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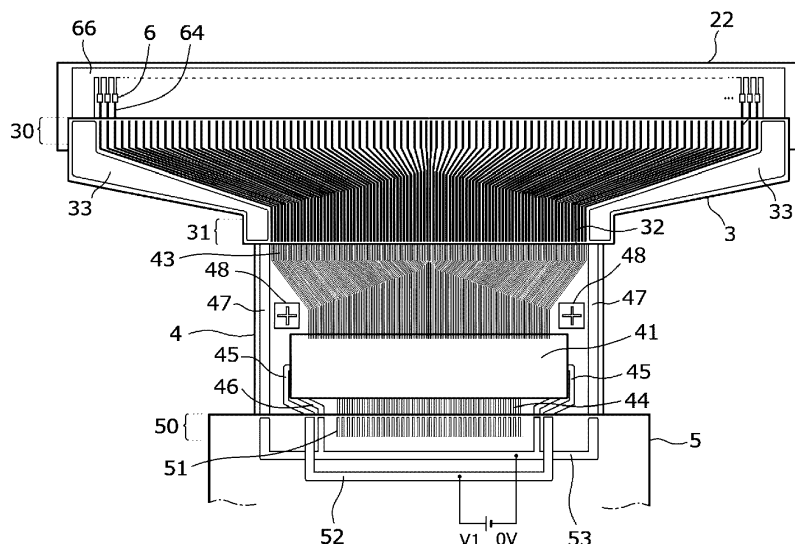
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(54) **DRIVE DEVICE AND LIQUID EJECTION HEAD**

(57) According to one embodiment, a drive device in which conductors from a plurality of elements arranged in terminal parts on respective boards and conductors from a plurality of channels of a drive IC are connected with a high accuracy is provided. The drive device according to an embodiment includes a first board (22), a second board (4), and a relay board (3). On the first board (22), a plurality of elements (6) are arranged, and a plurality of first conductors (64) that respectively send a drive signal to the plurality of elements are arranged in a terminal part (20). On the second board (4), a drive IC (41) that drives the plurality of elements is mounted, and second conductors (43) from a plurality of channels of the

drive IC are arranged in a terminal part (40). On the relay board (3), a plurality of third conductors (32) are formed from a terminal part (30) to be connected to the first board (22) to a terminal part (31) to be connected to the second board (4), and the third conductors (32) each having a width larger than a pitch of the second conductors (43) are arranged at a lower density than the second conductors (43) in the terminal part (31) connected to the second board (4), so that each of the first conductors (64) that sends a drive signal to the elements (6) is connected to each of the second conductors (43) from two or more of the channels of the drive IC (41).

FIG. 5



Description

FIELD

[0001] Embodiments described herein relate to a drive device and a liquid ejection head.

BACKGROUND

[0002] Liquid ejection heads that eject liquids are known. The liquid ejection heads are mounted on, for example, an inkjet printer, a 3D printer, a dispensing device, or the like. The inkjet printer ejects ink droplets from an inkjet head to form an image or the like on a surface of a recording medium. The 3D printer ejects droplets of a modeling material from a modeling material ejection head and cures the modeling material to form a three-dimensional modeled object. The dispensing device ejects droplets of a sample and supplies a predetermined amount of the sample to a plurality of containers or the like.

[0003] The liquid ejection head includes a plurality of channels for separately ejecting liquids. Each channel includes a nozzle for ejecting the liquid and an actuator for driving the liquid to be ejected from the nozzle. The actuators for the plurality of channels are formed on a common actuator board. A drive integrated circuit (IC) for driving these actuators, such as a chip on film (COF), is mounted on a flexible printed wiring board and is used. When driving the actuators, the drive IC sends a drive signal to each actuator through an individual wiring for each channel. The individual wirings are formed at respective terminal parts of the actuator board and the flexible printed wiring board such that a wiring width and a pitch match each other, and are connected by, for example, thermocompression bonding.

[0004] Since the flexible printed wiring board equipped with the drive IC such as the COF requires a development cost, the development cost can be reduced if a common flexible printed wiring board can be used for liquid ejection heads having different numbers of channels. However, in the flexible printed wiring board equipped with the drive IC such as the COF, the number of channels of drivers is increasing, and the wiring width and the pitch are made finer accordingly. Thus, in the mounting process of the actuator board and the flexible printed wiring board, high accuracy is required for the alignment between wirings to be connected.

DESCRIPTION OF THE DRAWINGS

[0005]

FIG. 1 is an overall configuration diagram of an inkjet printer provided with an inkjet head according to a first embodiment;

FIG. 2 is a perspective view of the inkjet head;

FIG. 3 is a cross-sectional view of an actuator of the

inkjet head;

FIG. 4 is a development view before connecting an actuator board, a relay flexible printed wiring board, a flexible printed wiring board, and a printed circuit board to each other;

FIG. 5 is a plan view of a state in which the actuator board, the relay flexible printed wiring board, the flexible printed wiring board, and the printed circuit board are connected to each other;

FIG. 6 is a side view of the state in which the actuator board, the relay flexible printed wiring board, the flexible printed wiring board, and the printed circuit board are connected to each other;

FIG. 7 is an enlarged view of a wiring connection portion between the relay flexible printed wiring board and the flexible printed wiring board;

FIGS. 8A and 8B are enlarged views of the wiring connection portion between the relay flexible printed wiring board and the flexible printed wiring board; and

FIG. 9 is a perspective view of a display device according to a second embodiment.

DETAILED DESCRIPTION

[0006] In general, according to one embodiment, a drive device and a liquid ejection head are provided, in which conductors from a plurality of elements arranged in terminal parts on respective boards and conductors from a plurality of channels of a drive IC are connected with a high accuracy.

[0007] The drive device according to the embodiment includes a first board, a second board, and a relay board. On the first board, a plurality of elements are arranged, and a plurality of first conductors configured to respectively send a drive signal to each of the plurality of elements are arranged in a terminal part. On the second board, a drive IC configured to drive the plurality of elements is mounted, and second conductors from a plurality of channels of the drive IC are arranged in a terminal part. On the relay board, a plurality of third conductors are formed from a terminal part to be connected to the first board to a terminal part to be connected to the second board, and the third conductors each having a width larger than a pitch of the second conductors are arranged at a lower density than the second conductors in the terminal part to be connected to the second board, so that each of the first conductors configured to send the drive signal to each of the elements is connected to each of the second conductors from two or more of the channels of the drive IC.

[0008] Preferably, the drive IC is set such that outputs of two or more of the channels connected to one of the elements are the same.

[0009] Preferably, the width of each of the third conductors is the same as a width from an outer end of one of two or more adjacent second conductors to an outer end of the other one thereof.

[0010] Preferably, a separation distance between adjacent third conductors is the same as a separation distance between adjacent second conductors.

[0011] Preferably, the third conductors in the terminal part to be connected to the second board are arranged at half the density of the second conductors in the terminal part to be connected to the relay board.

[0012] Preferably, each of the second conductors is connected to any one of the third conductors.

[0013] According to an embodiment, the drive device is configured as a liquid ejection head comprising: an actuator board on which actuators of a plurality of channels configured to eject a liquid are arranged, and a plurality of first conductors configured to respectively send a drive signal to each of the plurality of actuators are arranged in a terminal part; a flexible board on which a drive integrated circuit (IC) configured to drive the actuators is mounted, and second conductors from a plurality of channels of the drive IC are arranged in a terminal part; and a relay flexible board on which a plurality of third conductors are formed from a terminal part to be connected to the actuator board to a terminal part to be connected to the flexible board, and the third conductors each having a width larger than a pitch of the second conductors are arranged at a lower density than the second conductors in the terminal part to be connected to the flexible board, so that each of the first conductors configured to send the drive signal to each of the actuators is connected to each of the second conductors from two or more of the channels of the drive IC.

[0014] According to an embodiment, the drive device is configured as a display device comprising a display board, a flexible printed wiring board, and a relay flexible printed wiring board.

[0015] Hereinafter, a drive device and a liquid ejection head according to embodiments will be described in detail with reference to the accompanying drawings. In the drawings, the same configurations are denoted by the same reference numerals.

(First Embodiment)

[0016] A drive device according to a first embodiment will be described in detail by taking a liquid ejection head as an example. The liquid ejection head is, for example, an inkjet head mounted on an inkjet printer 10 that forms an image on a recording medium. FIG. 1 shows a schematic configuration of the inkjet printer 10. The inkjet printer 10 is provided with a cassette 12 for storing sheets S that are an example of a recording medium, an upstream conveyance path 13 for the sheets S, a conveyance belt 14 for conveying the sheets S picked up from the cassette 12, a plurality of inkjet heads 100 to 103 for ejecting ink droplets toward the sheets S on the conveyance belt 14, a downstream conveyance path 15 for the sheets S, a discharge tray 16, and a control board 17 inside a housing 11. An operation unit 18, which is a user interface, is arranged on an upper side of the housing 11.

[0017] Image data to be printed on the sheets S is generated by, for example, a computer 200 that is an externally connected device. The image data generated by the computer 200 is sent to the control board 17 of the inkjet printer 10 through a cable 201 and connectors 202, 203.

[0018] The sheets S are fed one by one by a pickup roller 204 from the cassette 12 to the upstream conveyance path 13. The upstream conveyance path 13 includes a feed roller pair 131, 132, and sheet guide plates 133, 134. The sheets S are sent to an upper surface of the conveyance belt 14 via the upstream conveyance path 13. An arrow 104 in the drawing indicates a conveyance path of the sheets S from the cassette 12 to the conveyance belt 14.

[0019] The conveyance belt 14 is a net-shaped endless belt including a large number of through holes formed on a surface thereof. The conveyance belt 14 is rotatably supported by three rollers of a driving roller 141 and driven rollers 142, 143. A motor 205 rotates the conveyance belt 14 by rotating the driving roller 141. In the drawing, an arrow 105 indicates a rotation direction of the conveyance belt 14. The conveyance belt 14 is provided with a negative pressure container 206 on a back surface side thereof. The negative pressure container 206 is connected to a depressurizing fan 207. The fan 207 creates a negative pressure in the negative pressure container 206 by forming an air flow, and causes the sheets S to be adsorbed to and held on the upper surface of the conveyance belt 14. In the drawing, an arrow 106 indicates a flow of the air flow.

[0020] The inkjet heads 100 to 103, which are examples of the liquid ejection heads, are arranged so as to face the sheets S adsorbed to and held on the conveyance belt 14 with a slight gap of, for example, 1 mm. The inkjet heads 100 to 103 eject ink droplets toward the sheets S, respectively. The inkjet heads 100 to 103 print an image on the sheets S that pass below. The inkjet heads 100 to 103 have the same structure except that colors of ink to be ejected are different. The colors of the ink are, for example, cyan, magenta, yellow, and black.

[0021] The inkjet heads 100 to 103 are connected to ink tanks 315 to 318 and ink supply pressure adjusting devices 321 to 324 via ink flow paths 311 to 314, respectively. The ink tanks 315 to 318 are arranged above the inkjet heads 100 to 103, respectively. To prevent ink from leaking from nozzles 25 (see FIG. 2) of the inkjet heads 100 to 103 during standby, the ink supply pressure adjusting devices 321 to 324 respectively adjust the inside of the inkjet heads 100 to 103 to be a negative pressure with respect to the atmospheric pressure, for example, -1.2 kPa. When an image is formed, the ink in the ink tanks 315 to 318 is supplied to the inkjet heads 100 to 103 by the ink supply pressure adjusting devices 321 to 324.

[0022] After forming the image, the sheets S are sent from the conveyance belt 14 to the downstream conveyance path 15. The downstream conveyance path 15 in-

cludes feed roller pairs 151, 152, 153, 154, and sheet guide plates 155, 156 that define the conveyance path of the sheets S. The sheets S are sent from a discharge port 157 to the discharge tray 16 via the downstream conveyance path 15. An arrow 107 in the drawing indicates the conveyance path of the sheets S.

[0023] Subsequently, the configurations of the inkjet heads 100 to 103 will be described. Hereinafter, the inkjet head 100 will be described with reference to FIGS. 2 to 6, but the inkjet heads 101 to 103 also have the same structure as the inkjet head 100.

[0024] As shown in FIG. 2, the inkjet head 100 includes a nozzle head unit 2 that is an example of a liquid ejection unit. The nozzle head unit 2 includes a nozzle plate 21, an actuator board 22, a sealing member 23 for sealing openings of pressure chambers 61 and air chambers 62 formed on the actuator board 22, and an ink supply port 24 formed in the sealing member 23. The ink supply port 24 is connected to the ink supply pressure adjusting device 321 of FIG. 1 via the ink flow path 311.

[0025] The actuator board 22 as the first board is connected to a flexible printed wiring board 4 as the second board via a relay flexible printed wiring board 3 as the relay board. The flexible printed wiring board 4 is further connected to a printed circuit board 5 as a third board. The relay flexible printed wiring board 3 is an example of a relay flexible board. The flexible printed wiring board 4 is an example of a flexible board.

[0026] The flexible printed wiring board 4 is equipped with an integrated circuit (IC) 41 for driving (hereinafter referred to as a drive IC) that is a driver chip. The drive IC 41 temporarily stores printing data sent from the control board 17 of the inkjet printer 10 via the printed circuit board 5, and outputs a drive signal for discharging ink at a predetermined timing.

[0027] The nozzle plate 21, which is an example of a nozzle unit, is a rectangular plate made of a resin such as polyimide or a metal such as stainless steel. The nozzles 25 for discharging ink are arranged along a longitudinal direction (X direction) of the nozzle plate 21. A density of the nozzles is set, for example, within the range of 150 to 1200 dpi. The nozzles 25 are not limited to one row, and may be arranged in two or more rows. FIG. 2 shows a small number of nozzles 25 for the convenience of drawing.

[0028] The actuator board 22 is, for example, a rectangular board made of insulating ceramics. A plurality of pressure chambers 61 and air chambers 62 are alternately arranged on the actuator board 22 along a first direction, for example, the X direction. Each of the pressure chambers 61 communicates with a respective one of the nozzles 25. The pressure chambers 61 communicate with the ink supply port 24 via, for example, a common ink chamber (not shown) formed on the actuator board 22 or the sealing member 23. On the other hand, each of the air chambers 62 arranged adjacent to a respective one of the pressure chambers 61 is, for example, a closed space that does not communicate with the noz-

zles 25 and the common ink chamber (not shown).

[0029] As shown in FIG. 3, the pressure chambers 61 and the air chambers 62 are formed by cutting out, for example, two piezoelectric members 26, 27 in a second direction such as a Z direction, for example, in a rectangular groove shape, the two piezoelectric members 26, 27 being laminated in directions in which polarization directions thereof are opposite to each other (for example, opposing directions) on the actuator board 22. That is, the pressure chamber 61 and the air chamber 62 adjacent thereto are partitioned by a side wall formed by the piezoelectric members 26, 27 laminated in a third direction, for example, a Y direction.

[0030] Each of electrodes 63 is integrally formed on a bottom surface and two side surfaces of each of the pressure chambers 61. The electrode 63 of the pressure chamber 61 is connected to an individual wiring 64 that is a wiring electrode. Each of electrodes 65 is integrally formed on a bottom surface and two side surfaces of each of the air chambers 62. The electrode 65 of the air chamber 62 is connected to a common wiring 66 which is a wiring electrode. That is, a connection point between the electrode 63 of the pressure chamber 61 and the individual wiring 64 is one terminal of each of actuators 6. A connection point between the electrode 65 of the air chamber 62 and the common wiring 66 is the other terminal of each of the actuators 6. The electrodes 63, 65 are formed of, for example, a nickel thin film. The actuators 6 arranged on the actuator board 22 are examples of elements arranged on the first board.

[0031] The individual wiring 64 is connected to a driver D (that is, a drive circuit) of the drive IC 41. In this case, the individual wiring 64 from each of the actuators 6 is connected to two drivers D of the drive IC 41 by adopting a wiring connection structure described in detail later. That is, an actuator 6 of #1ch is connected to the drivers D of two channels #1ch and #2ch of the drive IC 41. The same applies to actuators 6 of other channels. The drive IC 41 applies a drive voltage V1 as the drive signal to an actuator 6 of a channel for discharging ink. In this case, the drive IC 41 is set such that outputs of two drivers D connected to one actuator 6 are the same. On the other hand, the common wiring 66 is connected to, for example, ground (GND). With this configuration, in the actuator 6 to which the drive voltage V1 is applied, an electric field is applied in a direction intersecting (preferably orthogonal to) polarization axes of the piezoelectric members 26, 27, and the piezoelectric members 26, 27, which are side walls of the pressure chamber 61 in the X direction, are deformed symmetrically in the X direction in a shear mode.

[0032] That is, each of the pressure chambers 61 for the ink is formed by being sandwiched between a pair of columnar actuators 6 using the piezoelectric members 26, 27. A potential difference is applied to both walls of the columnar actuator 6, that is, an inner wall and an outer wall of the pressure chamber 61, and the actuator 6 is deformed by being charged. Accordingly, a volume

of the pressure chamber 61 changes, and as a result, an ink pressure in the pressure chamber 61 changes. By adjusting a magnitude and timing of this change, the ink is ejected from the nozzle 25.

[0033] FIGS. 4 to 6 show wiring structures of the actuator board 22, the relay flexible printed wiring board 3, the flexible printed wiring board 4, and the printed circuit board 5, separately. FIG. 4 is a development view before connecting the boards to each other. FIG. 5 is a plan view of a state in which the boards are connected. FIG. 6 is a side view of the state in which the boards are connected. A terminal part 20 of the actuator board 22 and a terminal part 30 of the relay flexible printed wiring board 3 are connected with each other. A terminal part 31 of the relay flexible printed wiring board 3 and a terminal part 40 of the flexible printed wiring board 4 are connected with each other. A terminal part 42 of the flexible printed wiring board 4 and a terminal part 50 of the printed circuit board 5 are connected with each other.

[0034] On the actuator board 22, each of the individual wirings 64 drawn from one terminal of each of the actuators 6 is formed up to the terminal part 20. FIGS. 4 and 5 simplify the illustration of the actuators 6 for the convenience of drawing. As the individual wirings 64 in the terminal part 20, wirings formed with the same wiring width are arranged in parallel at equal intervals, for example. The individual wirings 64 are formed in a thin film form using, for example, nickel, aluminum, gold, or an alloy of these metals. In order to ensure an insulating property, for example, an insulating layer or an insulating member is provided in a region excluding the terminal part 20. The wiring width and wiring interval of the individual wirings 64 in the terminal part 20 are selected, for example, within the range of 10 μm to 100 μm . As an example, a wiring density of the individual wirings 64 in the terminal part 20 is set in terms of a resolution of 150 dpi. The thickness of the individual wirings 64 is, for example, 0.4 μm . The individual wirings 64 formed in the terminal part 20 of the actuator board 22 are an example of the first conductor from the elements formed on the first board.

[0035] Each of the common wirings 66 is formed on a surface of the actuator board 22 along an arrangement direction of the actuators 6 and is connected to the other terminal of each of the actuators 6. The common wirings 66 are further formed up to the terminal part 20. In this case, the common wirings 66 are preferably formed from both ends of the portions formed along the arrangement direction of the actuators 6 to the terminal part 20, so that a voltage drop due to current concentration can be reduced even though a charge or discharge current is supplied to a large number of actuators 6. Also in the terminal part 20, the common wirings 66 are arranged on both sides of a group of the individual wirings 64. The common wirings 66 are formed in a thin film form using, for example, nickel, aluminum, gold, or an alloy of these metals. In order to ensure the insulating property, for example, an insulating layer or an insulating member is provided

in a region excluding the terminal part 20. The wiring width of the common wirings 66 at the terminal part 20 is, for example, 1.5 mm. The thickness of the common wirings 66 is, for example, 0.4 μm .

[0036] The relay flexible printed wiring board 3 is a flexible printed wiring board using a synthetic resin film such as polyimide. On the relay flexible printed wiring board 3, individual relay wirings 32 and common relay wirings 33 extending from one terminal part 30 to the other terminal part 31 are formed separately. The number of the individual relay wirings 32 and the number of the common relay wirings 33 are at least the same as the number of the individual wirings 64 and the number of the common wirings 66 of the terminal part 20 of the actuator board 22, respectively. It is preferable that the wirings 32, 33 are formed on the same side (one side) of the board. The number, wiring width, and wiring density of individual relay wirings 32 in the terminal part 30 are preferably the same as the number, wiring width, and wiring density of the individual wirings 64 of the terminal part 20 of the actuator board 22. On the other hand, the number and wiring width of individual relay wirings 32 in the terminal part 31 do not change, but the wiring density is increased by narrowing a width of the board so as to match the width of the flexible printed wiring board 4 that is a connection counterpart. The wiring density is in terms of, for example, a resolution of 300 dpi. The individual relay wirings 32 are an individual wiring formed on the relay flexible printed wiring board 3. Thus, the individual relay wirings 32 formed in the terminal part 31 of the relay flexible printed wiring board 3 are an example of the third conductor formed in the relay board.

[0037] The flexible printed wiring board 4 is a flexible printed wiring board using a synthetic resin film such as polyimide. That is, the flexible printed wiring board 4 is a board of the same type as the relay flexible printed wiring board 3. The drive IC 41 is, for example, a driver chip formed on a silicon semiconductor substrate. A preferred example of the flexible printed wiring board 4 is a chip on film (COF). The flexible printed wiring board 4 is provided with output wirings 43, input wirings 44, power supply wirings 45 for the voltage V_I, ground wirings 46, and common wirings 47. Reference numeral 48 indicates a portion for alignment. It is preferable that the wirings 43 to 47 and the drive IC 41 are formed on the same surface (one side) of the board. In the case of COF, the wirings 43 to 47 and the drive IC 41 are formed on one side, but when the wirings 43 to 47 and the drive IC 41 are formed on both sides, a through hole or the like is additionally formed. The output wirings 43 drawn out from the drive IC 41 are formed up to the terminal part 40. The output wirings 43 are individual wirings formed on the flexible printed wiring board 4. Thus, the output wirings 43 formed in the terminal part 40 of the flexible printed wiring board 4 are an example of the second conductor from channels of the drive IC 41 mounted on the second board.

[0038] Here, the connection between the individual relay wirings 32 of the relay flexible printed wiring board 3

and the output wirings 43 of the flexible printed wiring board 4 will be described in more detail with reference to FIG. 7. (a) of FIG. 7 is a plan view of the connection portion between the individual relay wirings 32 and the output wirings 43. (b) of FIG. 7 is a cross-sectional view of the connection portion between the individual relay wirings 32 and the output wirings 43. (c) of FIG. 7 shows an example of the wiring width and wiring interval of the individual relay wirings 32 and the output wirings 43. As described above, the flexible printed wiring board 4 equipped with the drive IC 41 such as the COF has an increasing number of driver channels, and by implementing fine pitch of wirings without increasing a size of the board, the output wirings 43 in the terminal part 40 form a high-density arrangement. The number of channels of the drive IC 41 is, for example, 1500. The wiring density of the output wirings 43 of the terminal part 40 is in terms of, for example, a resolution of 600 dpi. The wiring width of the output wirings 43 is, for example, 18 μm . The wiring interval is, for example, 20 μm .

[0039] On the other hand, the number of channels for ejecting the ink in the nozzle head unit 2 also depends on a density of nozzles, and is, for example, 700 to 1500. As described above, the relay flexible printed wiring board 3 is prepared so that the common flexible printed wiring board 4 can be used even when the number of the channels for ejecting the ink (that is, the number of actuators 6) is smaller than the number of the channels of the drive IC 41.

[0040] For more details, the wiring width of the individual relay wirings 32 of the relay flexible printed wiring board 3 is increased while the wiring density in the terminal part 31 is low according to the number of the channels for ejecting the ink and the number of the channels of the drive IC 41. As a preferable example in (a) to (c) of FIG. 7, the wiring density of the individual relay wirings 32 in the terminal part 31 of the relay flexible printed wiring board 3 is reduced to a low density of half of the wiring density of the output wirings 43 in the terminal part 40 of the flexible printed wiring board 4, and the wiring width is set to be the same as a width (separation distance) L1 from an outer end of one of two adjacent output wirings 43 to an outer end of the other one thereof. That is, the wiring density is set in terms of a resolution of 300 dpi, and the wiring width is set to 56 μm . Further, the wiring width of the individual relay wiring 32 is set to 20 μm , which is the same as the wiring width of the output wiring 43.

[0041] By setting in this way, when the terminal parts 31, 40 are overlapped with each other, the individual relay wiring 32 is connected to the two adjacent output wirings 43. In addition, as a desirable form, every output wiring 43 is connected to any one of the individual relay wirings 32. As a result, all the channels of the drive IC 41 can be used even though the number of the channels for ejecting the ink and the number of the channels of the drive IC 41 are different. As shown in FIG. 3, if one actuator 6 is driven with the same output of the two drivers D, a drive

capacity for the actuator 6 using the piezoelectric members 26, 27 is high. The impedance is low due to the increased wiring width.

[0042] As shown in FIG. 8A, even though the wiring density in the terminal part 31 of the relay flexible printed wiring board 3 is 300 dpi, a usage rate of the channels of the drive IC 41 is halved when the wiring width of the individual relay wiring 32 is 18 μm , which is the same as that of the output wiring 43. The drive capacity for charging or discharging the actuators 6 may be insufficient. As shown in FIG. 8B, when the wiring density in the terminal part 31 is set to 600 dpi and a wiring density on the terminal part 30 side is set to 300 dpi by connecting two individual relay wirings 32 to one, the usage rate of the channels of the drive IC 41 is improved, but a high alignment accuracy of the wirings is required in a mounting process for connecting boards to each other. Since the wiring width of the individual relay wiring 32 is narrow, the impedance becomes high, and the drive capacity for charging or discharging the actuators 6 may be limited.

[0043] FIG. 7 shows a configuration in which one individual relay wiring 32 is connected to two output wirings 43 as a preferable example, but the wiring width of the individual relay wiring 32 may be changed to be connected to three or more output wirings 43. The wiring width of the individual relay wiring 32 is preferably the same as the width from the outer end of one of the two adjacent output wirings 43 to the outer end of the other one thereof, but the wiring width of the individual relay wiring 32 can be any value as long as the width is at least larger than a pitch L2 of the two adjacent output wirings 43 (see (a) of FIG. 7). The wiring density and wiring width of the individual relay wirings 32 of the relay flexible printed wiring board 3 can be appropriately adjusted based on the number of the channels for ejecting the ink and the number of the channels of the drive IC 41. Accordingly, a common flexible printed wiring board 4 can be used for various actuator boards 22. Two or more flexible printed wiring boards 4 may be connected to one actuator board 22 on both sides or one side in parallel depending on the number of channels for ejecting the ink.

[0044] Returning to FIGS. 4 to 6, the input wirings 44 drawn out from the drive IC 41 are formed up to the terminal part 42 on the side to be connected to the printed circuit board 5. Since the drive IC 41 can be controlled by serial communication, the number of the input wirings 44 can be smaller than the number of the output wirings 43. The common wirings 47 are formed from the terminal part 40 to the terminal part 42.

[0045] The power supply wirings 45 and the ground wirings 46 are connected to the drive IC 41 separately. The power supply wirings 45 and the ground wirings 46 are formed up to the terminal part 42 to be connected to the printed circuit board 5 separately. The output wirings 43, the input wirings 44, the power supply wirings 45, the ground wirings 46, and the common wirings 47 are formed in a thin film shape using, for example, copper. The thickness is, for example, 8 μm . The wiring width

and wiring interval of the output wirings 43 of the terminal part 40 are, for example, 10 μm to 30 μm . The wiring width and wiring interval of the input wirings 44 of the terminal part 42 are, for example, 0.15 mm. The wiring width of the power supply wirings 45 and the ground wirings 46 is, for example, 0.4 mm. The wiring width of the common wirings 47 is, for example, 0.85 mm.

[0046] The printed circuit board 5 is a hard through-hole board in which an epoxy resin layer containing glass fibers and a copper wiring layer are laminated in a plurality of layers. The terminal part 50 is provided with output wirings 51, a power supply wiring 52, and a ground wiring 53 separately. Each of the output wirings 51 is connected to a respective one of the input wirings 44 of the flexible printed wiring board 4. The power supply wiring 52 is connected to the power supply wirings 45 of the flexible printed wiring board 4. The ground wiring 53 is connected to the ground wirings 46 and the common wirings 47 of the flexible printed wiring board 4. A signal for selectively driving each actuator 6 from the control board 17 of the inkjet printer 10 is sent to the output wirings 51. The drive voltage V1 is applied to the power supply wiring 52. The ground wiring 53 is connected to the ground (GND) by, for example, the control board 17 of the inkjet printer 10.

[0047] As shown in FIG. 6, the terminal part 20 of the actuator board 22 and the terminal part 30 of the relay flexible printed wiring board 3 are connected via an anisotropic conductive film (ACF) 7 as a preferable example. Specifically, the wirings of the terminal parts 20, 30 are connected all at once by arranging the terminal part 20 of the actuator board 22 and the terminal part 30 of the relay flexible printed wiring board 3 so as to face each other, interposing the ACF 7 between the terminal parts 20, 30, and then, for example, thermocompression-bonding the ACF 7 and the terminal parts 20, 30 with a thermocompression bonding tool. Accordingly, each of the individual wirings 64 can be electrically connected to a respective one of the individual relay wirings 32, and each of the common wirings 66 can be electrically connected to a respective one of the common relay wirings 33.

[0048] The terminal part 31 of the relay flexible printed wiring board 3 and the terminal part 40 of the flexible printed wiring board 4 are also connected via the ACF 7. The terminal part 42 of the flexible printed wiring board 4 and the terminal part 50 of the printed circuit board 5 are also connected via the ACF 7.

[0049] The inkjet head 100 is not limited to shear mode type actuators 6 in which the pressure chambers 61 and the air chambers 62 are alternately arranged. Shear mode and share wall type actuators 6 in which the pressure chambers 61 are continuously arranged may also be used. Drop-on-demand piezo type actuators or the like may also be used.

[0050] In the above-described embodiment, the inkjet head 100 of the inkjet printer 10 is described as an example of the liquid ejection head, but the liquid ejection head may be a modeling material ejection head of a 3D

printer or a sample ejection head of a dispensing device.

(Second Embodiment)

[0051] Next, a drive device according to a second embodiment will be described by taking a display device 8 such as a liquid crystal display and an organic electroluminescence display as an example. However, the same components as those in the first embodiment are denoted by the same reference numerals, and detailed descriptions thereof will be omitted.

[0052] The display device 8 includes a display board 80 such as a liquid crystal board. Although not shown, a plurality of elements such as liquid crystal elements are arranged in the X direction and the Y direction on the display board 80. The display board 80 is connected to the flexible printed wiring board 4 via the relay flexible printed wiring board 3. The flexible printed wiring board 4 is further connected to the printed circuit board 5. Elements of the display board 80 are driven by the drive IC 41 mounted on the flexible printed wiring board 4.

[0053] According to either one of the above embodiments, the relay flexible printed wiring board 3 is interposed between the boards 22, 80 on which the elements such as the actuators 6 are arranged and the flexible printed wiring board 4 on which the drive IC 41 is mounted, and the wiring density and wiring width of the individual relay wirings 32 of the relay flexible printed wiring board 3 are adjusted, so that the individual wirings 64 from the plurality of elements and the output wirings 43 from the plurality of channels of the drive IC 41 can be connected with high accuracy via the individual relay wirings 32.

[0054] The embodiments have been presented as examples and are not intended to limit the scope of the disclosure. The novel embodiments can be implemented in other various forms, and various omissions, replacements, and changes can be made without departing from the spirit of the disclosure. The embodiments and modifications thereof are included in the scope and gist of the disclosure, and are also included in the invention described in the scope of the claims and an equivalent scope thereof.

Claims

1. A drive device comprising:

a first board (22) on which a plurality of elements (6) are arranged, and a plurality of first conductors (64) configured to respectively send a drive signal to each of the plurality of elements are arranged in a terminal part (20);

a second board (4) on which a drive integrated circuit (IC) (41) configured to drive the plurality of elements is mounted, and second conductors (43) from a plurality of channels of the drive IC

are arranged in a terminal part (40); and
 a relay board (3) on which a plurality of third
 conductors (32) are formed from a terminal part
 (30) to be connected to the first board (22) to a
 terminal part (31) to be connected to the second
 board (4), and the third conductors (32) each
 having a width larger than a pitch of the second
 conductors (43) are arranged at a lower density
 than the second conductors (43) in the terminal
 part (31) to be connected to the second board
 (4), so that each of the first conductors (64) con-
 figured to send the drive signal to each of the
 elements (6) is connected to each of the second
 conductors (43) from two or more of the chan-
 nels of the drive IC (41).

2. The drive device according to claim 1, wherein the
 drive IC (41) is set such that outputs of two or more
 of the channels connected to one of the elements
 (6) are the same.
3. The drive device according to claim 1 or 2, wherein
 the width of each of the third conductors (32) is the
 same as a width from an outer end of one of two or
 more adjacent second conductors (43) to an outer
 end of the other one thereof.
4. The drive device according to any one of claims 1 to
 3, wherein a separation distance between adjacent
 third conductors (32) is the same as a separation
 distance between adjacent second conductors (43).
5. The drive device according to any one of claims 1 to
 4, wherein the third conductors (32) in the terminal
 part (31) to be connected to the second board (4)
 are arranged at half the density of the second con-
 ductors (43) in the terminal part (40) to be connected
 to the relay board (3).
6. The drive device according to any one of claims 1 to
 5, wherein each of the second conductors (43) is
 connected to any one of the third conductors (32).
7. The drive device according to any one of claims 1 to
 6 configured as a liquid ejection head (100) compris-
 ing:

the first board configured as an actuator board
 on which actuators of a plurality of channels con-
 figured to eject a liquid are arranged, and a plu-
 rality of first conductors configured to respec-
 tively send a drive signal to each of the plurality
 of actuators are arranged in a terminal part;
 the second board configured as a flexible board
 on which a drive integrated circuit (IC) config-
 ured to drive the actuators is mounted, and sec-
 ond conductors from a plurality of channels of
 the drive IC are arranged in a terminal part; and

the relay board configured as a relay flexible
 board on which a plurality of third conductors
 are formed from a terminal part to be connected
 to the actuator board to a terminal part to be
 connected to the flexible board, and the third
 conductors each having a width larger than a
 pitch of the second conductors are arranged at
 a lower density than the second conductors in
 the terminal part to be connected to the flexible
 board, so that each of the first conductors con-
 figured to send the drive signal to each of the
 actuators is connected to each of the second
 conductors from two or more of the channels of
 the drive IC.

8. The drive device according to any one of claims 1 to
 7 configured as a display device (8), comprising the
 first board configured as a display board (80), the
 second board configured as a flexible printed wiring
 board (4), and the relay board configured as a relay
 flexible printed wiring board (3).

FIG. 1

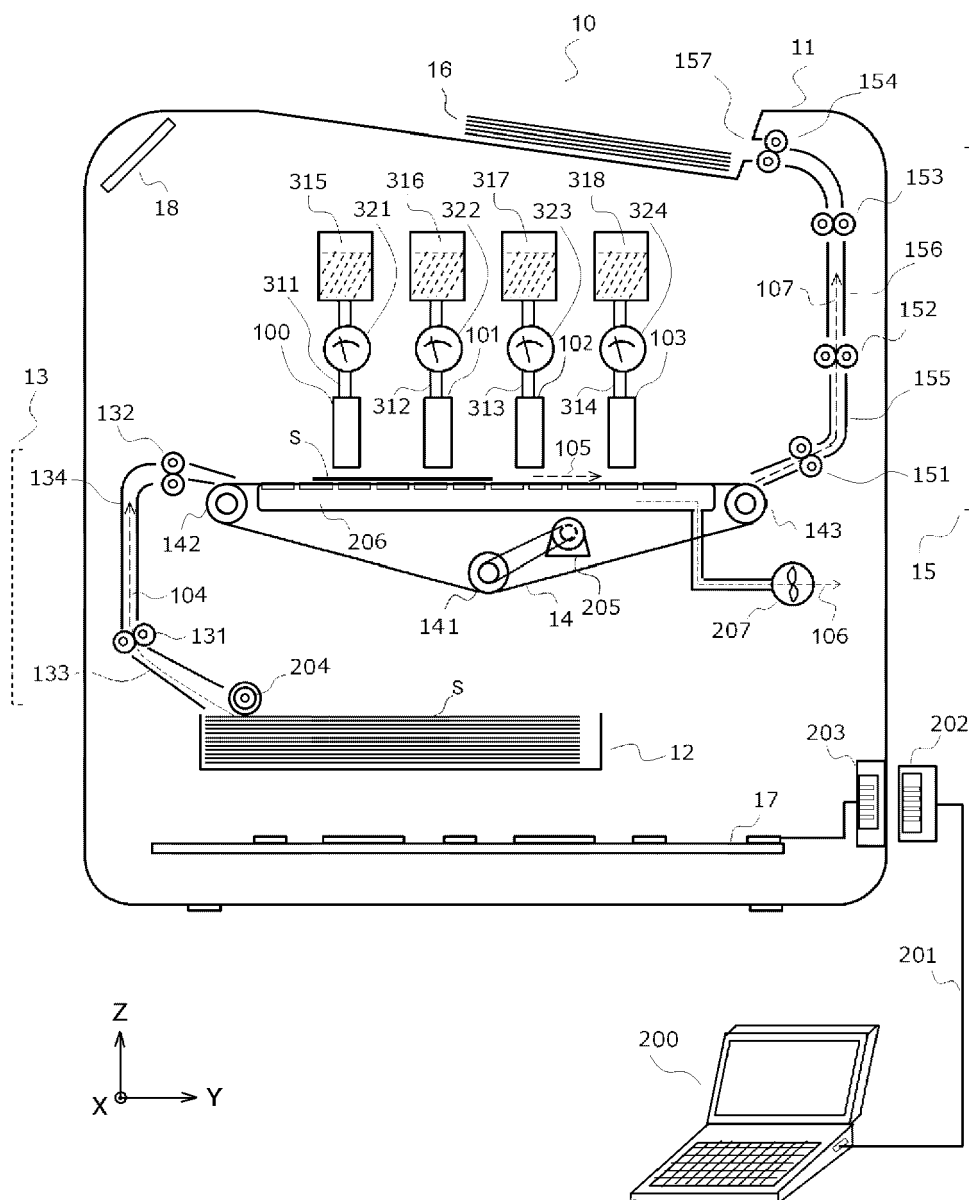


FIG. 2

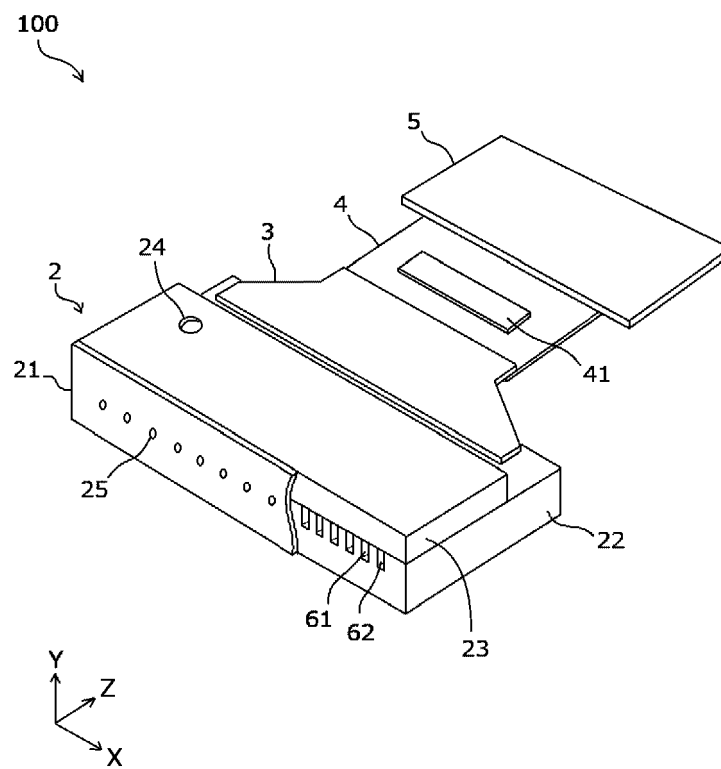


FIG. 3

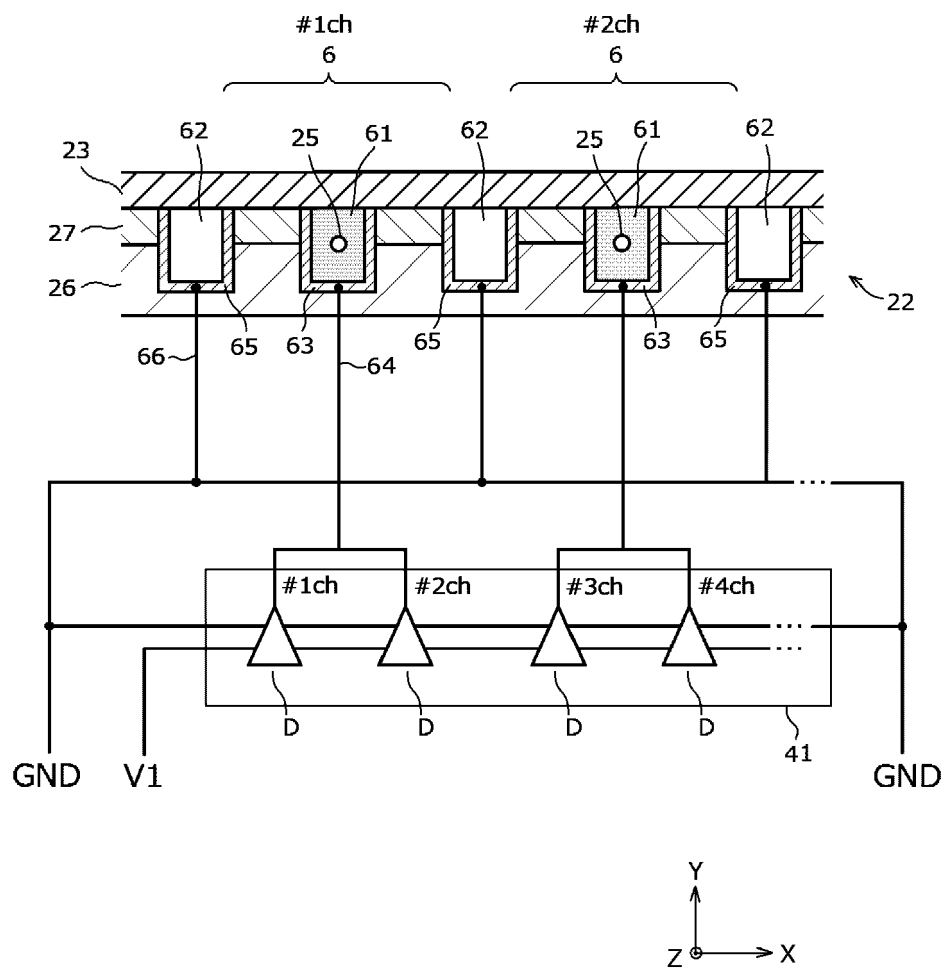


FIG. 4

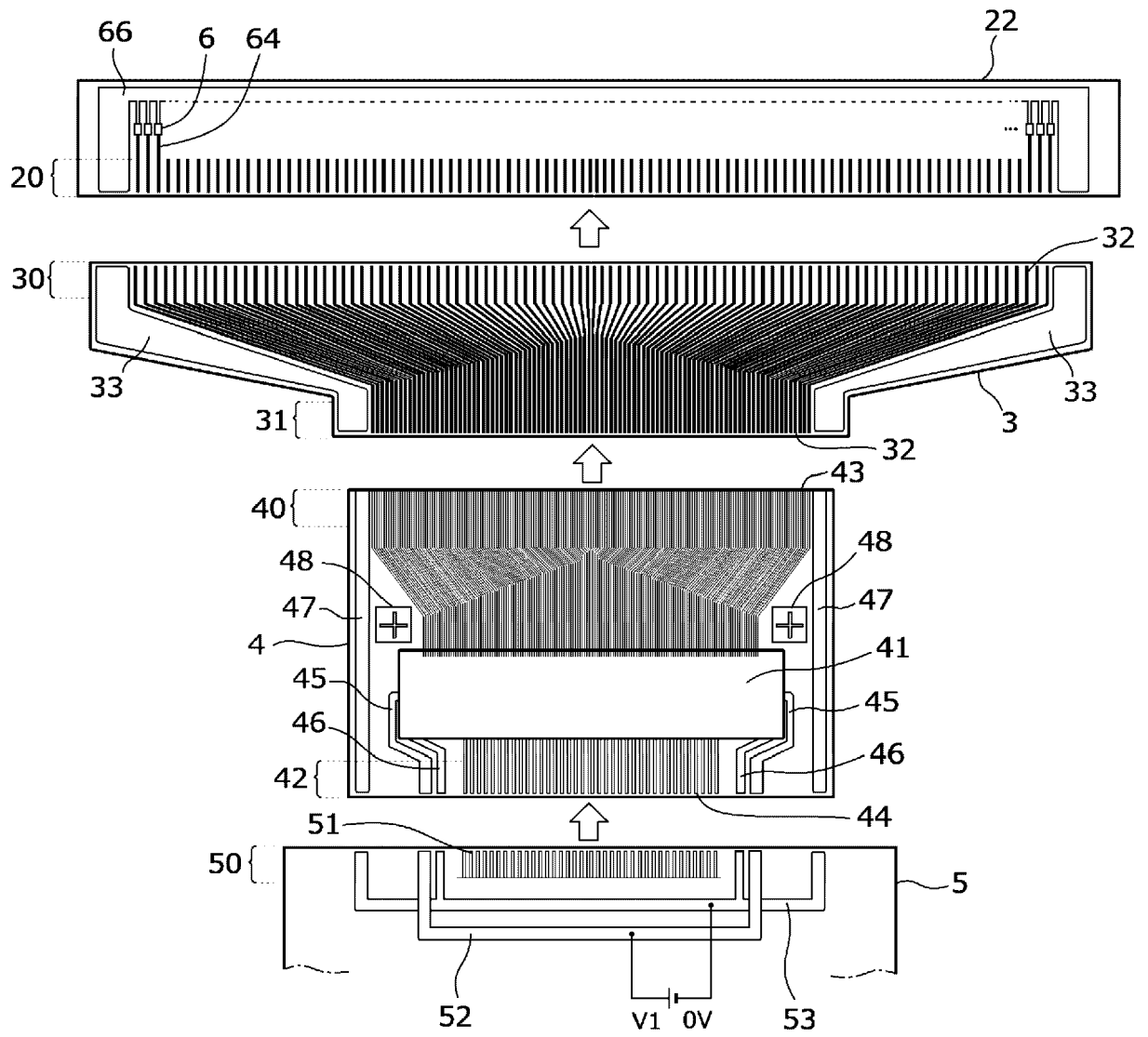


FIG. 5

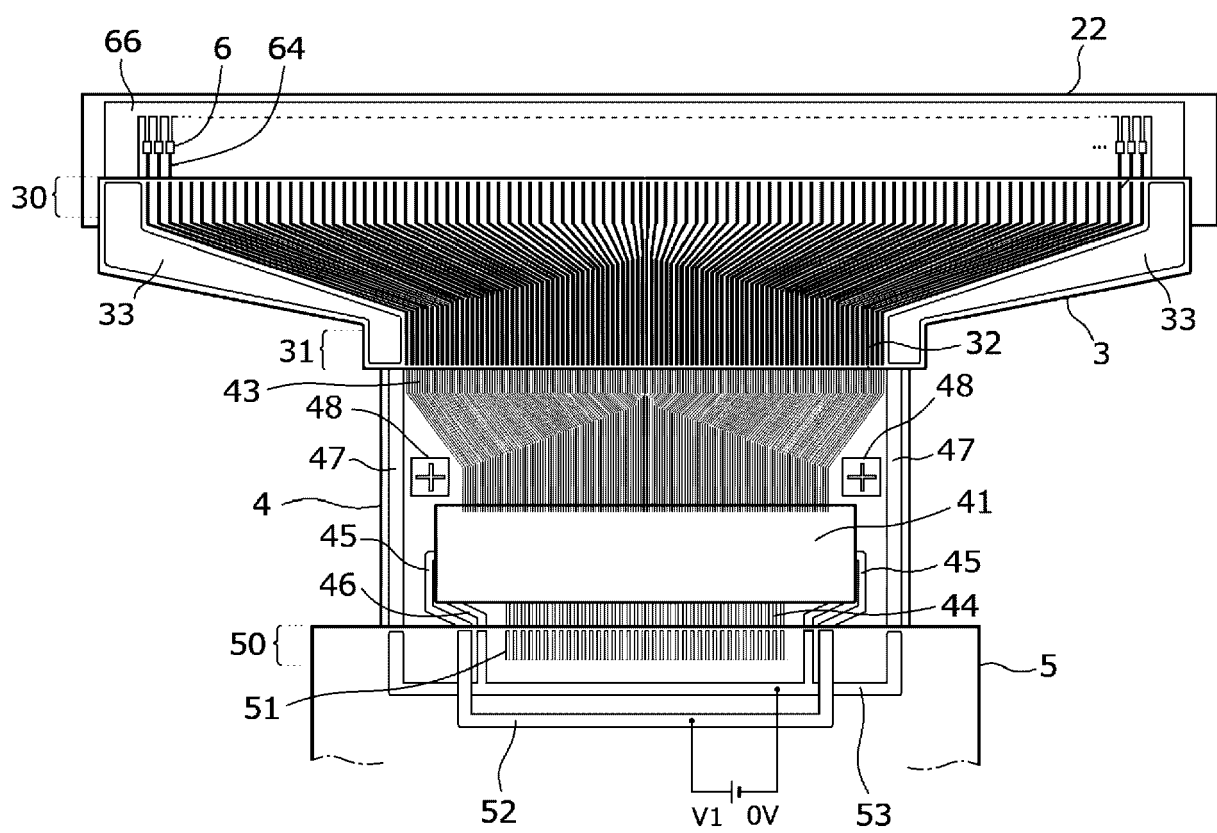


FIG. 6

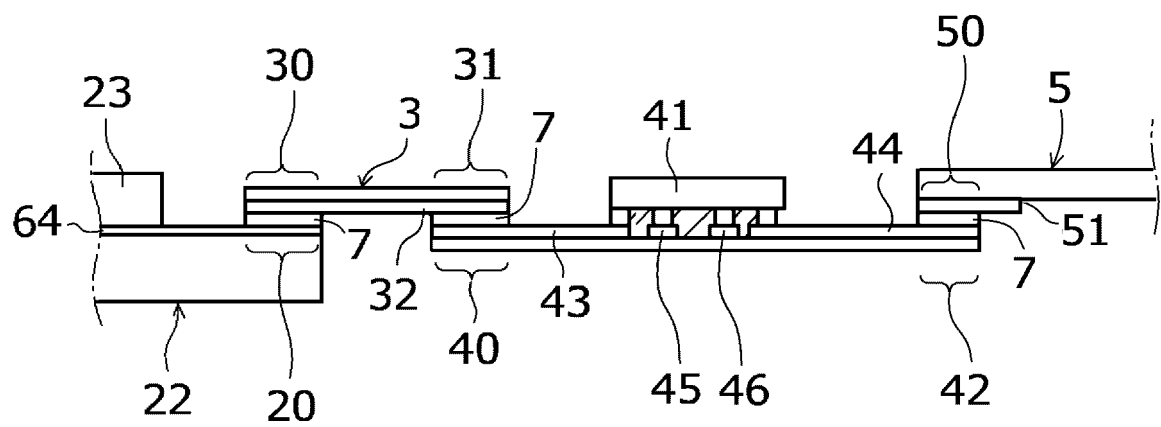


FIG. 7

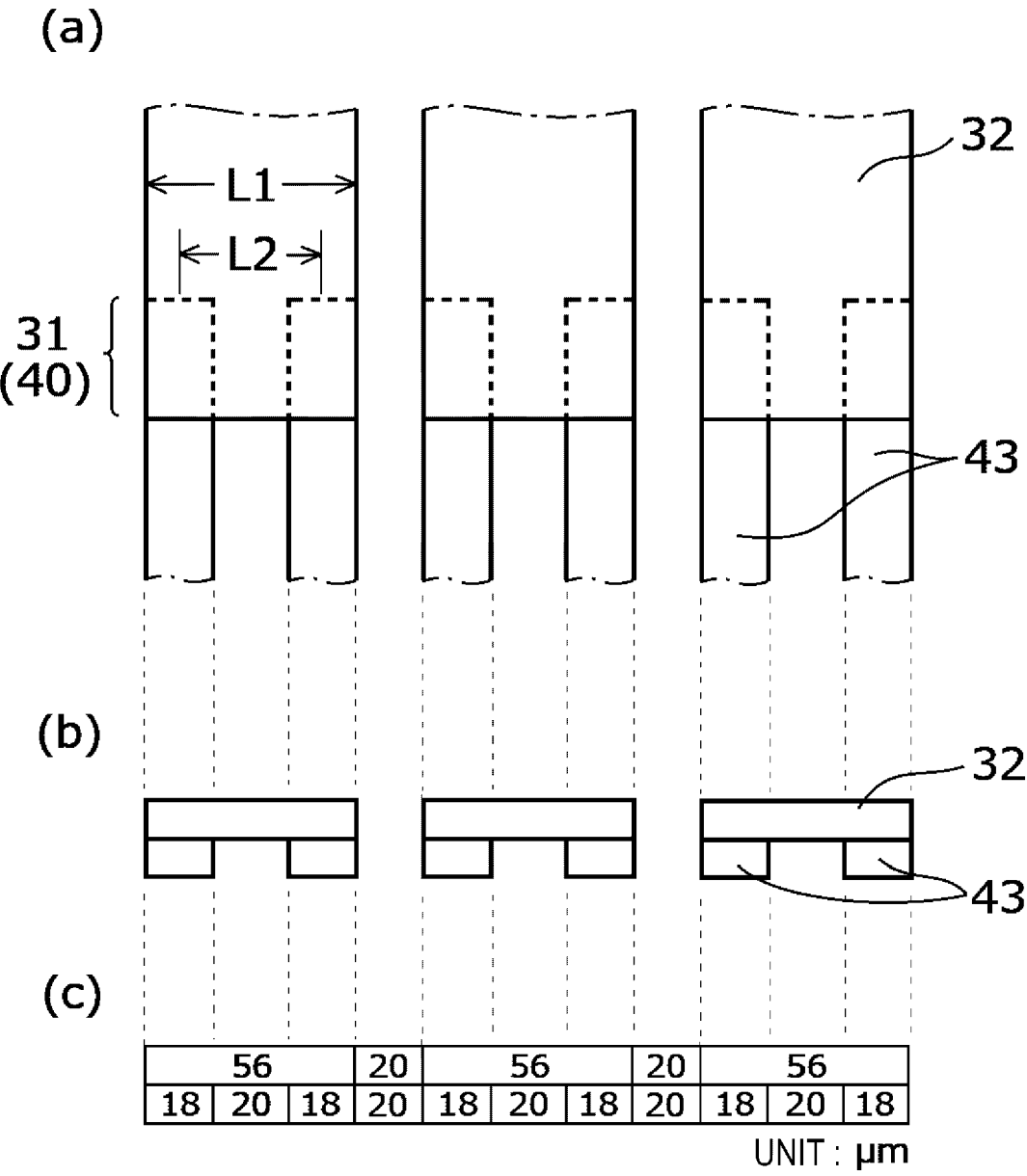


FIG. 8A

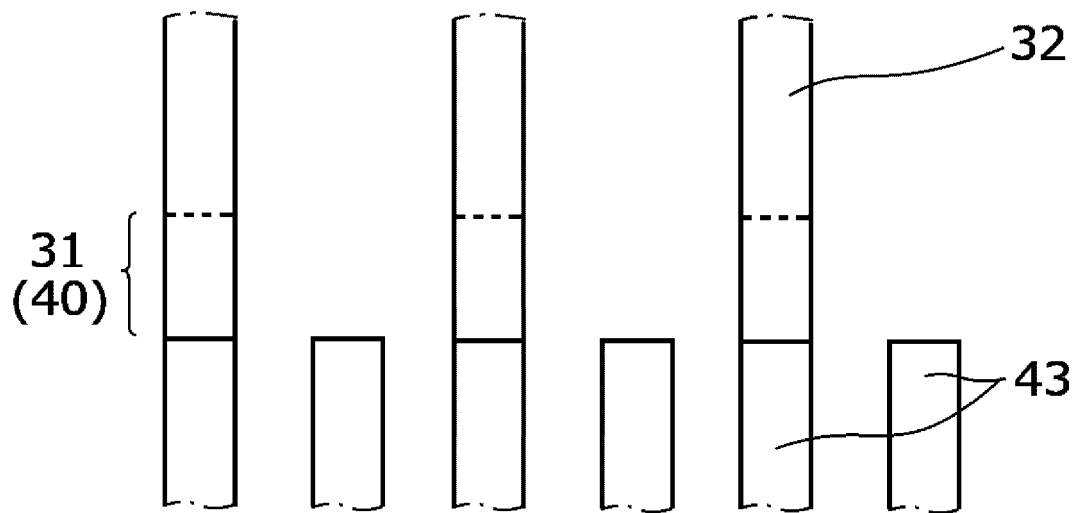


FIG. 8B

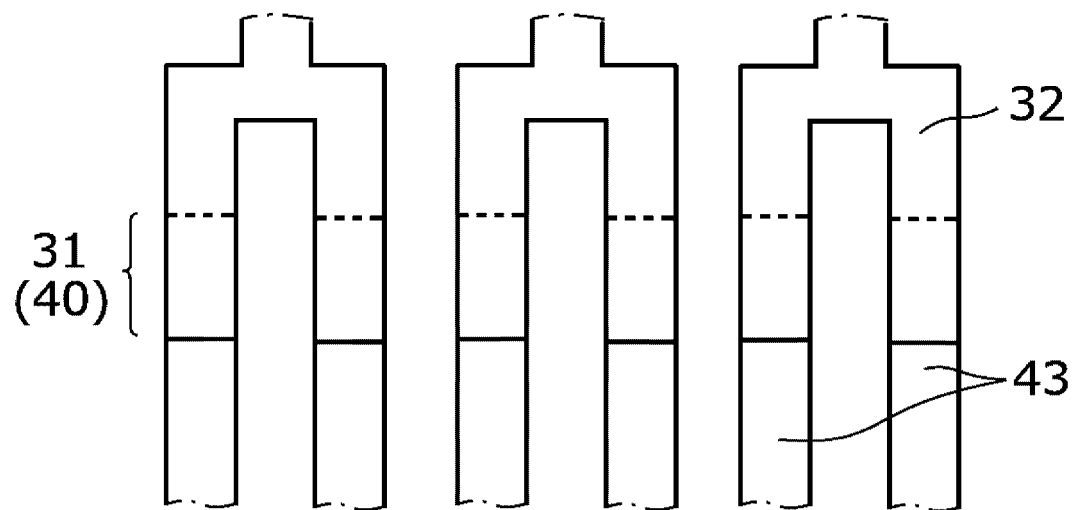
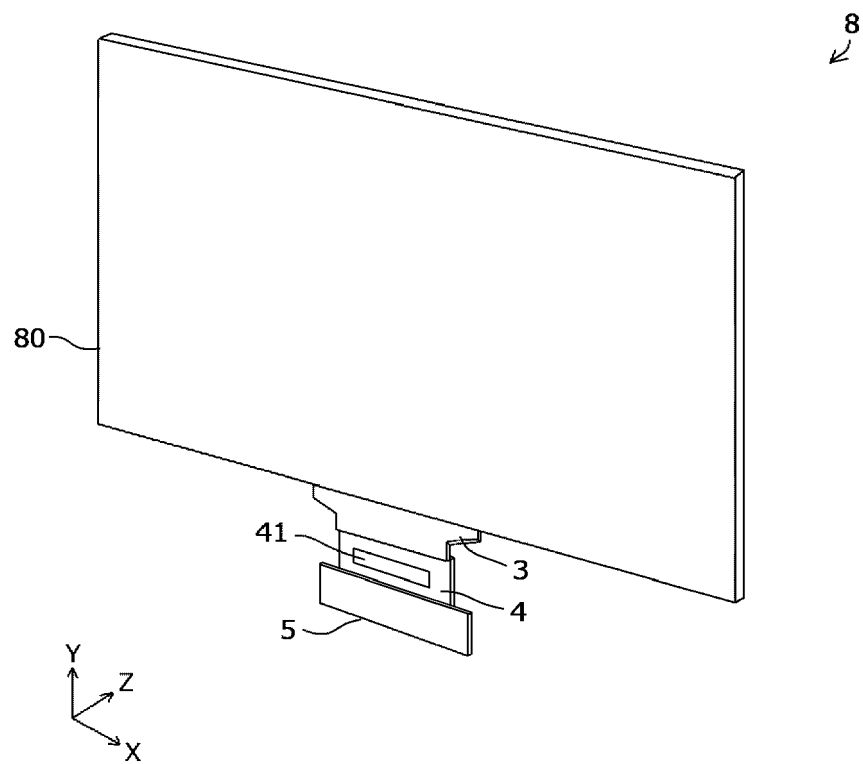


FIG. 9





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