18



**REFERENCES CITED IN THE DESCRIPTION**

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