US012391039B2

(12) **United States Patent**
Tsuyuki et al.

(10) **Patent No.: US 12,391,039 B2**
(45) **Date of Patent: Aug. 19, 2025**

(54) **LIQUID DISCHARGE APPARATUS**

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

(72) Inventors: **Masahiko Tsuyuki**, Chino (JP); **Makoto Takamuku**, Matsumoto (JP)

(73) Assignee: **SEIKO EPSON CORPORATION** (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 180 days.

(21) Appl. No.: **18/478,404**

(22) Filed: **Sep. 29, 2023**

(65) **Prior Publication Data**

US 2024/0109313 A1 Apr. 4, 2024

(30) **Foreign Application Priority Data**

Sep. 30, 2022 (JP) 2022-158889

(51) **Int. Cl.**

B41J 2/045 (2006.01)
D06P 5/30 (2006.01)

(52) **U.S. Cl.**

CPC ***B41J 2/04581*** (2013.01); ***B41J 2/04541*** (2013.01); ***D06P 5/30*** (2013.01)

(58) **Field of Classification Search**

CPC ... B41J 2/04548; B41J 2/04541; B41J 2/0455
See application file for complete search history.

(56) **References Cited**

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Matsumoto, Machine TranslationofCN-114425911-A, 2022 (Year: 2022).*

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Primary Examiner — Scott A Richmond
(74) *Attorney, Agent, or Firm* — Harness, Dickey & Pierce, P.L.C.

(57) **ABSTRACT**

There is provided a liquid discharge apparatus including: a substrate unit; a compressor that sends out compressed air; and a tube, in which the substrate unit includes a first drive circuit, a second drive circuit, and a wiring substrate having a plurality of rigid members and a flexible member, a first rigid member provided with a first drive circuit, having a first front surface, and laminated on the first surface of the first region, and a second rigid member provided with a second drive circuit, having a second front surface, and laminated on the first surface of the second region are positioned facing each other, and the compressor supplies the compressed air to a region where the first front surface and the second front surface face each other.

3 Claims, 32 Drawing Sheets

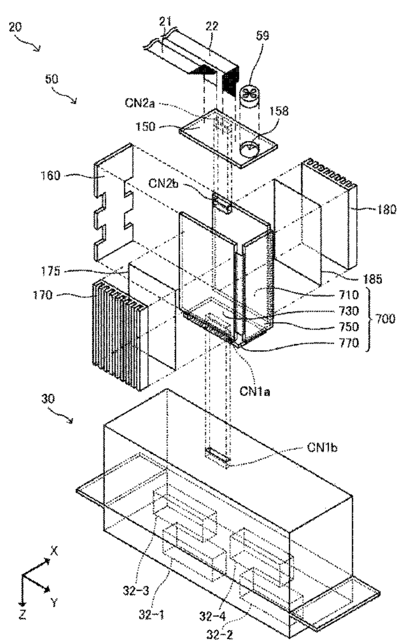


FIG. 1

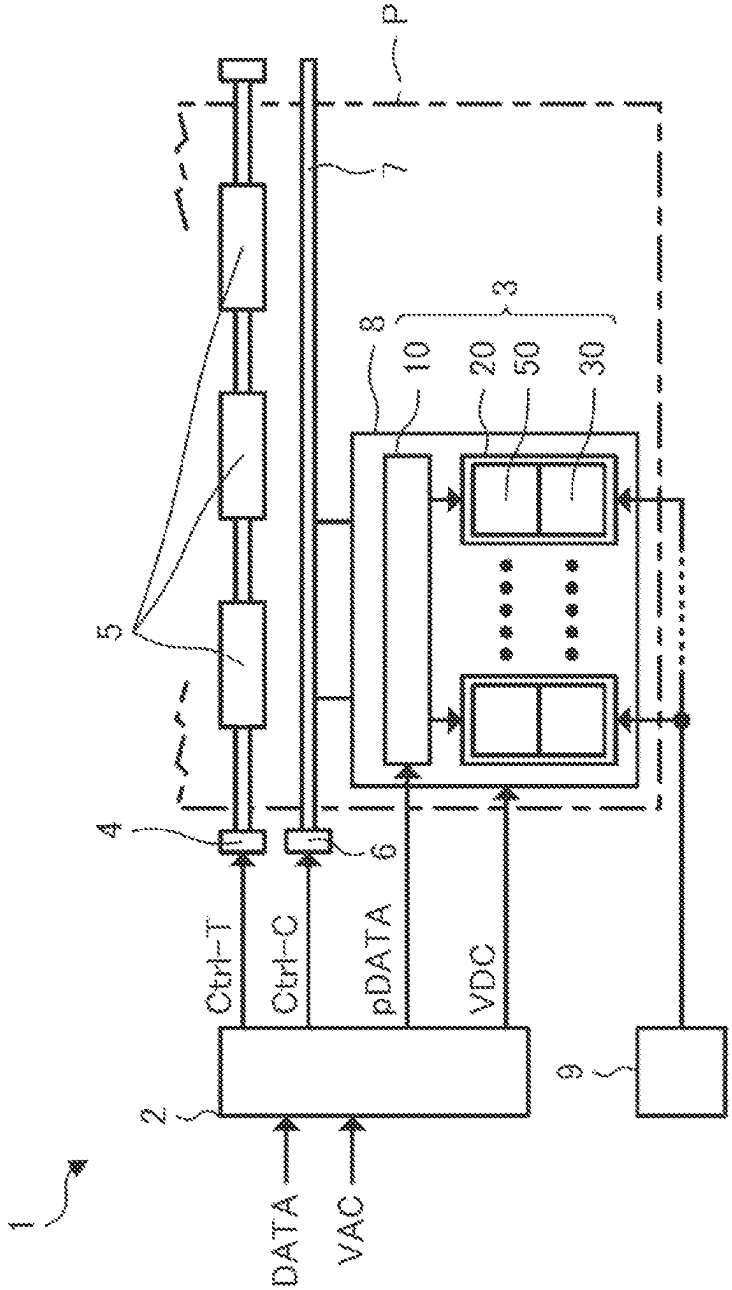
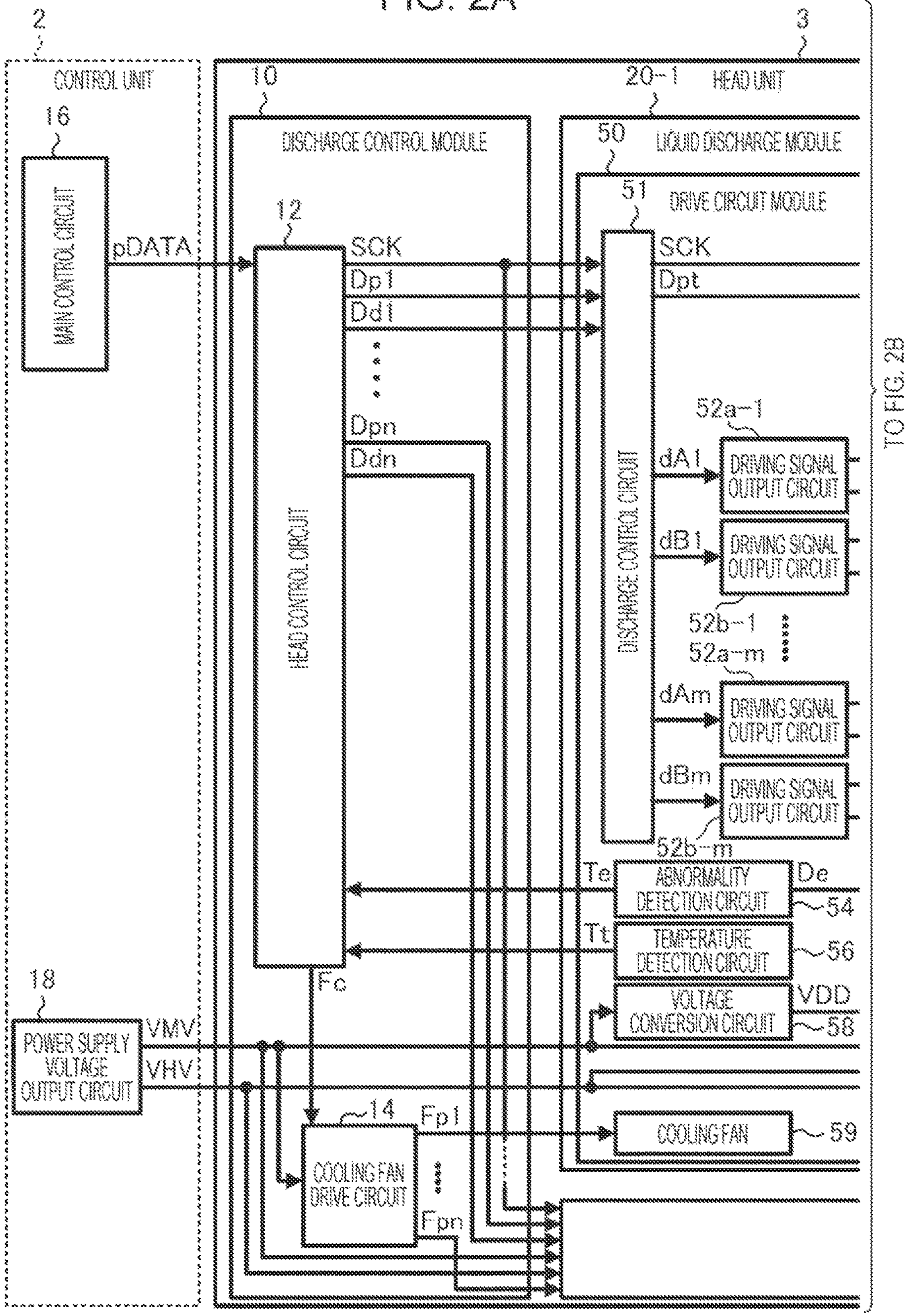


FIG. 2A



2
CONTROL UNIT
16
MAIN CONTROL CIRCUIT
pDATA
18
POWER SUPPLY VOLTAGE OUTPUT CIRCUIT
VMV
VHV
3
HEAD UNIT
10
DISCHARGE CONTROL MODULE
12
HEAD CONTROL CIRCUIT
SCK
Dp1
Dd1
Dpn
Ddn
Fc
14
COOLING FAN DRIVE CIRCUIT
Fp1
Fpn
20-1
LIQUID DISCHARGE MODULE
50
DRIVE CIRCUIT MODULE
51
DISCHARGE CONTROL CIRCUIT
SCK
Dpt
dA1
dB1
dAm
dBm
52a-1
52b-1
52a-m
52b-m
DRIVING SIGNAL OUTPUT CIRCUIT
DRIVING SIGNAL OUTPUT CIRCUIT
DRIVING SIGNAL OUTPUT CIRCUIT
DRIVING SIGNAL OUTPUT CIRCUIT
Te
De
ABNORMALITY DETECTION CIRCUIT
54
Tt
TEMPERATURE DETECTION CIRCUIT
56
VOLTAGE CONVERSION CIRCUIT
VDD
58
COOLING FAN
59
TO FIG. 2B

FIG. 2B

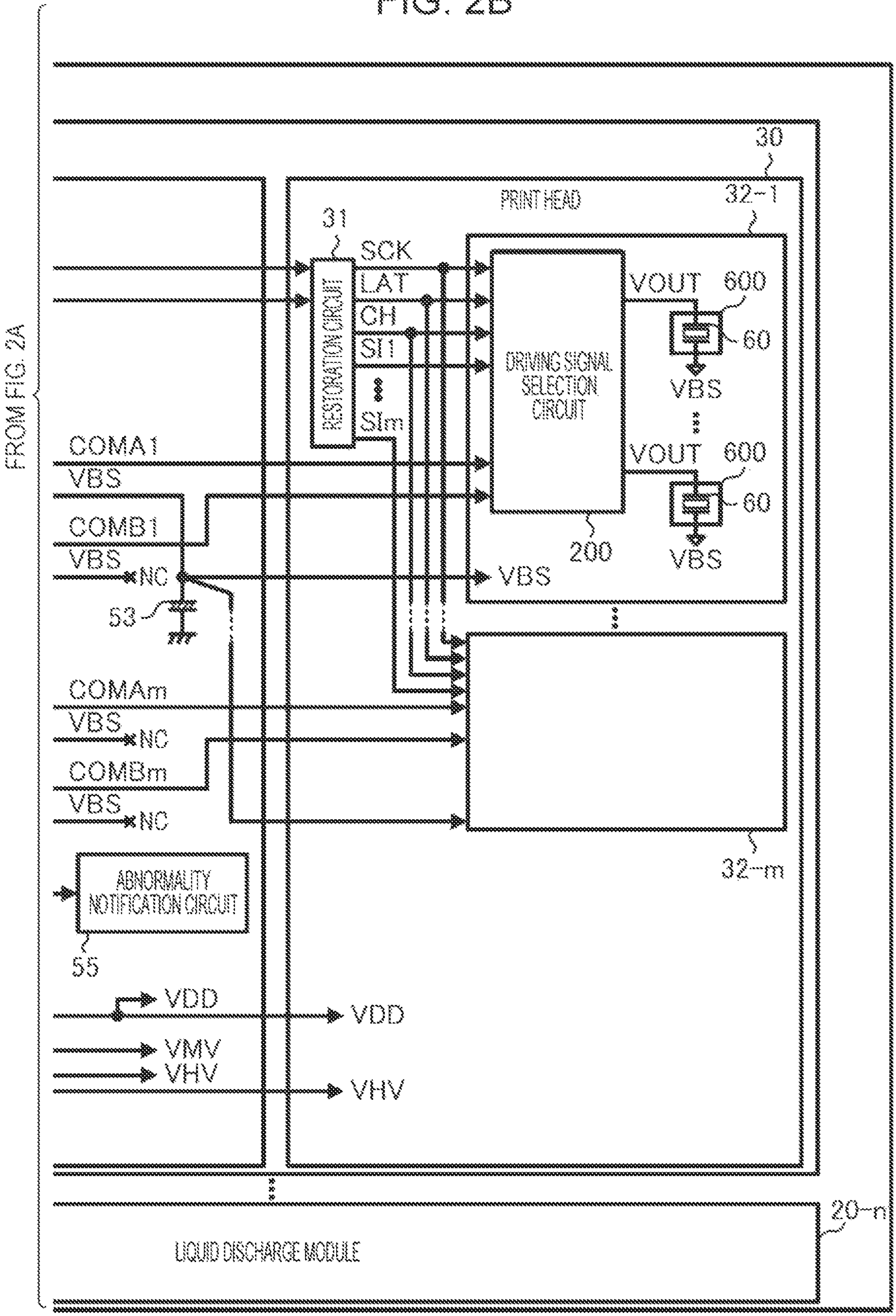

FROM FIG. 2A
PRINT HEAD
30
32-1
31
SCK
LAT
CH
SI1
SIm
RESTORATION CIRCUIT
DRIVING SIGNAL SELECTION CIRCUIT
VOUT
600
60
VBS
200
COMA1
VBS
COMB1
VBS
NC
53
COMAm
VBS
NC
COMBm
VBS
NC
32-m
ABNORMALITY NOTIFICATION CIRCUIT
55
VDD
VMV
VHV
LIQUID DISCHARGE MODULE
20-n

FIG. 3

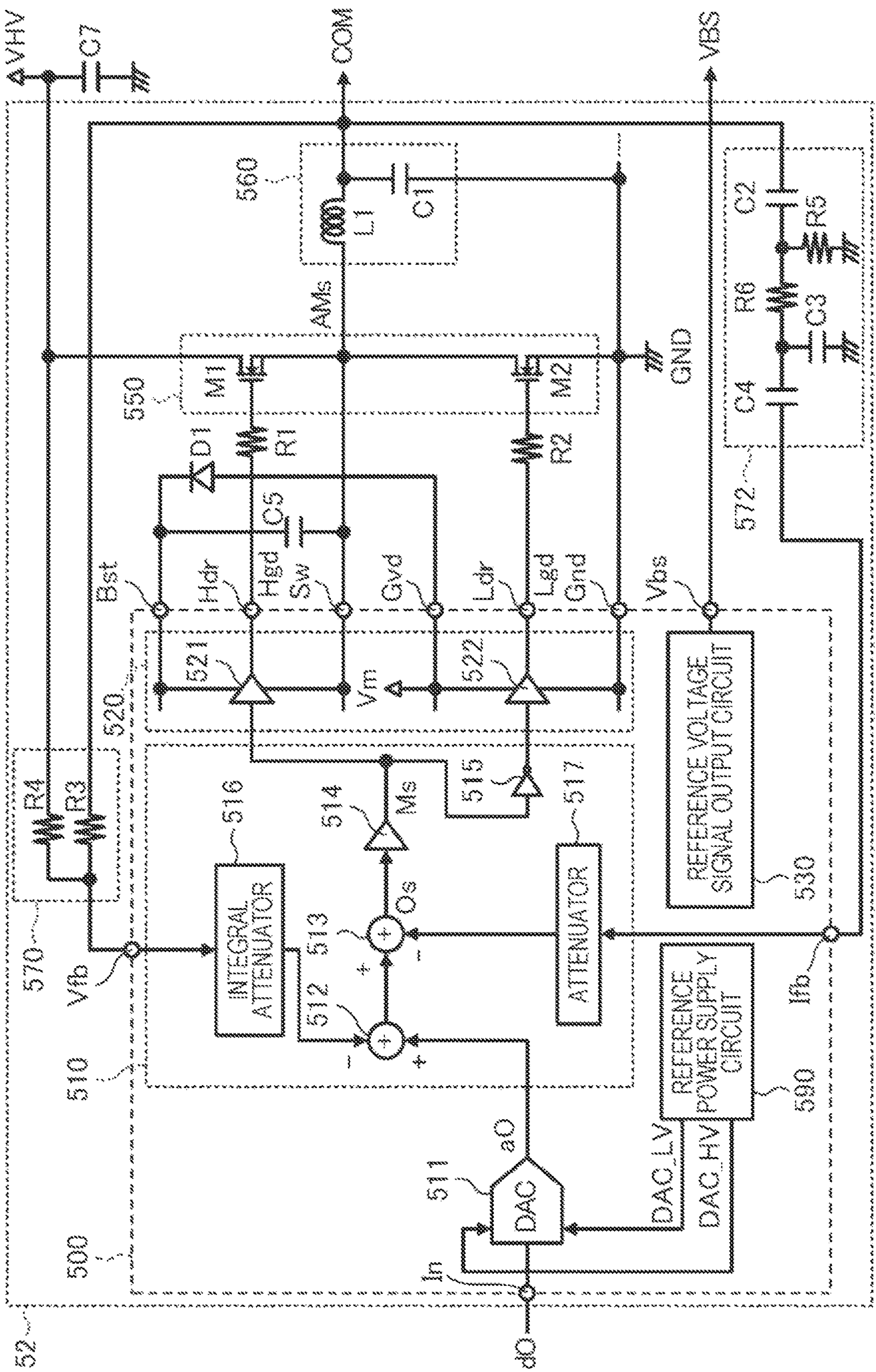

VHV
C7
COM
VBS
560
L1
C1
C2
R5
R6
C3
C4
572
AMs
GND
550
M1
M2
D1
R1
R2
C5
Bst
Hdr
Hgd
Sw
Gvd
Ldr
Lgd
Gnd
Vbs
521
522
Vm
520
515
517
516
514
Ms
513
Os
512
R4
R3
570
Vfb
INTEGRAL ATTENUATOR
ATTENUATOR
REFERENCE VOLTAGE SIGNAL OUTPUT CIRCUIT
530
REFERENCE POWER SUPPLY CIRCUIT
590
Ifb
510
511
DAC
aO
DAC_LV
DAC_HV
500
In
52
dO

FIG. 4

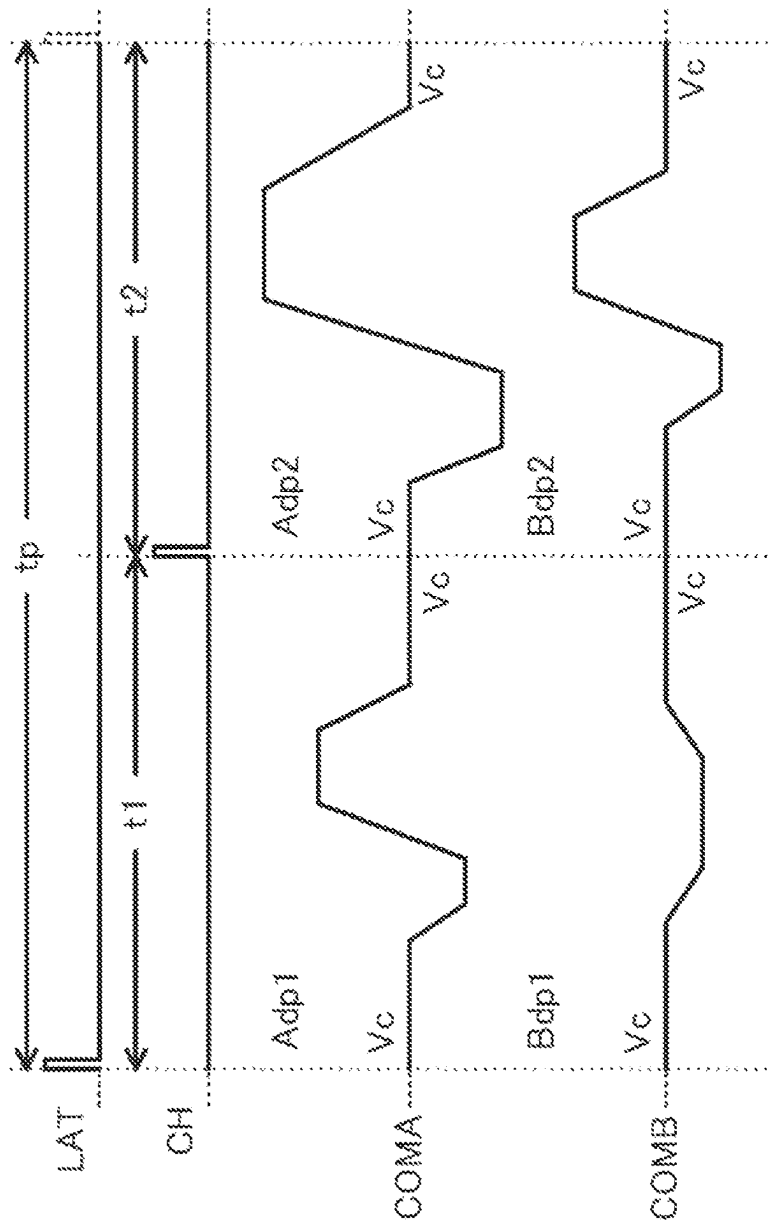


FIG. 5

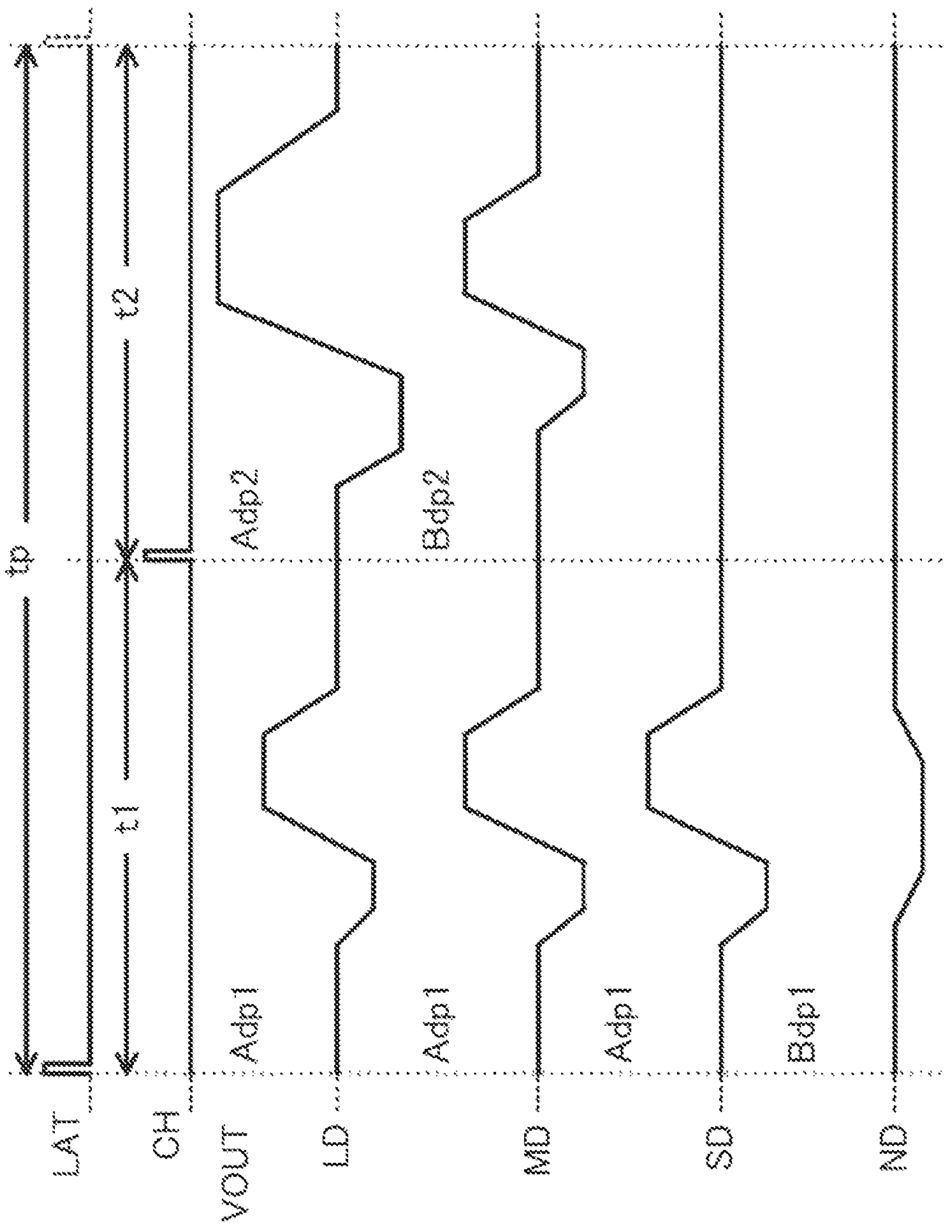


FIG. 6

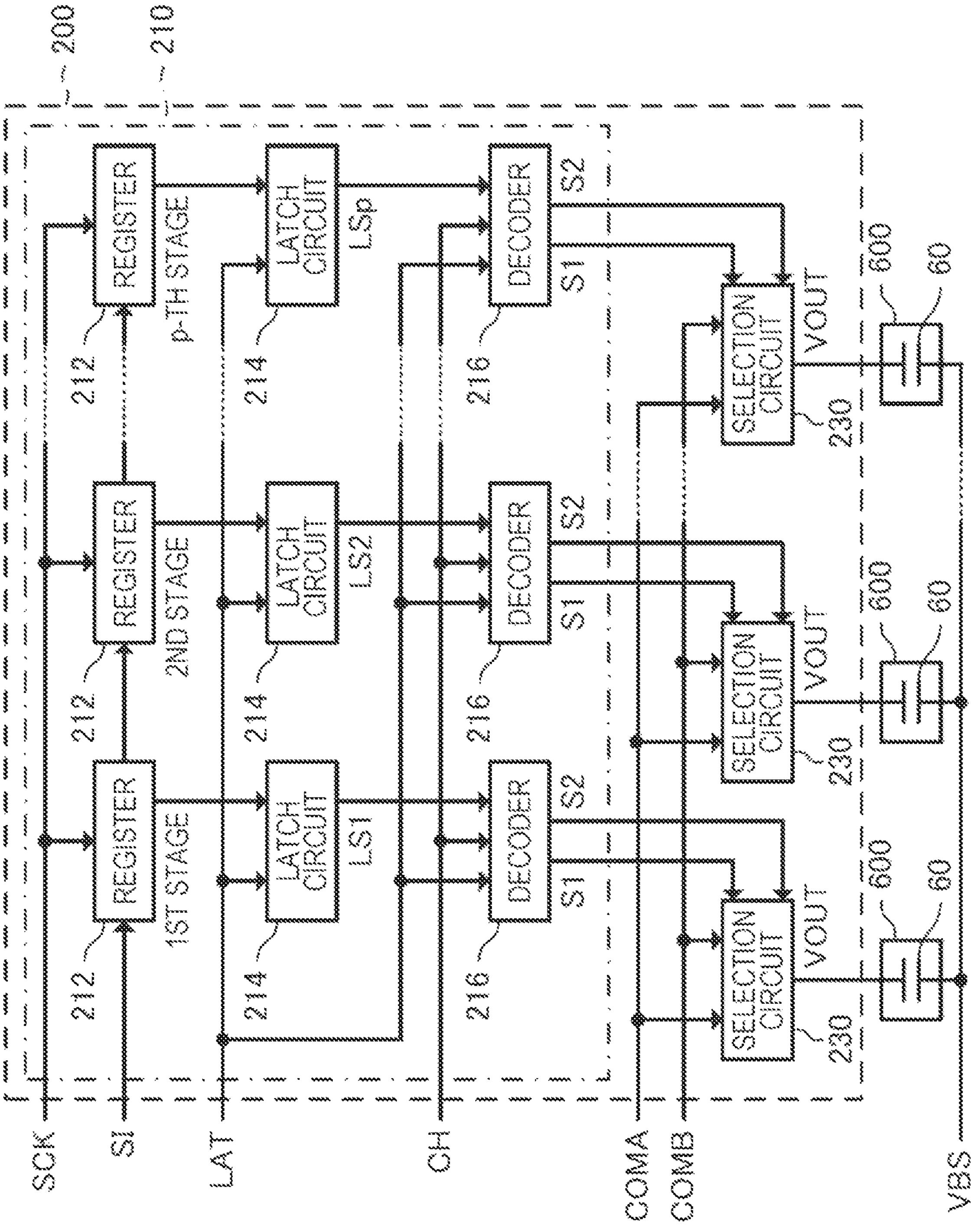

200
210
212
REGISTER
1ST STAGE
2ND STAGE
p-TH STAGE
214
LATCH CIRCUIT
LS1
LS2
LSp
216
DECODER
S1
S2
SELECTION CIRCUIT
VOUT
230
600
60
SCK
SI
LAT
CH
COMA
COMB
VBS

FIG. 7

[SIH, SIL]		[1, 1] (LD)	[1, 0] (MD)	[0, 1] (SD)	[0, 0] (ND)
S1	t1	H	H	H	L
	t2	H	L	L	L
S2	t1	L	L	L	H
	t2	L	H	L	L

FIG. 8

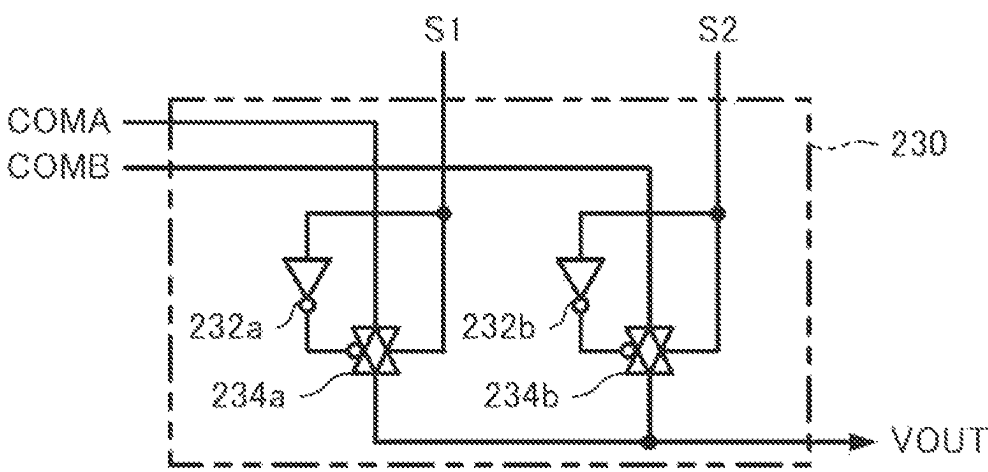
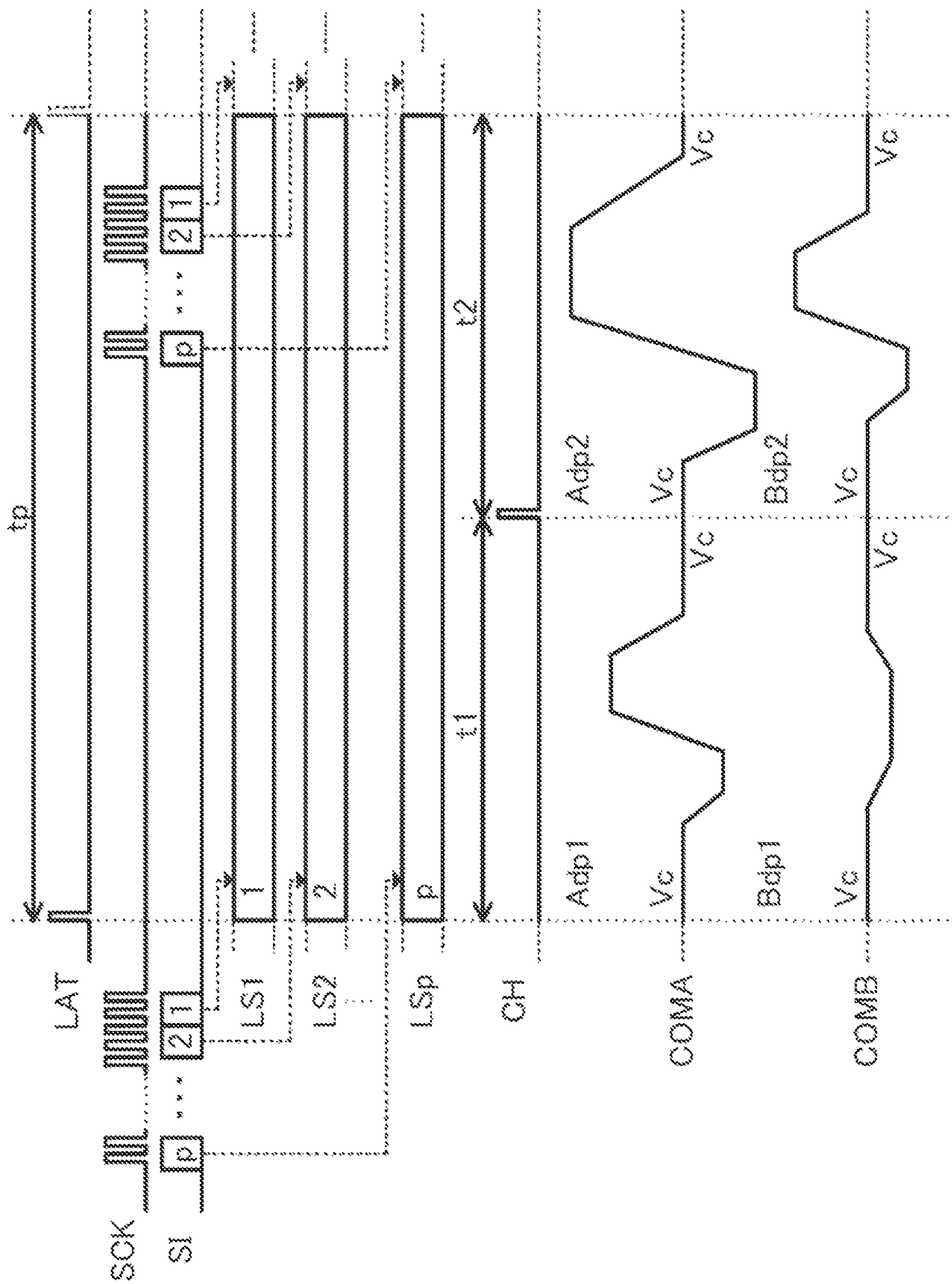


FIG. 9



LAT
SCK
SI
LS1
LS2
LSp
CH
COMA
COMB
tp
t1
t2
Adp1
Adp2
Bdp1
Bdp2
Vc

FIG. 10

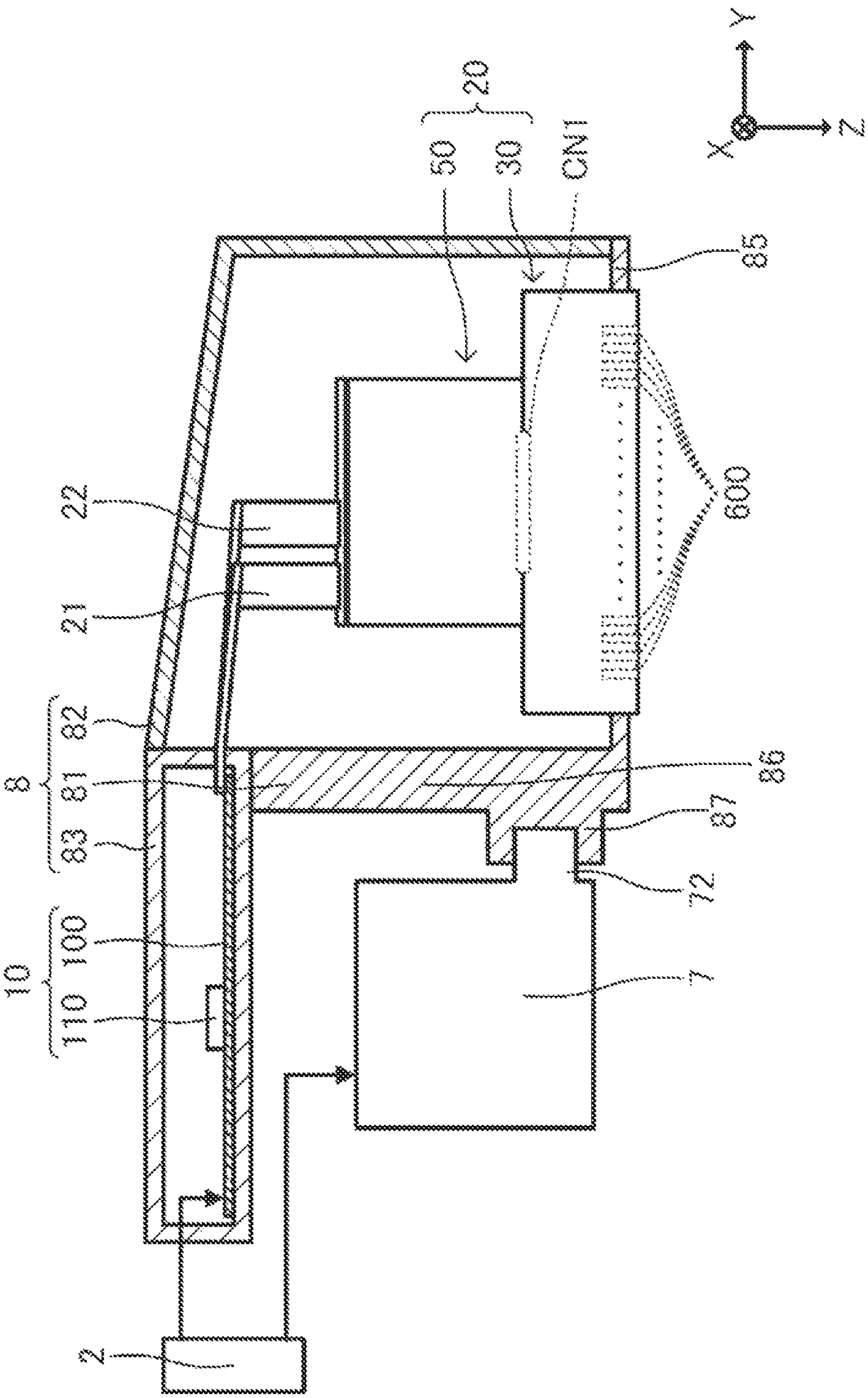


FIG. 11

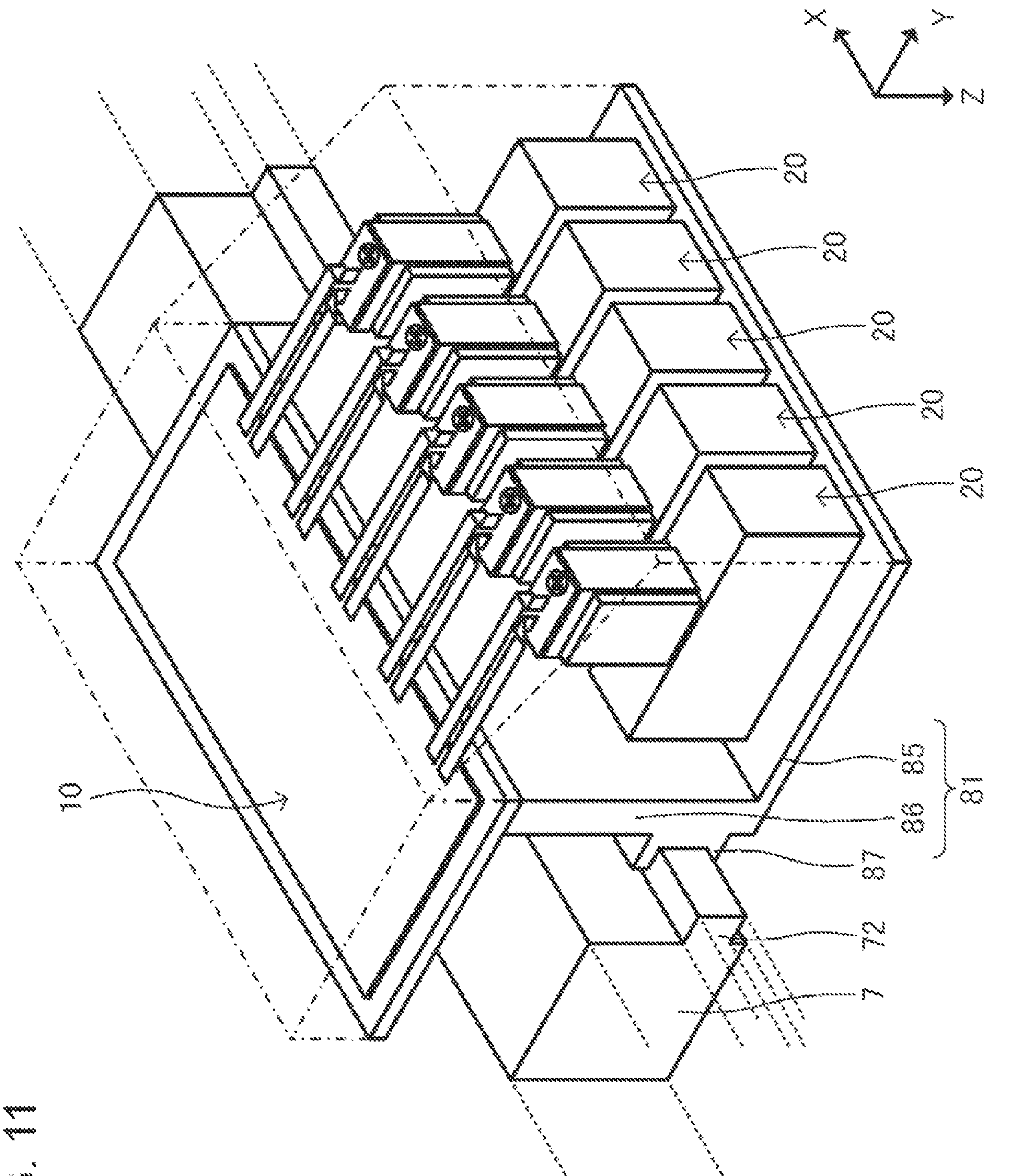


FIG. 12

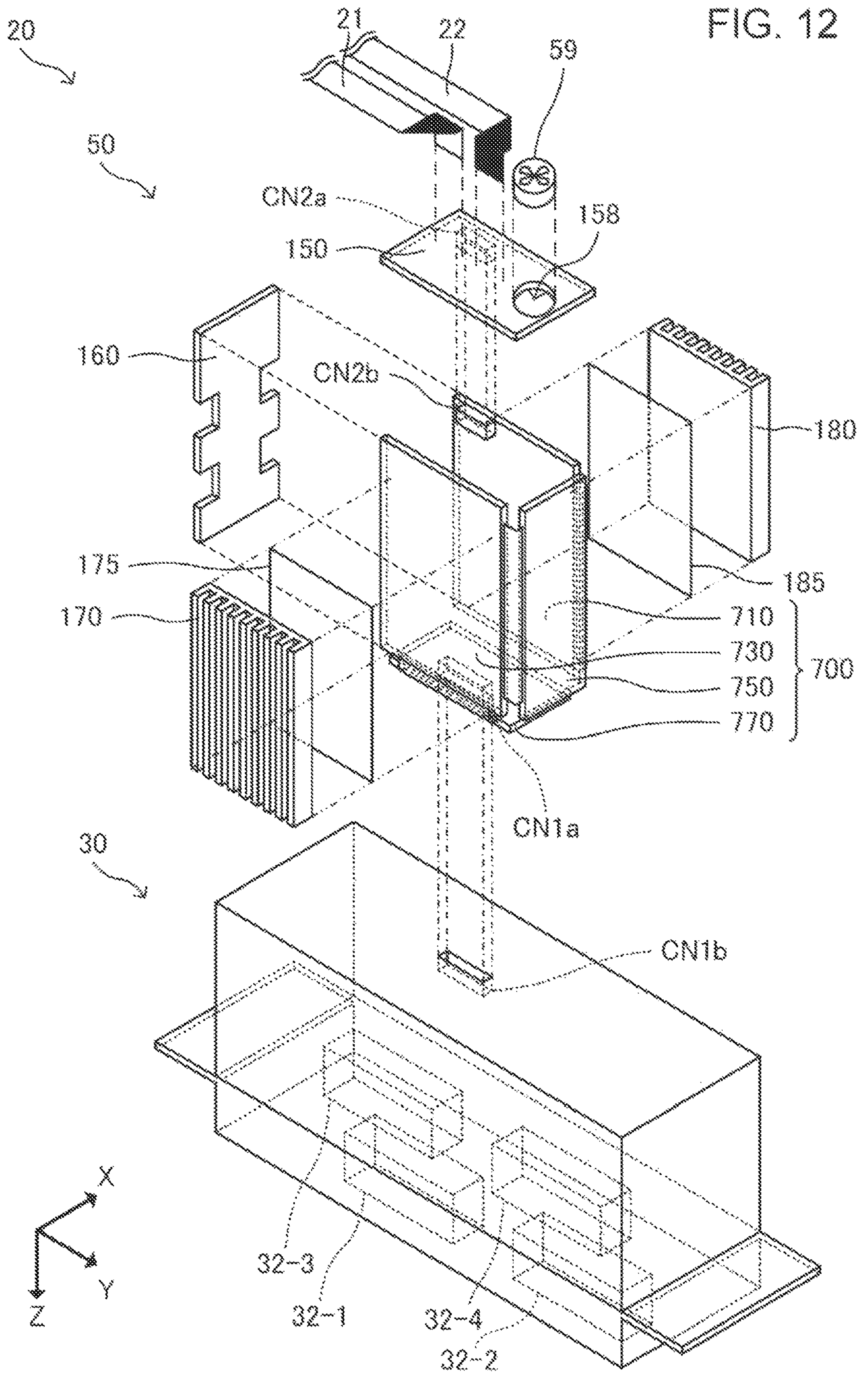

20
21
22
59
50
CN2a
158
150
160
CN2b
180
175
185
170
710
730
700
750
770
CN1a
30
CN1b
X
Y
Z
32-3
32-1
32-4
32-2

FIG. 13

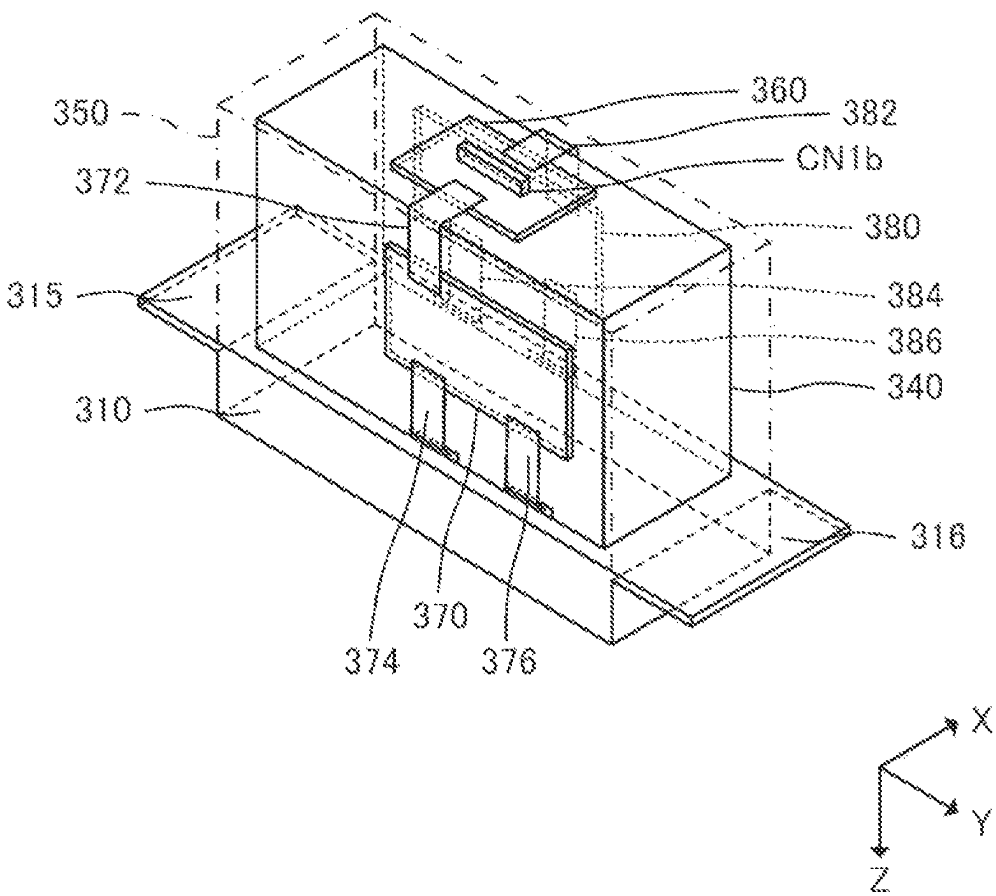


FIG. 14

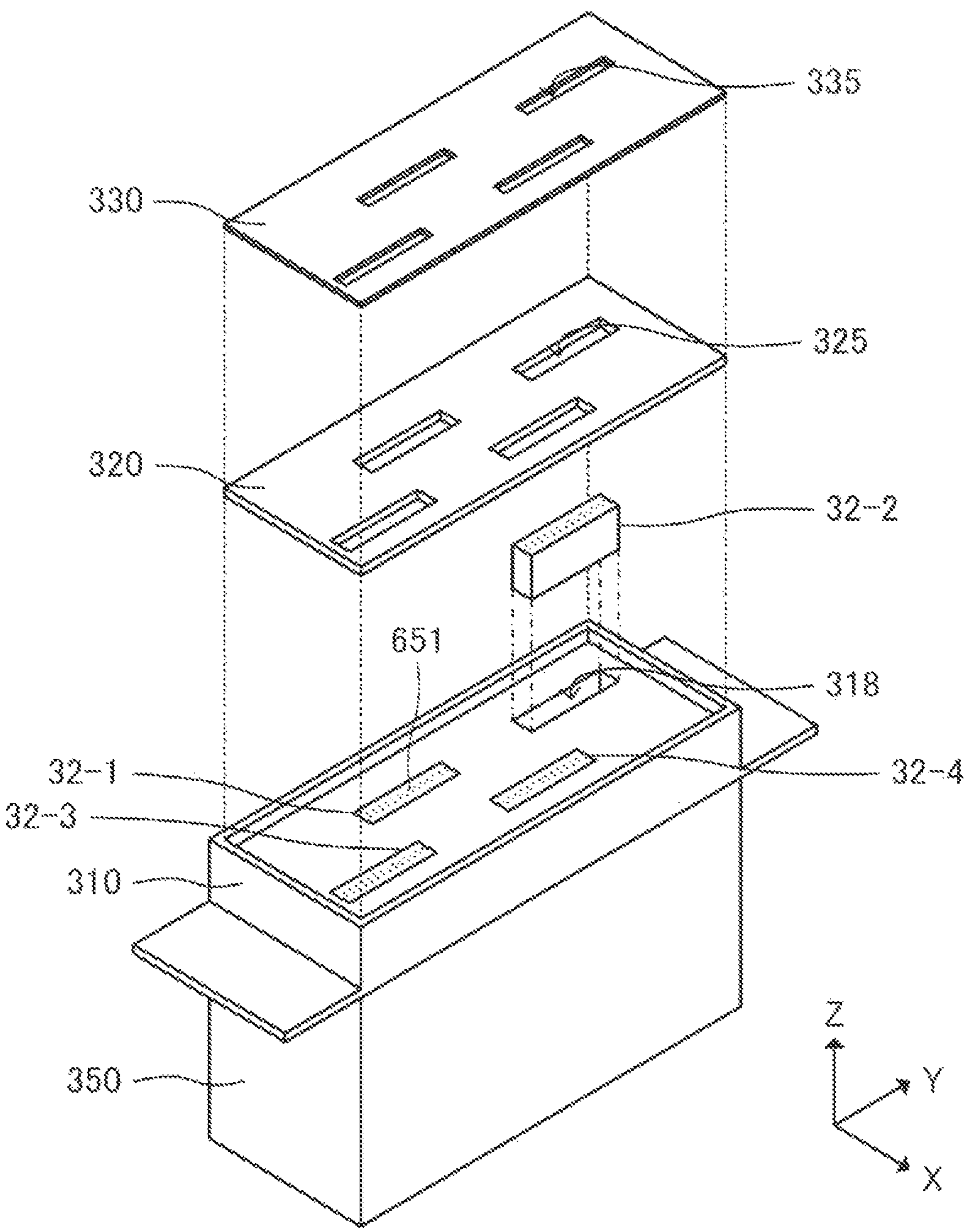


FIG. 15

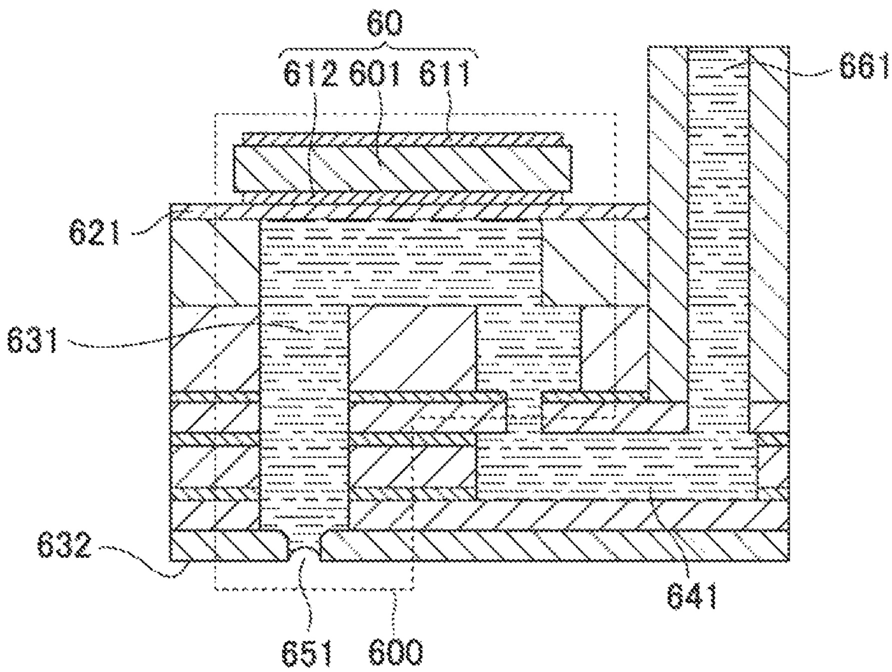


FIG. 16

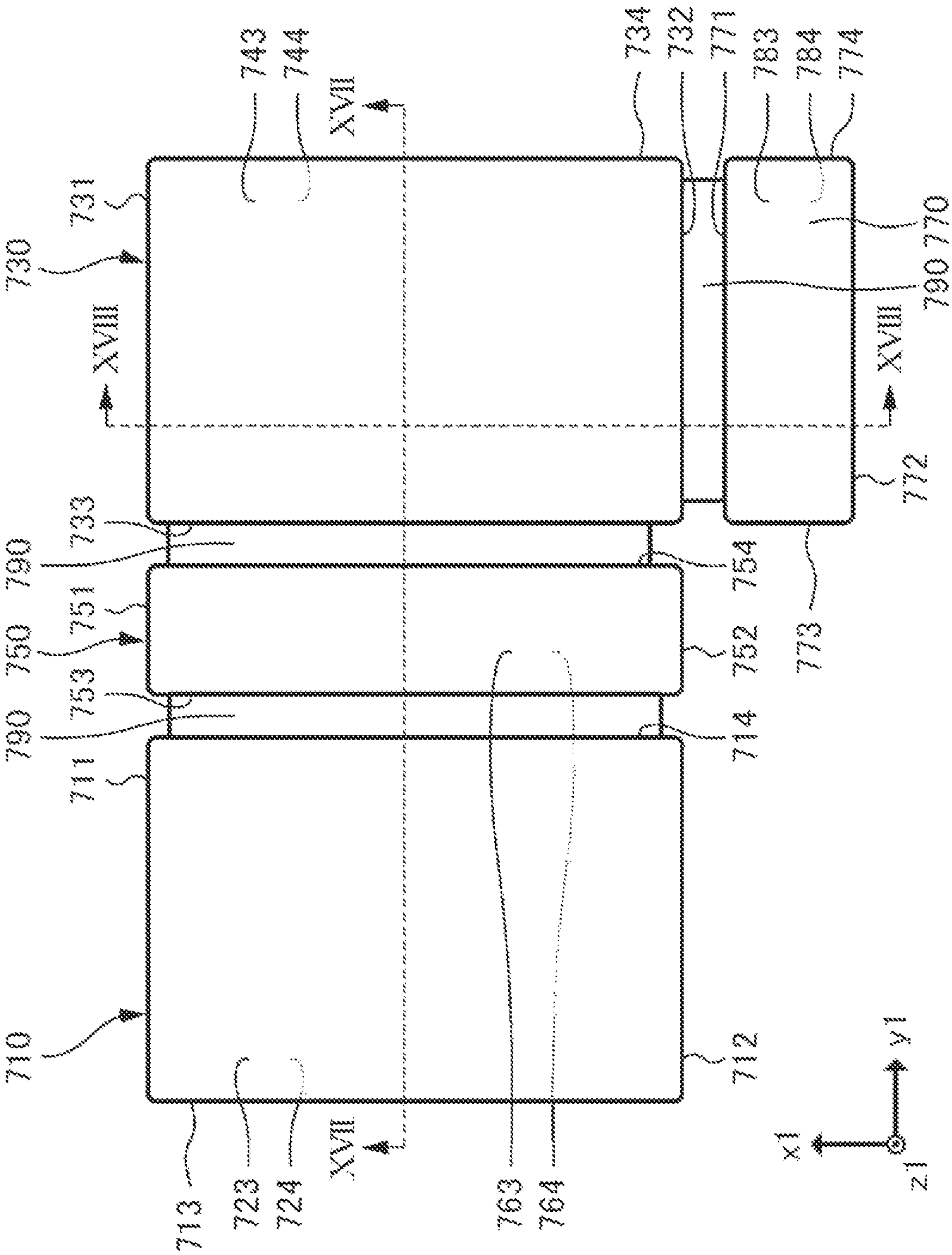
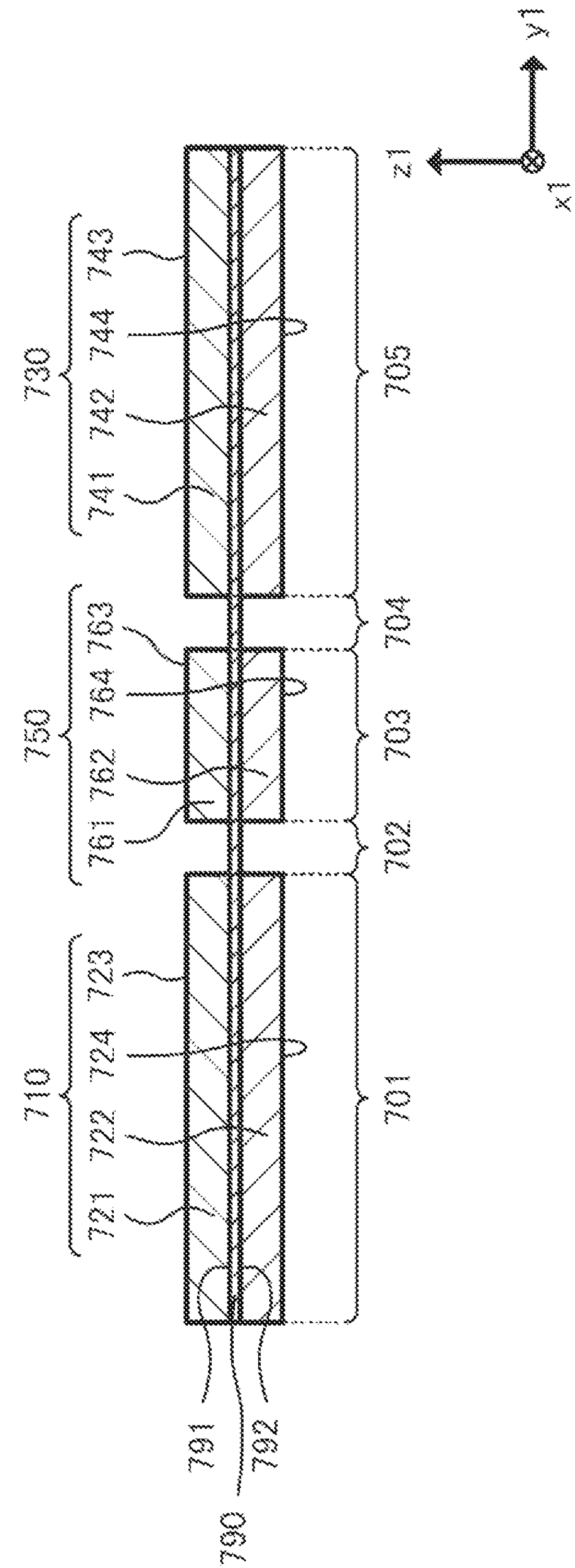

710
711
712
713
714
723
724
730
731
732
733
734
743
744
750
751
752
753
754
763
764
770
771
772
773
774
783
784
790
XVII
XVIII
x1
y1
z1

FIG. 17



710
721
722
724
723
750
761
762
764
763
730
741
742
744
743
701
702
703
704
705
791
790
792
x1
y1
z1

FIG. 18

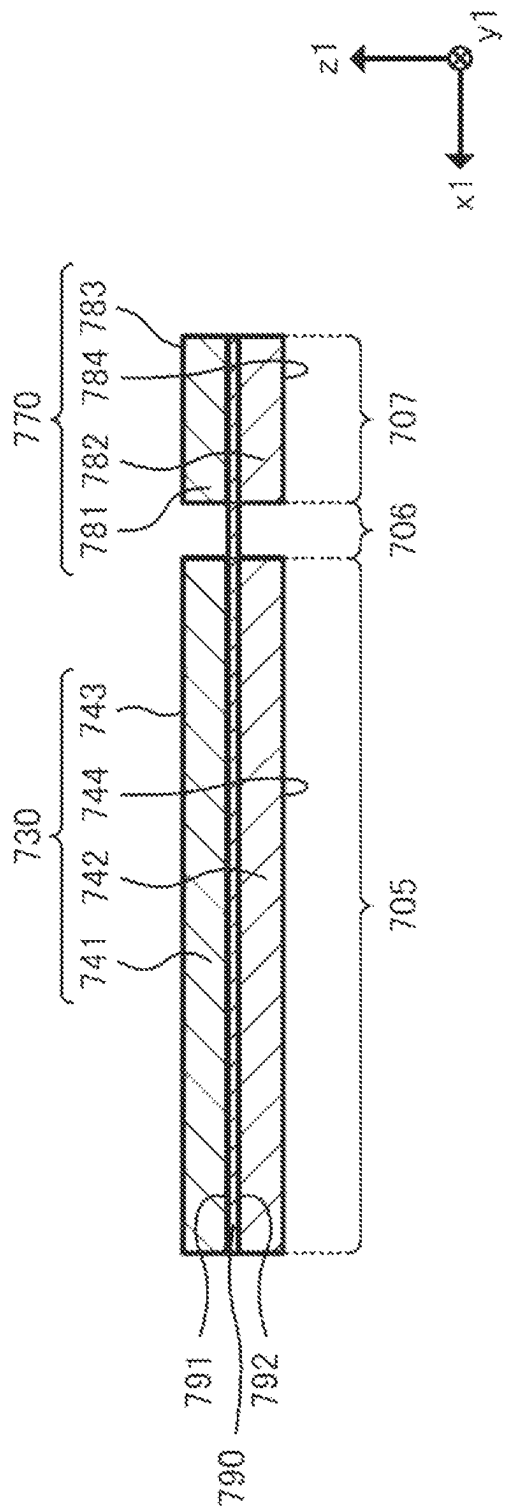
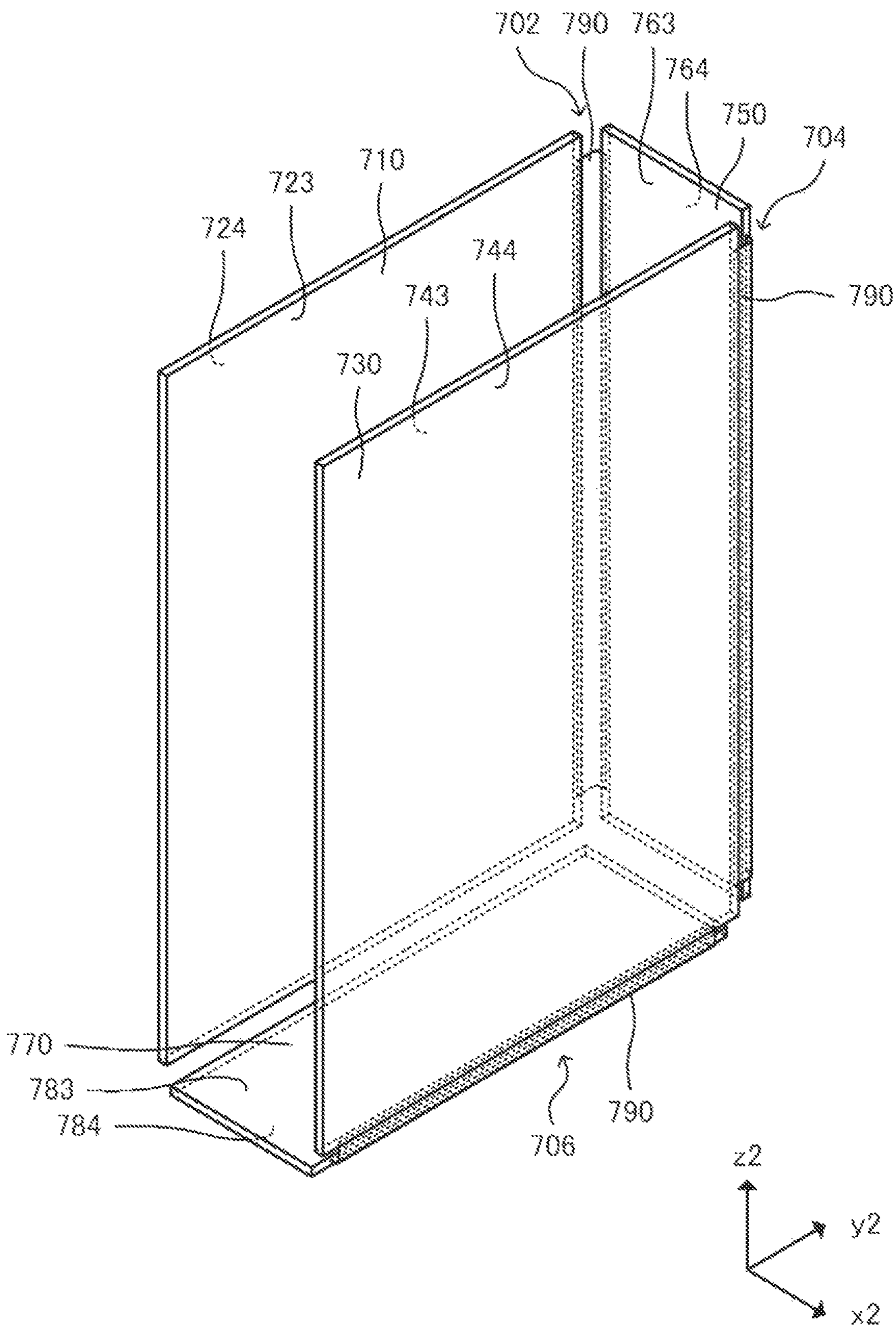

z1
y1
x1
770
783
784
782
781
707
706
730
743
744
742
741
705
791
790
792

FIG. 19


702
790
763
764
750
704
710
723
724
744
790
743
730
770
783
784
706
790
z2
y2
x2

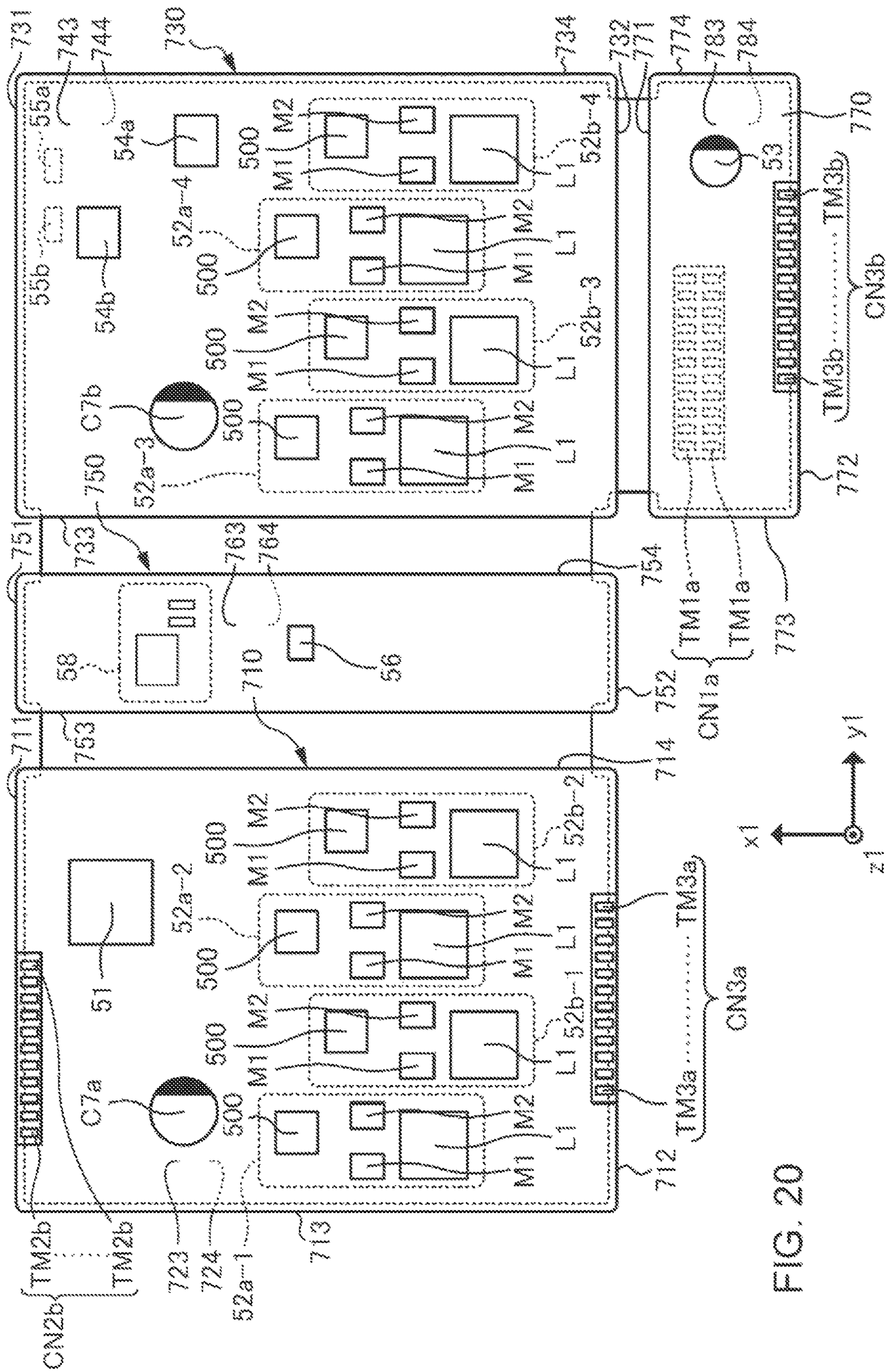

730
750
710
770
731
743
744
734
732
771
774
783
784
55a
55b
54a
54b
500
M1
M2
L1
52a-1
52a-2
52a-3
52a-4
52b-1
52b-2
52b-3
52b-4
C7a
C7b
53
51
56
58
763
764
751
752
753
754
711
712
713
714
723
724
733
772
773
TM1a
CN1a
TM2b
CN2b
TM3a
CN3a
TM3b
CN3b
x1
y1
z1

FIG. 20

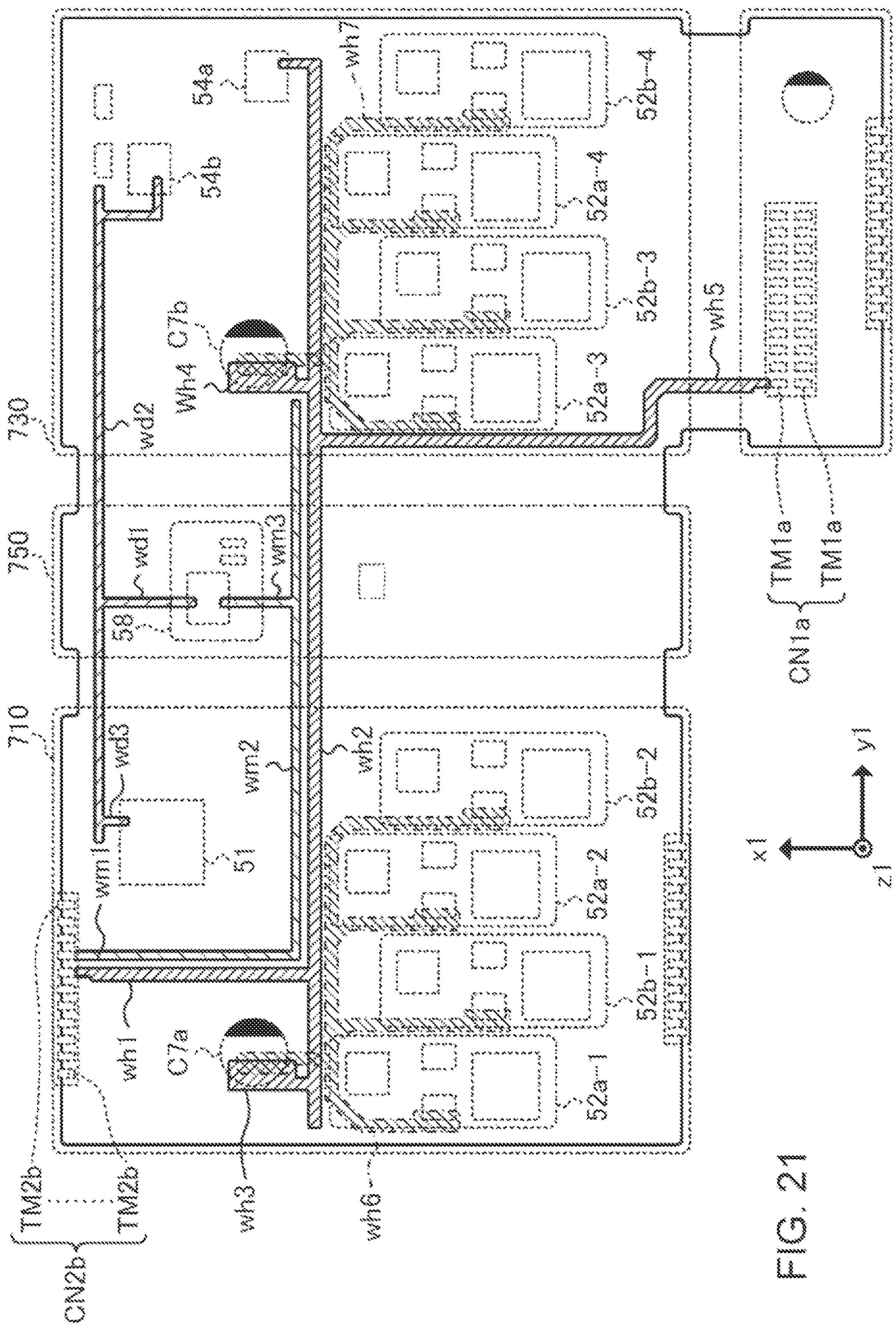
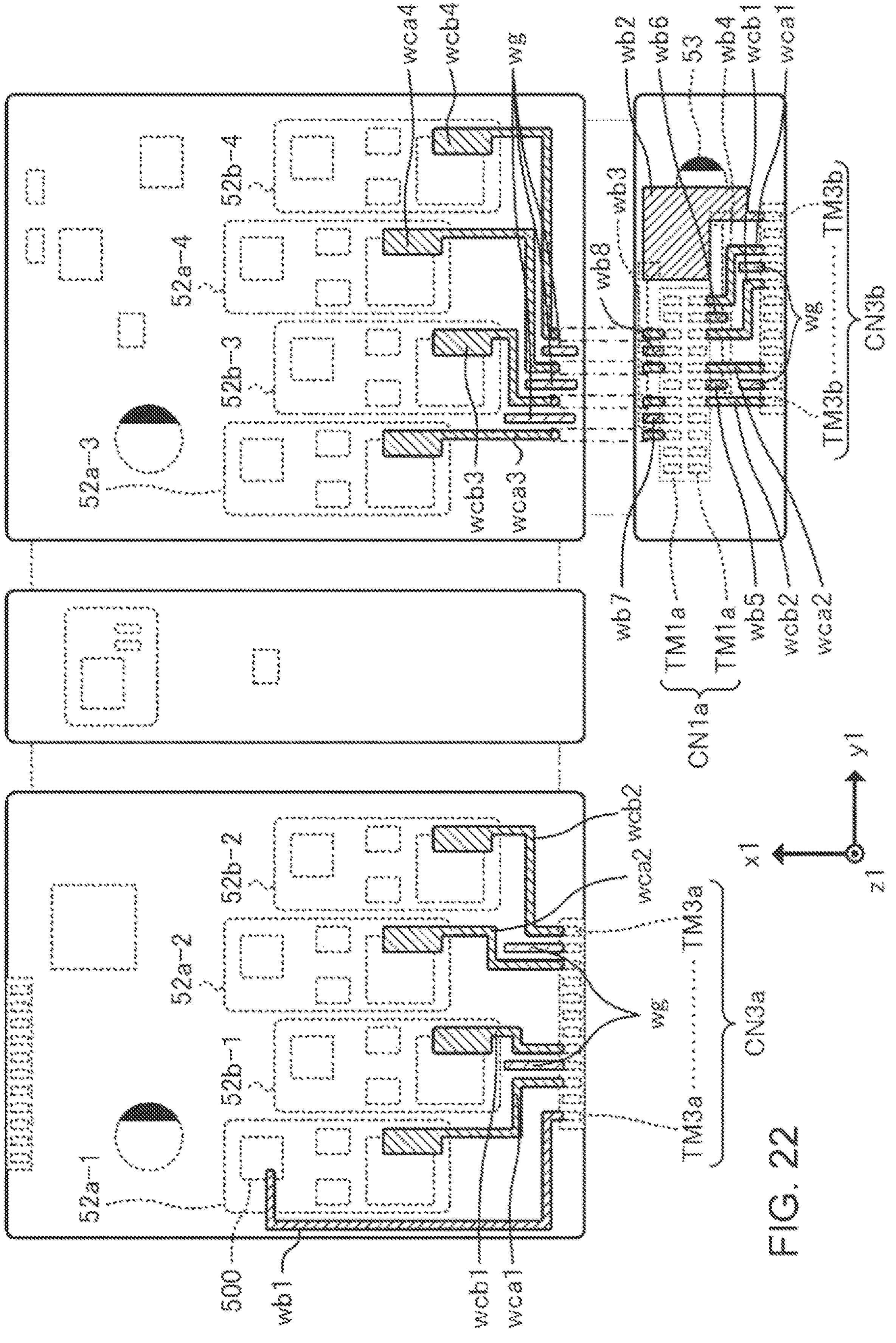

730
750
710
wd2
wd1
wd3
wm1
wm2
wm3
wh1
wh2
wh3
Wh4
wh5
wh6
wh7
C7a
C7b
54a
54b
58
51
52a-1
52b-1
52a-2
52b-2
52a-3
52b-3
52a-4
52b-4
TM1a
TM1a
CN1a
TM2b
TM2b
CN2b
x1
y1
z1

FIG. 21



wca4
wcb4
wg
wb2
wb6
53
wb4
wcb1
wca1
52b-4
wb3
52a-4
wb8
52b-3
52a-3
wcb3
wca3
TM3b
CN3b
wb7
TM1a
TM1a
CN1a
wb5
wcb2
wca2
500
wb1
52a-1
52b-1
52a-2
52b-2
TM3a
CN3a
x1
y1
z1

FIG. 22

FIG. 23

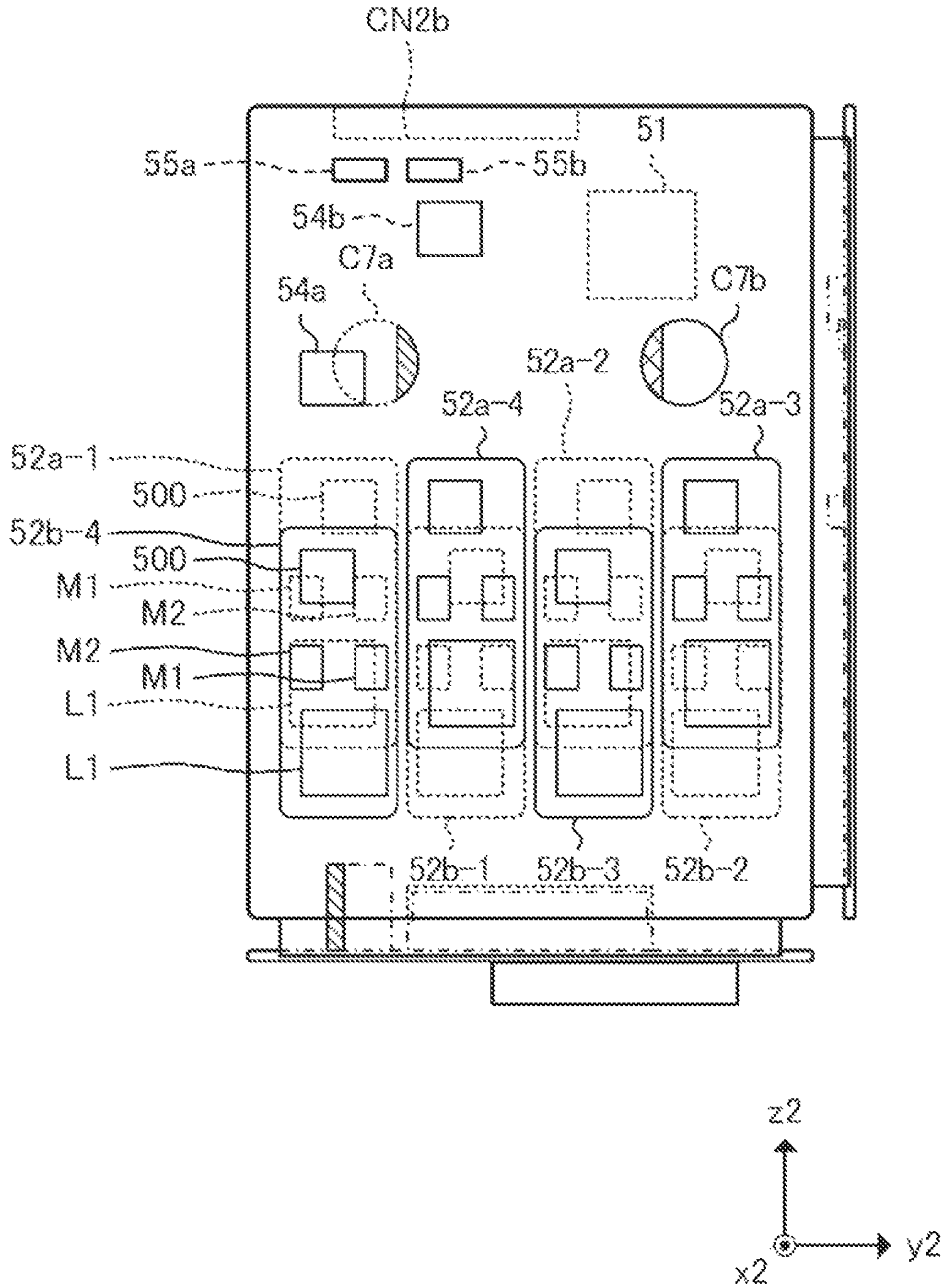
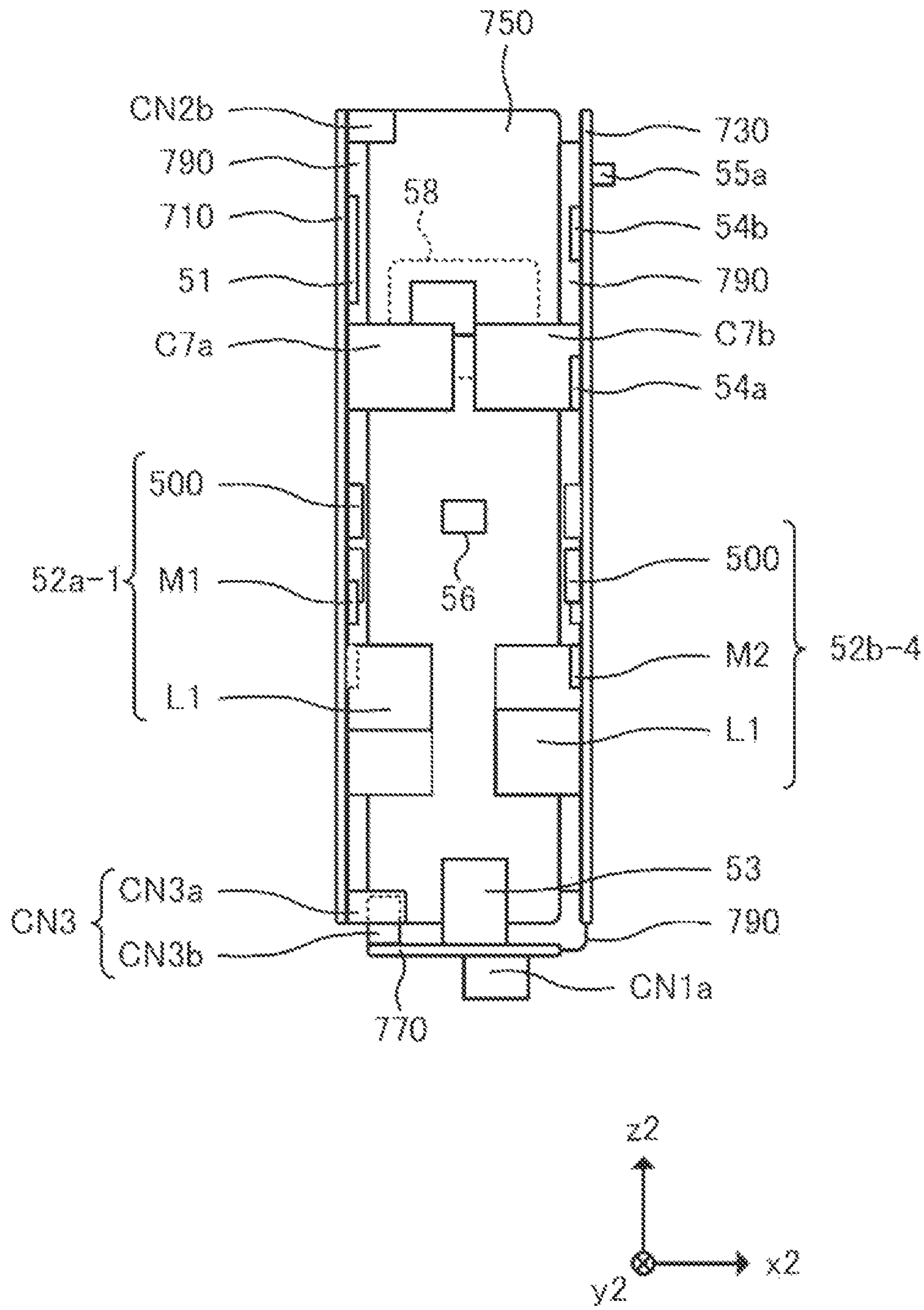

CN2b
51
55a
55b
54b
C7a
54a
C7b
52a-2
52a-4
52a-3
52a-1
500
52b-4
500
M1
M2
M2
M1
L1
L1
52b-1
52b-3
52b-2
z2
y2
x2

FIG. 24



750
CN2b
730
790
55a
58
710
54b
51
790
C7a
C7b
54a
500
52a-1
M1
56
500
M2
52b-4
L1
L1
53
CN3a
CN3
CN3b
790
CN1a
770
z2
x2
y2

FIG. 25

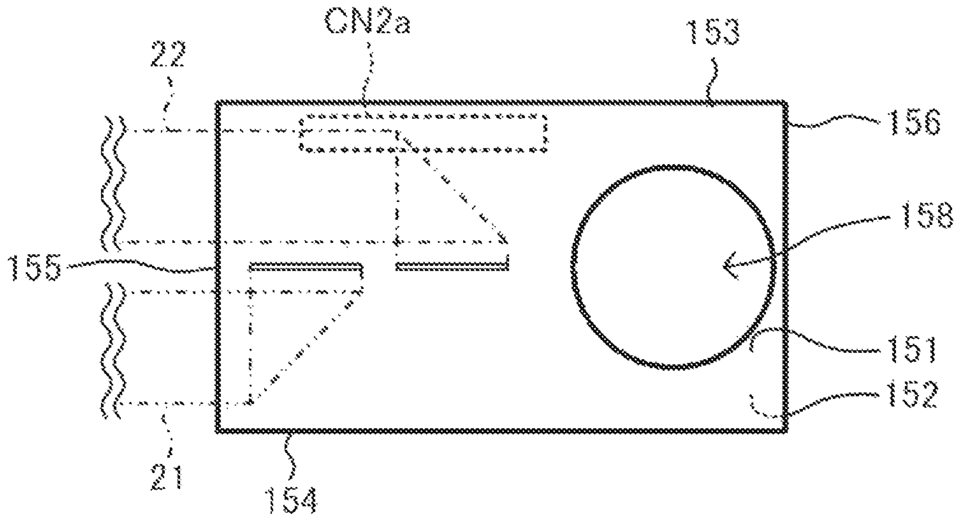


FIG. 26

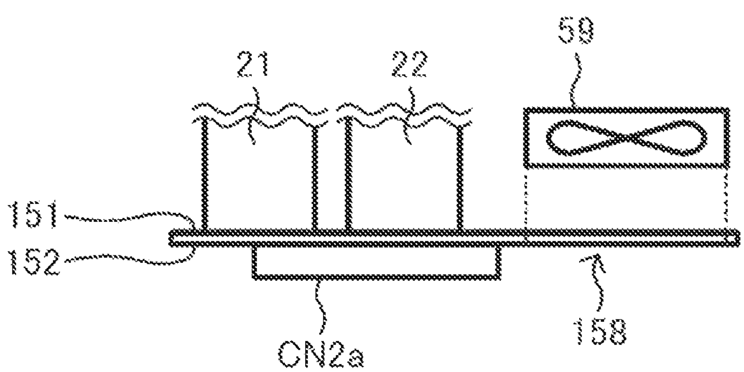


FIG. 27

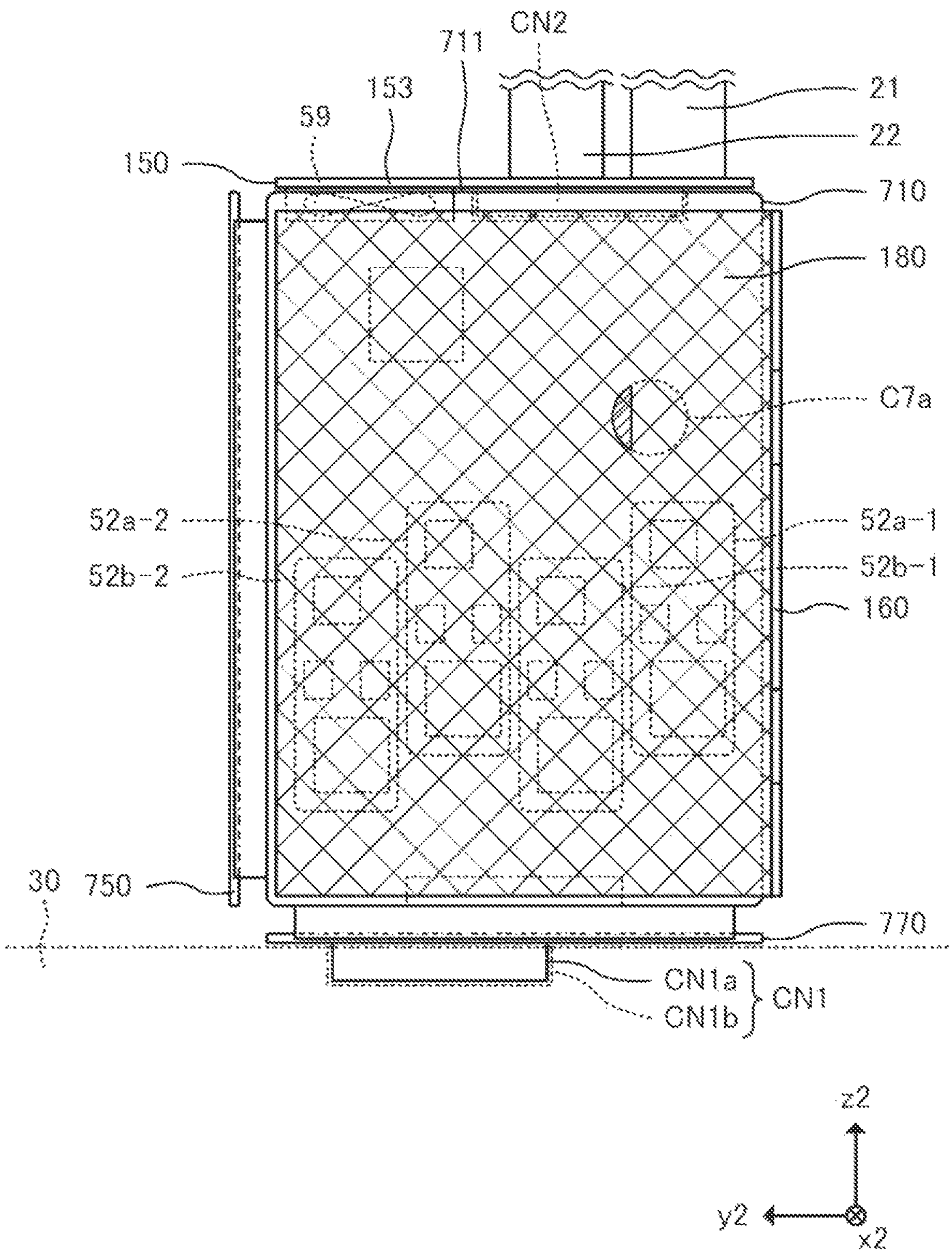
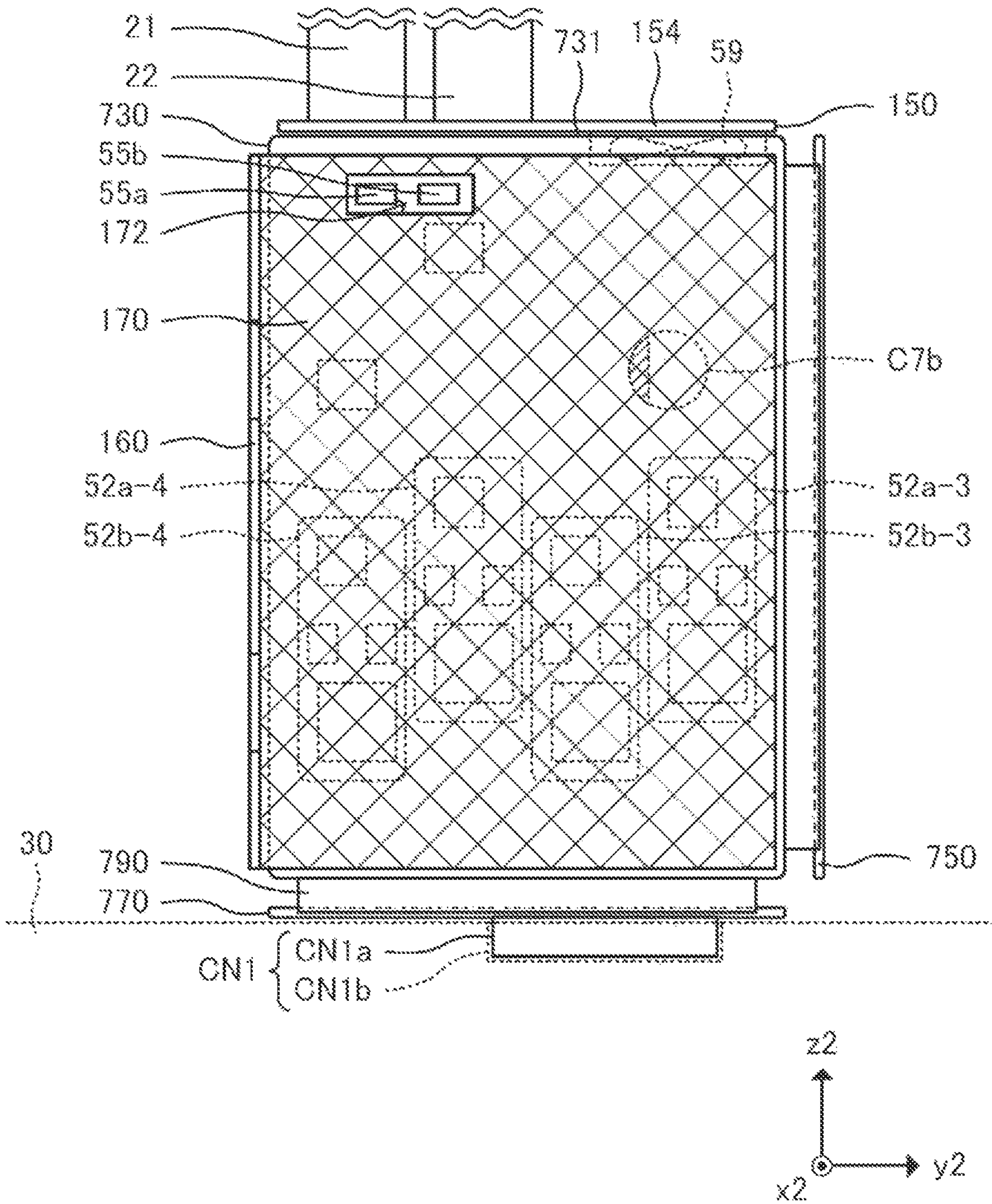

CN2
711
153
59
150
21
22
710
180
C7a
52a-2
52b-2
52a-1
52b-1
160
30
750
770
CN1a
CN1b
CN1
z2
y2
x2

FIG. 28



21
22
730
55b
55a
172
170
160
52a-4
52b-4
30
790
770
CN1
CN1a
CN1b
731
154
59
150
C7b
52a-3
52b-3
750
z2
y2
x2

FIG. 29

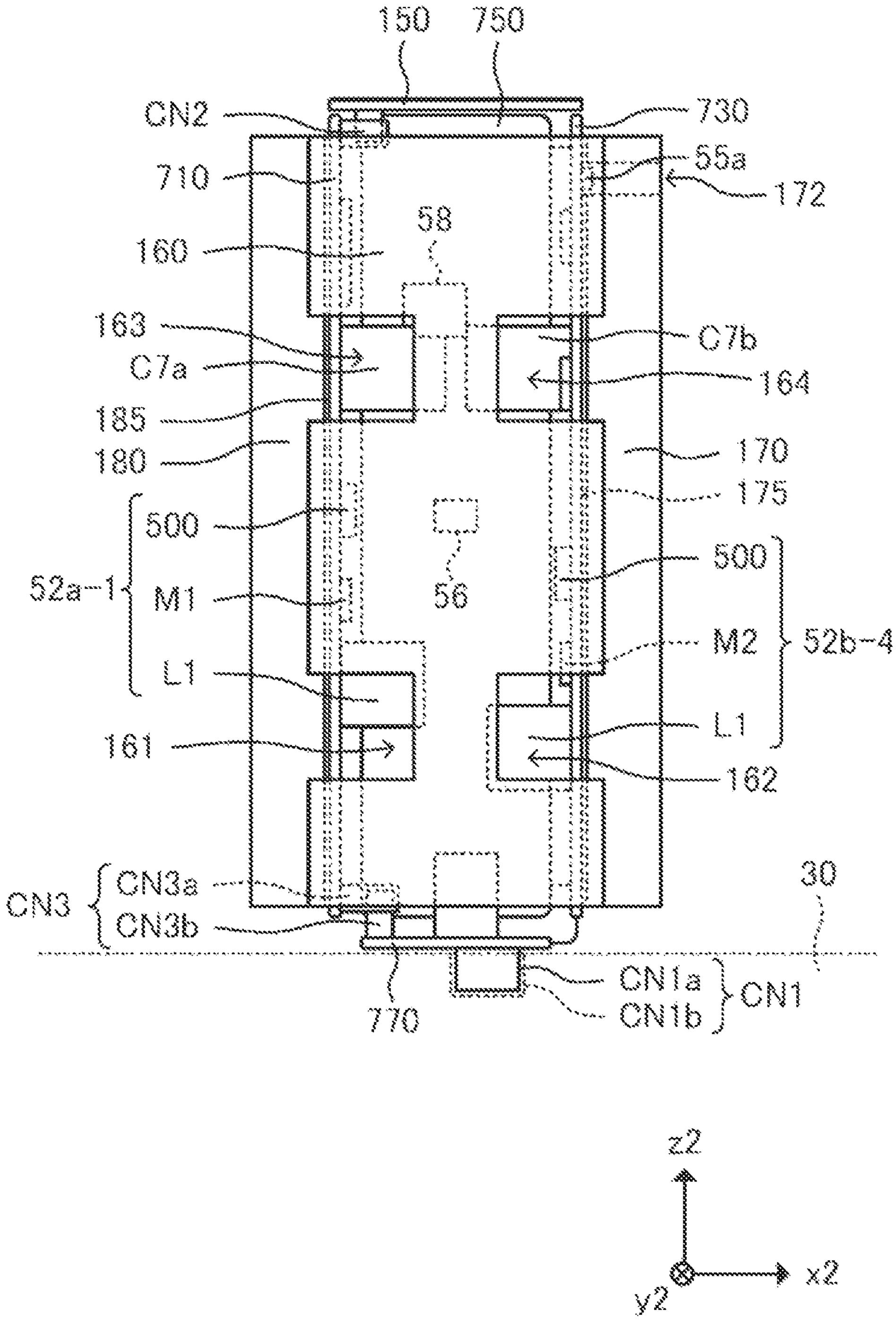

150
750
CN2
730
55a
172
710
58
160
163
C7b
C7a
164
185
170
180
175
500
500
52a-1
M1
56
M2
52b-4
L1
L1
161
162
CN3a
30
CN3
CN3b
CN1a
CN1
CN1b
770
z2
x2
y2

FIG. 30

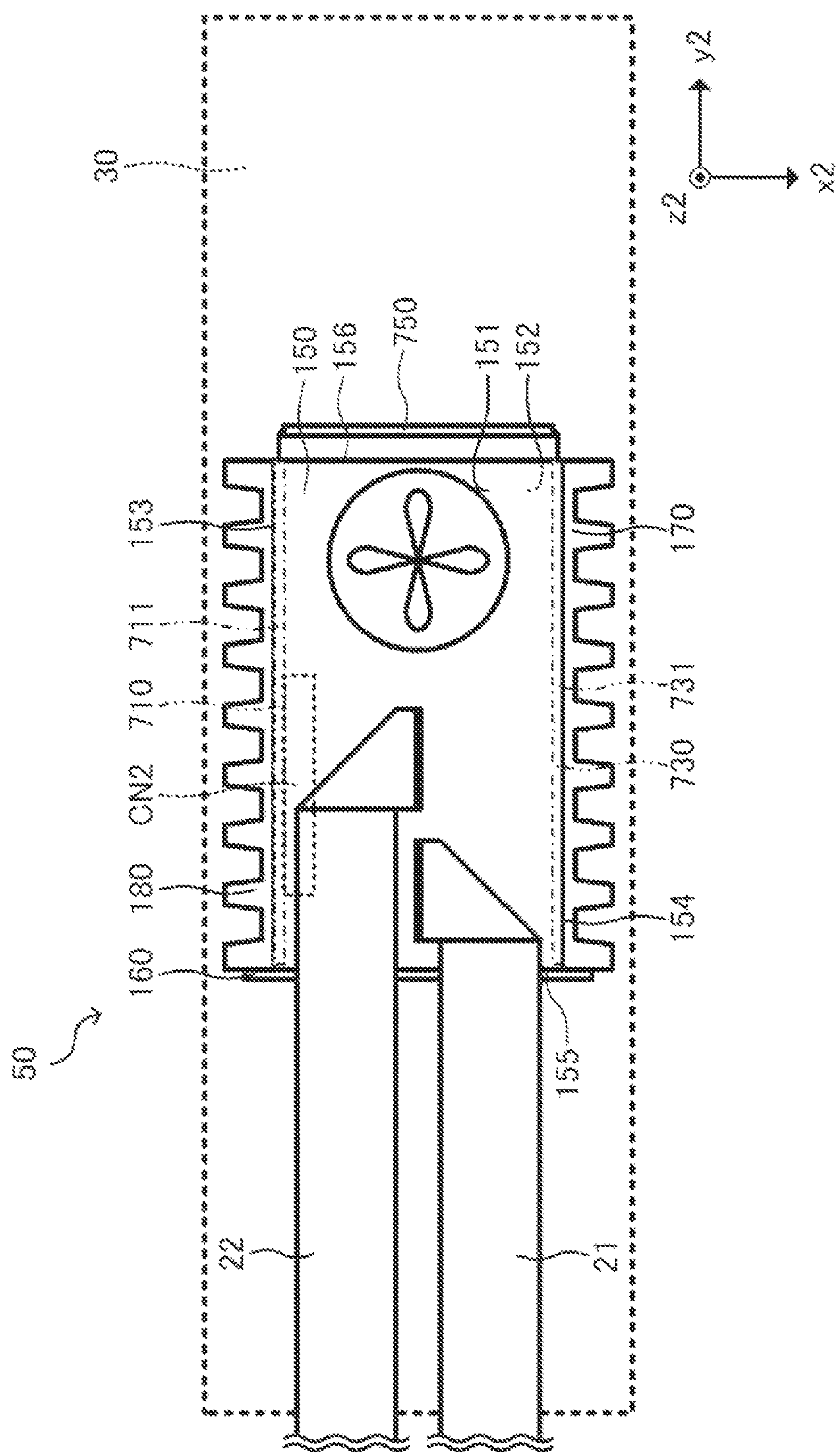

30
y2
x2
z2
150
156
750
151
152
153
170
711
710
731
730
CN2
180
154
160
155
50
22
21

FIG. 31

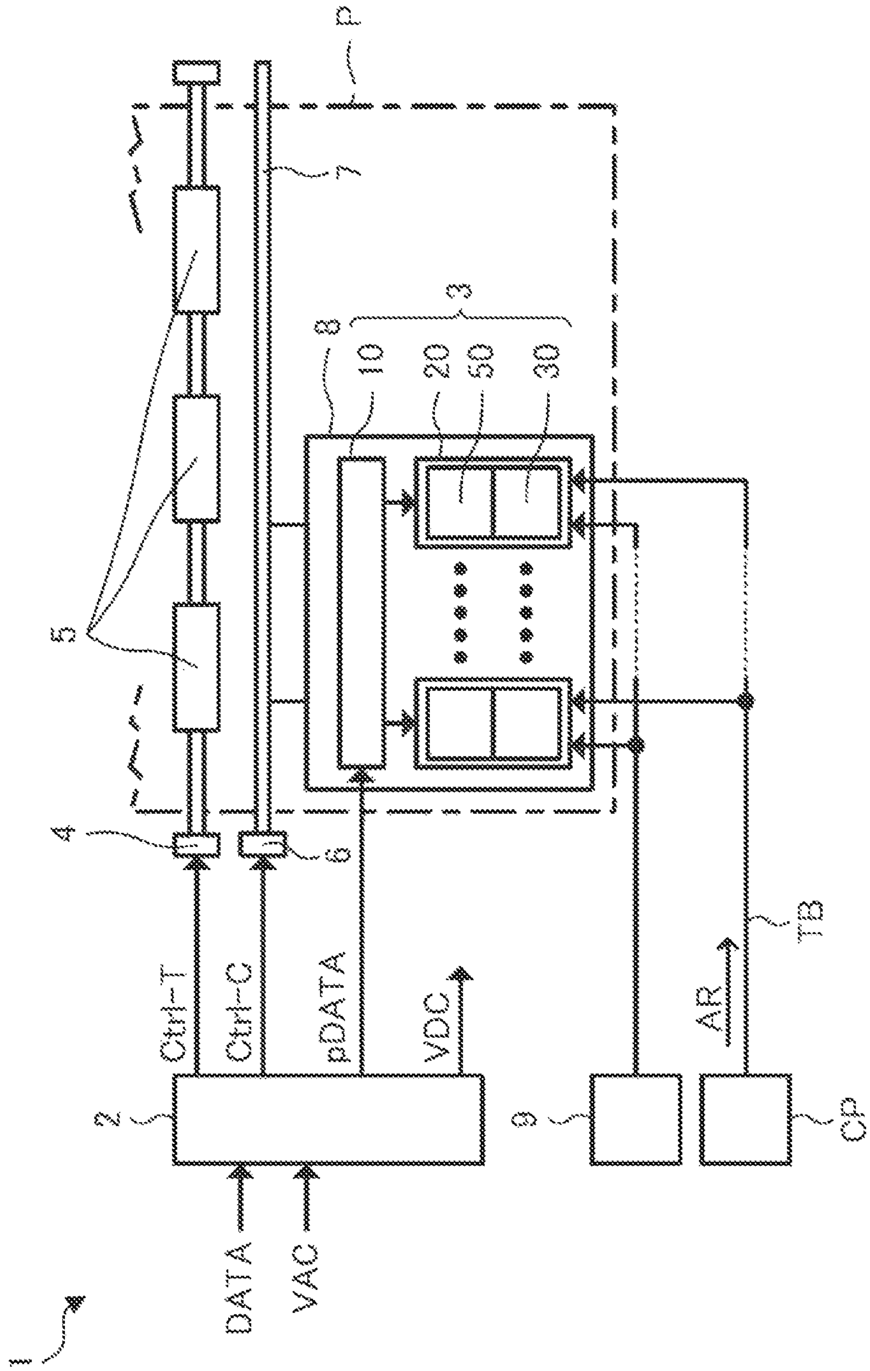
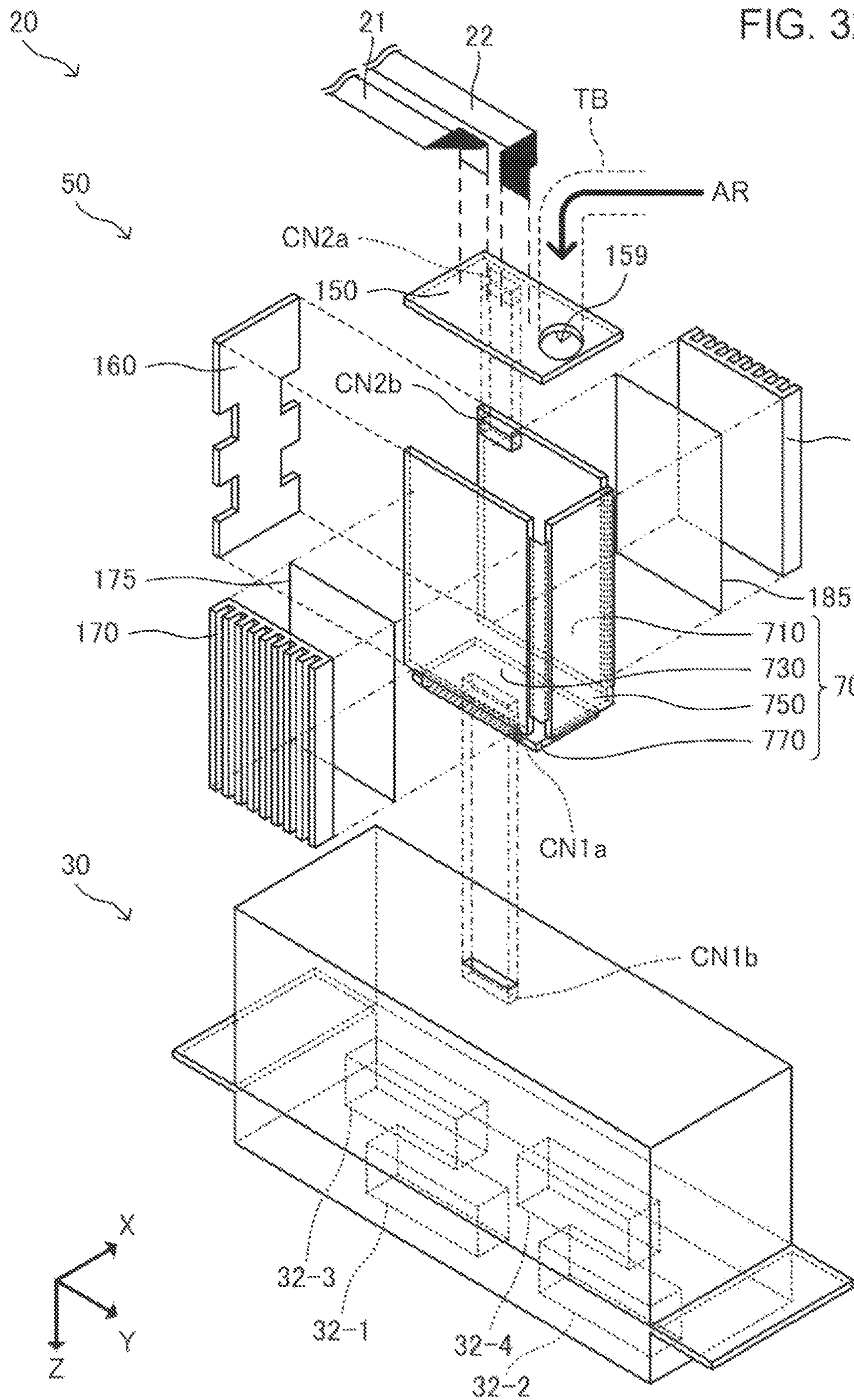


FIG. 32


20
21
22
TB
AR
50
CN2a
159
150
160
CN2b
180
175
185
170
710
730
700
750
770
CN1a
30
CN1b
X
Y
Z
32-3
32-1
32-4
32-2

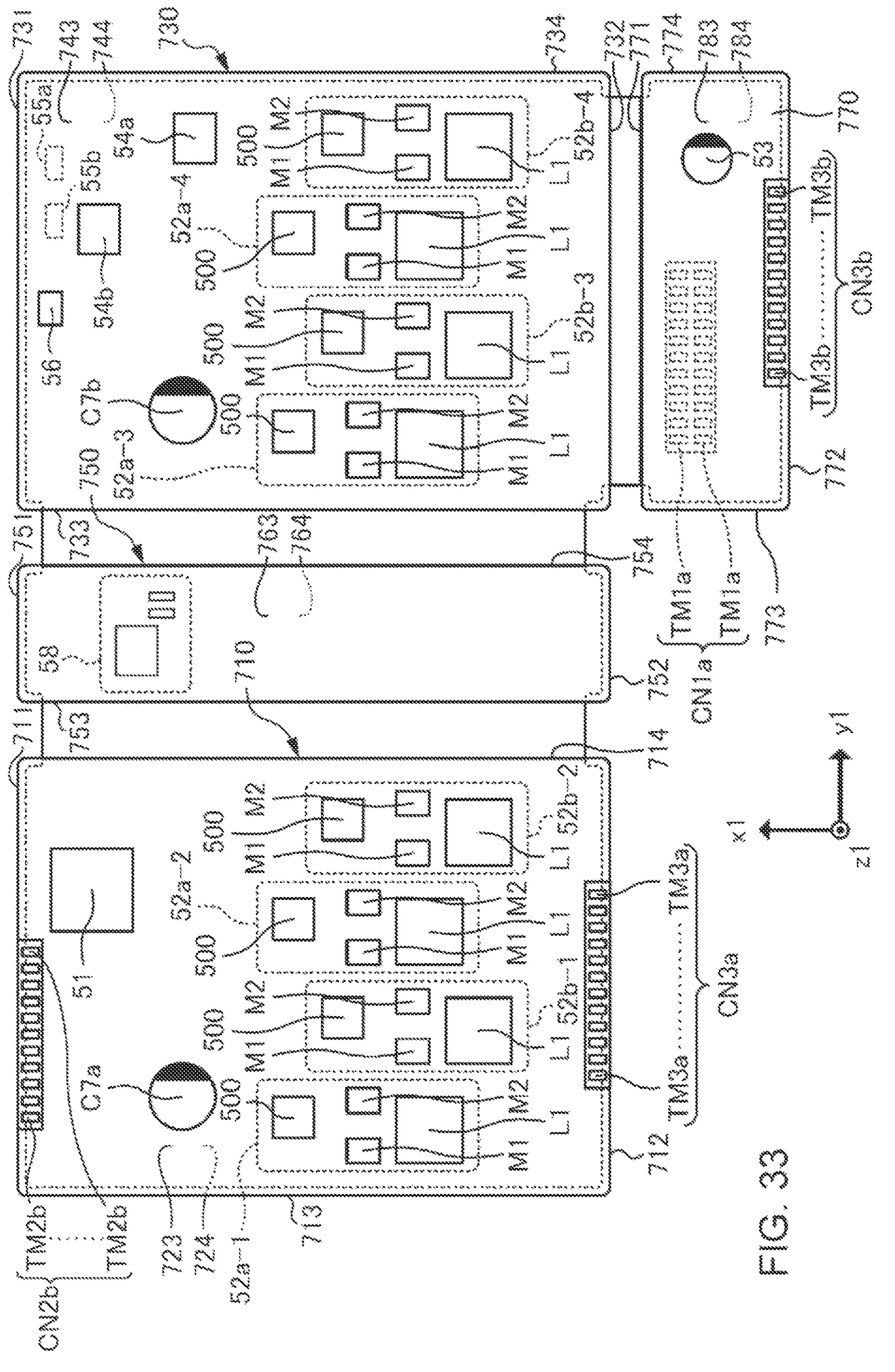

730
731
743
744
55a
55b
54a
54b
56
500
52a-4
52b-4
52a-3
52b-3
C7b
M1
M2
L1
734
732
771
774
783
784
770
53
TM3b
CN3b
772
773
750
751
733
763
764
58
754
752
753
TM1a
CN1a
710
711
714
712
713
51
52a-2
52b-2
52a-1
52b-1
C7a
723
724
TM3a
CN3a
TM2b
CN2b
x1
y1
z1

FIG. 33

LIQUID DISCHARGE APPARATUS

The present application is based on, and claims priority from JP Application Serial Number 2022-158889, filed Sep. 30, 2022, the disclosure of which is hereby incorporated by reference herein in its entirety.

BACKGROUND

1. Technical Field

The present disclosure relates to a liquid discharge apparatus.

2. Related Art

More than half a century passed since the liquid discharge technology using piezoelectric elements was invented, and the liquid discharge apparatus using the technology is utilized in a wide range of fields such as an ink jet printer and a color filter manufacturing apparatus. Nowadays, the basic technology of such a liquid discharge technology is established, and the focus of the market demand for a liquid discharge apparatus is to improve the productivity of a product produced by using the liquid discharge apparatus. In response to such market demands, the focus of technological development of liquid discharge technology is to increase the number of nozzles through which the liquid discharge apparatus discharges a liquid and to increase the discharge amount of ink discharged per unit time by the liquid discharge apparatus.

In JP-A-2018-099835, a printing apparatus (liquid discharge apparatus) devised to increase a discharge amount per unit time by using a plurality of heads provided with a large number of nozzles in order to increase productivity of a product, the apparatus including: a plurality of head units (liquid discharge heads) provided in a housing; a plurality of drive circuits for supplying a driving signal to the head unit; and a cooling mechanism for cooling the drive circuit, is disclosed.

However, although the liquid discharge apparatus described in JP-A-2018-099835 can improve productivity, it is not sufficient from the viewpoints of size reduction of the liquid discharge apparatus, improvement of liquid discharge accuracy, and the like, and there is room for improvement.

SUMMARY

According to an aspect of the present disclosure, there is provided a liquid discharge apparatus including: a print head that discharges a liquid; a substrate unit electrically coupled to the print head; a compressor that sends out compressed air; and a tube that couples the substrate unit and the compressor, in which the print head includes a first discharge section that has a first piezoelectric element that is displaced by receiving a first driving signal and discharges a liquid by displacement of the first piezoelectric element, a second discharge section that has a second piezoelectric element that is displaced by receiving a second driving signal and discharges a liquid by displacement of the second piezoelectric element, and a first connector electrically coupled to the substrate unit, the substrate unit includes a second connector that is electrically coupled to the print head by being fitted to the first connector, a first drive circuit that outputs the first driving signal, a second drive circuit that outputs the second driving signal, and a wiring substrate provided with the second connector, the first drive circuit, and the second drive circuit, the wiring substrate is a rigid flexible substrate including a plurality of rigid members provided with the second connector, the first drive circuit, and the second drive circuit, and a flexible member more flexible than the plurality of rigid members, the flexible member includes a first surface, a second surface opposite to the first surface, a first region, a second region, and a third region, the third region is positioned between the first region and the second region, the plurality of rigid members include a first rigid member and a second rigid member, the first rigid member includes a first front surface, and is laminated on the first surface of the first region such that the first front surface extends along the first surface, the second rigid member includes a second front surface, and is laminated on the first surface of the second region such that the second front surface extends along the first surface, the first drive circuit is provided on the first rigid member, the second drive circuit is provided on the second rigid member, the first rigid member and the second rigid member are positioned such that the first front surface and the second front surface face each other when the flexible member is bent in the third region, and the compressor supplies the compressed air via the tube to a region where the first front surface and the second front surface face each other.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram illustrating a schematic configuration of a liquid discharge apparatus.

FIGS. **2**A and **2**B are diagrams illustrating an example of a functional configuration of a head unit.

FIG. **3** is a diagram illustrating a configuration of a driving signal output circuit.

FIG. **4** is a diagram illustrating an example of signal waveforms of driving signals.

FIG. **5** is a diagram illustrating an example of a signal waveform of a driving signal.

FIG. **6** is a diagram illustrating a functional configuration of a driving signal selection circuit.

FIG. **7** is a table illustrating an example of decoding contents in a decoder.

FIG. **8** is a diagram illustrating a configuration of a selection circuit.

FIG. **9** is a diagram for describing an operation of the driving signal selection circuit.

FIG. **10** is a side view illustrating a structure of a carriage in which the head unit is mounted.

FIG. **11** is a perspective view illustrating a peripheral structure of the carriage in which the head unit is mounted.

FIG. **12** is an exploded perspective view illustrating an example of a structure of a liquid discharge module.

FIG. **13** is a perspective view illustrating an example of an internal structure of a print head.

FIG. **14** is an exploded perspective view of the print head.

FIG. **15** is a view illustrating an example of a configuration of a discharge section of a discharge module.

FIG. **16** is a view illustrating a planar structure of a drive circuit substrate.

FIG. **17** is a cross-sectional view when the drive circuit substrate is cut along the line XVII-XVII illustrated in FIG. **16**.

FIG. **18** is a cross-sectional view when the drive circuit substrate is cut along the line XVIII-XVIII illustrated in FIG. **16**.

FIG. **19** is a view illustrating an example of a structure of the drive circuit substrate having a substantially box shape.

FIG. **20** is a diagram illustrating an example of component arrangement in the drive circuit substrate in an expanded state.

FIG. **21** is a diagram illustrating an example of a wiring pattern in which voltage signals propagate.

FIG. **22** is a diagram illustrating an example of a wiring pattern in which a driving signal and a reference voltage signal propagate.

FIG. **23** is a diagram illustrating an example of component arrangement in the drive circuit substrate in an assembled state.

FIG. **24** is a diagram illustrating an example of component arrangement in the drive circuit substrate in an assembled state.

FIG. **25** is a plan view illustrating an example of a structure of a relay substrate.

FIG. **26** is a side view illustrating an example of the structure of the relay substrate.

FIG. **27** is a view of the drive circuit module viewed from a −x**2** side along an x**2** axis.

FIG. **28** is a view of the drive circuit module viewed from a +x**2** side along the x**2** axis.

FIG. **29** is a view of the drive circuit module viewed from a −y**2** side along a y**2** axis.

FIG. **30** is a view of the drive circuit module viewed from a +z**2** side along a z**2** axis.

FIG. **31** is a diagram illustrating a schematic configuration of a liquid discharge apparatus of a modification example.

FIG. **32** is an exploded perspective view illustrating an example of a structure of a liquid discharge module of a modification example.

FIG. **33** is a diagram illustrating an example of component arrangement in a drive circuit substrate in an expanded state of a modification example.

DESCRIPTION OF EMBODIMENTS

Hereinafter, appropriate embodiments of the present disclosure will be described with reference to the drawings. The drawing to be used is for convenience of description. In addition, the embodiments which will be described below do not inappropriately limit the contents of the present disclosure described in the range of the claims. Moreover, not all of the configurations which will be described below are necessarily essential components of the present disclosure.

1. Functional Configuration of Liquid Discharge Apparatus

1.1 Functional Configuration of Liquid Discharge Apparatus

FIG. **1** is a view illustrating a schematic configuration of a liquid discharge apparatus **1**. The liquid discharge apparatus **1** of the present embodiment is a so-called ink jet printer that forms a desired image on a front surface of a medium P by discharging an ink, which is an example of a liquid, to the transported medium P at a desired timing. Here, in the following description, the direction in which the medium P is transported may be referred to as a transport direction.

As illustrated in FIG. **1**, the liquid discharge apparatus **1** includes a control unit **2**, a head unit **3**, a transport motor **4**, a transport roller **5**, a carriage motor **6**, a carriage guide shaft **7**, a carriage **8**, and a liquid container **9**.

The control unit **2** generates a control signal for controlling each element of the liquid discharge apparatus **1** based on image data DATA supplied from an external device such as a host computer (not illustrated) provided outside the liquid discharge apparatus **1**, and outputs the control signal to the corresponding configuration. Further, the control unit **2** generates a voltage signal VDC used for a power supply voltage of each section of the liquid discharge apparatus **1** from a commercial voltage VAC of an AC voltage supplied to the liquid discharge apparatus **1**, and supplies the voltage signal VDC to each section of the liquid discharge apparatus **1**.

Specifically, the control unit **2** generates a transport control signal Ctrl-T as a control signal for controlling each element of the liquid discharge apparatus **1**, and outputs the transport control signal Ctrl-T to the transport motor **4**. The transport motor **4** is driven based on the input transport control signal Ctrl-T. The transport roller **5** is rotationally driven by the drive of the transport motor **4**. Then, the medium P is transported along the transport direction by the driving force generated by the rotational drive of the transport roller **5**. That is, the transport motor **4** and the transport roller **5** transport the medium P in response to the transport control signal Ctrl-T output by the control unit **2**.

Further, the control unit **2** generates a carriage control signal Ctrl-C as a control signal for controlling each element of the liquid discharge apparatus **1**, and outputs the carriage control signal Ctrl-C to the carriage motor **6**. The carriage motor **6** is driven based on the input carriage control signal Ctrl-C. The driving force generated by driving the carriage motor **6** is transmitted to the carriage **8** supported by the carriage guide shaft **7** via a timing belt (not illustrated). The carriage guide shaft **7** extends along the direction intersecting the transport direction and supports the carriage **8**. Then, the carriage **8** supported by the carriage guide shaft **7** by the driving force generated by the drive of the carriage motor **6** moves along the carriage guide shaft **7**. That is, the carriage motor **6** and the carriage guide shaft **7** move the carriage **8** along the carriage guide shaft **7** in response to the carriage control signal Ctrl-C output by the control unit **2**.

Further, the control unit **2** generates a print data signal pDATA as a control signal for controlling each element of the liquid discharge apparatus **1**, and outputs the print data signal pDATA to the head unit **3**. The head unit **3** has a discharge control module **10** and a plurality of liquid discharge modules **20**. Further, each of the plurality of liquid discharge modules **20** has a drive circuit module **50** and a print head **30**. That is, the head unit **3** has a plurality of sets of the drive circuit module **50** and the print head **30**. The head unit **3** is mounted on the carriage **8** and moves as the carriage **8** moves along the carriage guide shaft **7**.

The print data signal pDATA output by the control unit **2** is input to the discharge control module **10**. The discharge control module **10** generates a control signal for controlling the operation of each of the plurality of liquid discharge modules **20** based on the input print data signal pDATA, and outputs the control signal to the corresponding liquid discharge module **20**. The control signal output by the discharge control module **10** is input to the corresponding drive circuit module **50**. The drive circuit module **50** is electrically coupled to the corresponding print head **30**, and drives the print head **30** to discharge an amount of ink defined by the control signal at a timing defined by the input control signal. As a result, the print head **30** discharges a predetermined amount of ink at a predetermined timing. That is, the head unit **3** discharges a predetermined amount of ink from the print head **30** at a predetermined timing in accordance with the print data signal pDATA output by the control unit **2**.

The liquid container **9** stores ink discharged from the print head **30**. The ink stored in the liquid container **9** is supplied to the print head **30** via a tube (not illustrated) or the like. As the liquid container **9**, an ink cartridge, a bag-shaped ink pack made of a flexible film, an ink tank capable of replenishing ink, and the like can be used.

As described above, in the liquid discharge apparatus **1**, the control unit **2** controls the transport of the medium P, the movement of the carriage **8**, and the discharge timing of the ink from the print head **30** mounted on the carriage **8**. As a result, the ink can land on the medium P at a desired position, and as a result, a desired image is formed on the medium P.

1.2 Functional Configuration of Head Unit

Next, the details of the functional configuration of the head unit **3** included in the liquid discharge apparatus **1** will be described. FIGS. **2**A and **2**B are diagrams illustrating an example of a functional configuration of the head unit **3**. As illustrated in FIGS. **2**A and **2**B, the head unit **3** includes a discharge control module **10** and a plurality of liquid discharge modules **20**. Here, the plurality of liquid discharge modules **20** included in the head unit **3** all have the same configuration, but when the plurality of liquid discharge modules **20** are distinguished, the plurality of liquid discharge modules **20** may be referred to as liquid discharge modules **20-1** to **20**-*n*. That is, the head unit **3** illustrated in FIGS. **2**A and **2**B may be described as having n liquid discharge modules **20-1** to **20**-*n* as the n liquid discharge modules **20**.

In addition, FIGS. **2**A and **2**B illustrate a main control circuit **16** and a power supply voltage output circuit **18**, which are a part of the configuration included in the control unit **2**, in addition to the configuration of the head unit **3**. The main control circuit **16** included in the control unit **2** includes a processing circuit such as a central processing unit (CPU) and a field programmable gate array (FPGA), and a storage circuit such as a semiconductor memory. In addition, the main control circuit **16** performs predetermined signal processing on the image data DATA supplied from an external device such as a host computer (not illustrated) provided outside the liquid discharge apparatus **1**, generates the print data signal pDATA, and outputs the print data signal pDATA to the discharge control module **10**.

The power supply voltage output circuit **18** includes an AC/DC converter such as a flyback circuit and a DC/DC converter such as a step-down circuit or a booster circuit. The power supply voltage output circuit **18** generates a voltage signal VHV, which is a DC voltage signal having a voltage value of 42 V, and a voltage signal VMV, which is a DC voltage signal having a voltage value of 24 V, as the voltage signal VDC from the commercial voltage VAC input from the outside of the liquid discharge apparatus **1**, and outputs the generated signals to the discharge control module **10**. In addition, the voltage value of the voltage signal VHV and the voltage value of the voltage signal VMV are not limited to 42 V and 24 V. Further, the power supply voltage output circuit **18** may output a DC voltage signal having a different voltage value as the voltage signal VDC in place of or in addition to the voltage signals VHV and VMV.

The discharge control module **10** operates using the voltage signals VHV and VMV output by the power supply voltage output circuit **18** or the DC voltage signal generated from the voltage signals VHV and VMV as the power supply voltage. Then, the discharge control module **10** generates a control signal for controlling the operation of n liquid discharge modules **20** based on the print data signal pDATA output by the control unit **2**, and outputs the control signal to the corresponding liquid discharge module **20**.

The discharge control module **10** includes a head control circuit **12** and a cooling fan drive circuit **14**. The print data signal pDATA is input to the head control circuit **12** included in the discharge control module **10**. The head control circuit **12** generates and outputs a clock signal SCK that is commonly input to the n liquid discharge modules **20**, differential print data signals Dp**1** to Dpn corresponding to each of the n liquid discharge modules **20**, and differential drive data signals Dd**1** to Ddn corresponding to each of the n liquid discharge modules **20**, based on the input print data signal pDATA.

Specifically, the print data signal pDATA is a differential signal generated based on the image data DATA, and includes the clock signal SCK, the differential print data signals Dp**1** to Dpn, and the differential drive data signals Dd**1** to Ddn in serial. The head control circuit **12** deserializes and restores the input print data signal pDATA to generate the clock signal SCK that is commonly input to the n liquid discharge modules **20**, and the head control circuit **12** deserializes the input print data signal pDATA to generate the differential print data signals Dp**1** to Dpn and the differential drive data signals Dd**1** to Ddn corresponding to each of the n liquid discharge modules **20**. Then, the head control circuit **12** outputs the generated clock signal SCK, the differential print data signals Dp**1** to Dpn, and the differential drive data signals Dd**1** to Ddn to the corresponding liquid discharge module **20**.

Here, in the following description, the differential print data signal Dp**1** and the differential drive data signal Dd**1** will be described as signals corresponding to the liquid discharge module **20-1**, and the differential print data signal Dpn and the differential drive data signal Ddn will be described as signals corresponding to the liquid discharge module **20**-*n*. That is, it will be described that the clock signal SCK, the differential print data signal Dp**1**, and the differential drive data signal Dd**1** are input to the liquid discharge module **20-1**, and the clock signal SCK, the differential print data signal Dpn, and the differential drive data signal Ddn are input to the liquid discharge module **20**-*n*. Further, it will be described that the clock signal SCK, the differential print data signal Dp, and the differential drive data signal Dd are input to the liquid discharge module **20**.

Further, the head control circuit **12** generates a fan control signal Fc that controls the operation of the cooling fan drive circuit **14**, and outputs the fan control signal Fc to the cooling fan drive circuit **14**. The voltage signal VMV is input to the cooling fan drive circuit **14** in addition to the fan control signal Fc. The cooling fan drive circuit **14** switches whether or not to output the voltage signal VMV as fan driving signals Fp**1** to Fpn based on the input fan control signal Fc. That is, the cooling fan drive circuit **14** has n switch circuits for switching whether or not to output the voltage signal VMV as the fan driving signals Fp**1** to Fpn, and switches the conduction state of each of the n switch circuits by the input fan control signal Fc. That is, the cooling fan drive circuit **14** switches whether or not to output the voltage signal VMV as the fan driving signals Fp**1** to Fpn.

The fan driving signals Fp**1** to Fpn output by the cooling fan drive circuit **14** are output to the corresponding liquid discharge module **20**. In the following description, it will be described that the fan driving signal Fp**1** corresponds to the liquid discharge module **20-1** and the fan driving signal Fpn corresponds to the liquid discharge module **20**-*n*. That is, the fan driving signal Fp**1** is input to the liquid discharge module **20-1**, and the fan driving signal Fpn is input to the liquid discharge module **20**-*n*. Further, it will be described that the fan driving signal Fp is input to the liquid discharge module **20**.

In addition, the cooling fan drive circuit **14** may convert the voltage signal VMV to a predetermined voltage value based on the input fan control signal Fc, and output the converted signal to the fan driving signals Fp**1** to Fpn.

Further, the discharge control module **10** propagates the voltage signals VHV and VMV supplied from the power supply voltage output circuit **18** and supplies the voltage signals VHV and VMV to each of the liquid discharge modules **20-1** to **20**-*n*.

The clock signal SCK, the differential print data signal Dp**1**, the differential drive data signal Dd**1**, the fan driving signal Fp**1**, and the voltage signals VHV and VMV output by the discharge control module **10** are input to the liquid discharge module **20-1**. The liquid discharge module **20-1** operates using the voltage signals VHV and VMV or the DC voltage generated from the voltage signals VHV and VMV as the power supply voltage, and discharges an amount of ink defined by the differential print data signal Dp**1** and the differential drive data signal Dd**1** to the medium P at the timing defined by the differential print data signal Dp**1** and the differential drive data signal Dd**1**.

The liquid discharge module **20-1** includes the drive circuit module **50** and the print head **30**. Further, the drive circuit module **50** includes a discharge control circuit **51**, driving signal output circuits **52***a***-1** to **52***a*-*m* and **52***b***-1** to **52***b*-*m*, a capacitor **53**, an abnormality detection circuit **54**, an abnormality notification circuit **55**, a temperature detection circuit **56**, a voltage conversion circuit **58**, and a cooling fan **59**.

The clock signal SCK, the differential print data signal Dp**1**, and the differential drive data signal Dd**1** are input to the discharge control circuit **51**. The discharge control circuit **51** analyzes the input differential print data signal Dp**1** and the differential drive data signal Dd**1** to generate and output the differential print data signal Dpt for controlling the operation of the print head **30**, reference driving signals dA**1** to dAm which are the basis of the driving signals COMA**1** to COMAm to be described later, and reference driving signals dB**1** to dBm which are the basis of the driving signals COMB**1** to COMBm to be described later. The discharge control circuit **51** includes the FPGA configured with a circuit for analyzing the input differential print data signal Dp**1** and the differential drive data signal Dd**1**.

That is, in the drive circuit module **50**, the FPGA having the discharge control circuit **51** mounted thereon, into which the differential print data signal Dp**1** and the differential drive data signal Dd**1** are input, and which outputs the differential print data signal Dpt for controlling the operation of the print head **30** and the reference driving signals dA**1** to dAm and dB**1** to dBm which are the basis of the driving signals COMA**1** to COMBm and COMB**1** to COMBm based on the input differential print data signal Dp**1** and the differential drive data signal Dd**1**.

Specifically, the discharge control circuit **51** analyzes the input differential print data signal Dp**1** based on the input clock signal SCK. Then, the discharge control circuit **51** generates the differential print data signal Dpt of the differential signal corresponding to the analysis result of the differential print data signal Dp**1** and outputs the differential print data signal Dpt to the print head **30**. At this time, the discharge control circuit **51** may output the differential print data signal Dp**1** as the differential print data signal Dpt according to the analysis result of the differential print data signal Dp**1**, and may output the signal subjected to the predetermined signal processing to the differential print data signal Dp**1** as the differential print data signal Dpt. Further, the discharge control circuit **51** may output a signal including predetermined information read from a storage circuit (not illustrated) according to the analysis result of the differential print data signal Dp**1** as the differential print data signal Dpt.

Further, the discharge control circuit **51** restores and analyzes the input differential drive data signal Dd**1** into a single-ended signal based on the input clock signal SCK. Then, the discharge control circuit **51** generates reference driving signals dA**1** to dAm and dB**1** to dBm according to the analysis result, and outputs the generated signals to the corresponding driving signal output circuits **52***a***-1** to **52***a*-*m* and **52***b***-1** to **52***b*-*m*. Here, the discharge control circuit **51** may read out information held in a storage circuit (not illustrated) based on the analysis result of the single-ended signal obtained by restoring the differential drive data signal Dd**1**, generate the reference driving signals dA**1** to dAm and dB**1** to dBm including the read information, and output the generated signals to the corresponding driving signal output circuits **52***a***-1** to **52***a*-*m* and **52***b***-1** to **52***b*-*m*. Further, the discharge control circuit **51** may generate a single-ended signal by restoring the differential drive data signal Dd**1**, and deserialize the single-ended signal to generate the reference driving signals dA**1** to dAm and dB**1** to dBm and output the generated signals to the corresponding driving signal output circuits **52***a***-1** to **52***a*-*m* and **52***b***-1** to **52***b*-*m*.

Here, it will be described that the reference driving signal dA**1** output by the discharge control circuit **51** corresponds to the driving signal output circuit **52***a***-1**, and the reference driving signal dAm output by the discharge control circuit **51** corresponds to the driving signal output circuit **52***a*-*m*. Similarly, it will be described that the reference driving signal dB**1** output by the discharge control circuit **51** corresponds to the driving signal output circuit **52***b***-1**, and the reference driving signal dBm output by the discharge control circuit **51** corresponds to the driving signal output circuit **52***b*-*m*. That is, the reference driving signal dA**1** is input to the driving signal output circuit **52***a***-1**, the reference driving signal dAm is input to the driving signal output circuit **52***a*-*m*, the reference driving signal dB**1** is input to the driving signal output circuit **52***b***-1**, and the reference driving signal dBm is input to the driving signal output circuit **52***b*-*m*.

The driving signal output circuit **52***a***-1** performs digital-analog conversion of the input reference driving signal dA**1** and performs class D amplification to generate the driving signal COMA**1** and output the driving signal COMA**1** to the print head **30**. The driving signal output circuit **52***b***-1** performs digital-analog conversion of the input reference driving signal dB**1** and performs class D amplification to generate the driving signal COMB**1** and output the driving signal COMB**1** to the print head **30**. Similarly, the driving signal output circuit **52***a*-*m* performs digital-analog conversion of the input reference driving signal dAm and performs class D amplification to generate the driving signal COMAm and output the driving signal COMAm to the print head **30**, and the driving signal output circuit **52***b*-*m* performs digital-analog conversion of the input reference driving signal dBm and performs class D amplification to generate the driving signal COMBm and output the driving signal COMBm to the print head **30**. That is, each of the driving signal output circuits **52***a***-1** to **52***a*-*m* and **52***b***-1** to **52***b*-*m* performs digital-analog conversion of the input reference driving signals dA**1** to dAm and dB**1** to dBm and performs class D amplification to generate the driving signals COMA**1** to COMAm and COMB**1** to COMBm and output the generated signals to the print head **30**. In other words, the driving signal output circuits **52***a*-**1** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* each include a class D amplifier circuit, the driving signal output circuits **52***a*-**1** to **52***a*-*m* output the driving signals COMA**1** to COMAm, and the driving signal output circuits **52***b*-**1** to **52***b*-*m* output the driving signals COMB**1** to COMBm. At this time, each of the reference driving signals dA**1** to dAm and dB**1** to dBm output by the discharge control circuit **51** is a signal which is the basis of the driving signals COMA**1** to COMAm and COMB**1** to COMBm output by each of the driving signal output circuits **52***a*-**1** to **52***a*-**m** and **52***b*-**1** to **52***b*-*m*, that is, a signal that defines the signal waveforms of the driving signals COMA**1** to COMAm and COMB**1** to COMBm.

Here, it is described that the driving signal output circuits **52***a*-**1** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* class-D-amplify the signal waveforms defined by the reference driving signals dA**1** to dAm and dB**1** to dBm to generate the driving signals COMA**1** to COMAm and COMB**1** to COMBm, but the driving signal output circuits **52***a*-**1** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* may class-A-amplify, class-B-amplify, and class-AB-amplify the signal waveforms defined by the reference driving signals dA**1** to dAm and dB**1** to dBm to generate the driving signals COMA**1** to COMAm and COMB**1** to COMBm. However, the driving signal output circuits **52***a*-**1** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* consume a large amount of power and therefore generate a large amount of heat. The driving signal output circuits **52***a*-**1** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* are required to generate the driving signals COMA**1** to COMBm and COMB**1** to COMBm with high efficiency from the viewpoint of reducing power consumption and suppressing heat generation amount.

From the viewpoint above, the driving signal output circuits **52***a*-**1** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* are preferably configured to include class D amplification that can amplify the signal waveforms defined by the reference driving signals dA**1** to dAm and dB**1** to dBm with high efficiency. The details of the configurations of the driving signal output circuits **52***a*-**1** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* including the class D amplification will be described later.

The driving signal output circuits **52***a*-**1** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* each generate and output the reference voltage signal VBS. At this time, the drive circuit module **50** stabilizes the voltage value of the reference voltage signal VBS output by the driving signal output circuit **52***a*-**1** by the capacitor **53**. That is, the drive circuit module **50** has a capacitor **53** for reducing fluctuations in the voltage value of the reference voltage signal VBS. After the voltage value of the reference voltage signal VBS is stabilized by the capacitor **53**, the reference voltage signal VBS is branched and output to the print head **30**, and the wiring through which the reference voltage signal VBS output by each of the driving signal output circuits **52***a*-**2** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* propagates is set to the open state. That is, the drive circuit module **50** outputs the reference voltage signal VBS output by the driving signal output circuit **52***a*-**1** to the print head **30**, and does not output the reference voltage signal VBS output by each of the driving signal output circuits **52***a*-**2** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* to the print head **30**.

The reference voltage signal VBS functions as a reference potential for driving a piezoelectric element **60** (to be described later) of the print head **30**. When the voltage value of the reference voltage signal VBS that functions as such a reference potential fluctuates, the drive characteristic of the piezoelectric element **60** changes. On the other hand, by limiting the reference voltage signal VBS supplied to the piezoelectric element **60** to only the reference voltage signal VBS output by the driving signal output circuit **52***a*-**1**, even when the voltage value of the reference voltage signal VBS output by each of the driving signal output circuits **52***a*-**1** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* varies due to circuit variations and the like, a concern that the voltage value of the reference voltage signal VBS supplied to the piezoelectric element **60** fluctuates is reduced. Thereby, the driving accuracy of the piezoelectric element **60** is improved.

The reference voltage signal VBS output from the drive circuit module **50** and the reference voltage signal VBS input to the print head **30** may be the reference voltage signal VBS output by any one of the driving signal output circuits **52***a*-**1** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m*, and is not limited to the reference voltage signal VBS output by the driving signal output circuit **52***a*-**1**.

Here, the driving signal output circuits **52***a*-**1** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* all have the same configuration except that the input signal and the output signal are different. Therefore, in the following description, when it is not necessary to distinguish the driving signal output circuits **52***a*-**1** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* from each other, the driving signal output circuits **52***a*-**1** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* may be simply referred to as a driving signal output circuit **52**. In this case, it will be described that a reference driving signal dO is input to the driving signal output circuit **52**, and the driving signal output circuit **52** outputs the driving signal COM.

The temperature detection circuit **56** acquires the environmental temperature of the drive circuit module **50**. Here, the environmental temperature of the drive circuit module **50** includes not the temperature of the component itself of the drive circuit module **50** but the space temperature of the drive circuit module **50** that changes as the temperature of the component rises. Then, the temperature detection circuit **56** generates a temperature information signal Tt including the temperature information corresponding to the acquired environmental temperature, and outputs the temperature information signal Tt to the head control circuit **12**.

The head control circuit **12** estimates the temperature of the drive circuit module **50** based on the input temperature information signal Tt. The head control circuit **12** corrects the clock signal SCK, the differential print data signals Dp**1** to Dpn, and the differential drive data signals Dd**1** to Ddn according to the estimated temperature of the drive circuit module **50**, and outputs the corrected clock signal SCK, the differential print data signals Dp**1** to Dpn, and the differential drive data signals Dd**1** to Ddn. That is, the head control circuit **12** controls the operations of the driving signal output circuits **52***a*-**1** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* and the print head **30** based on the temperature information signal Tt corresponding to the environmental temperature acquired by the temperature detection circuit **56**.

Further, when the estimated temperature of the drive circuit module **50** is equal to or higher than a predetermined threshold value, the head control circuit **12** determines that a temperature abnormality occurred or that a temperature abnormality may occur in the drive circuit module **50**. In this case, the head control circuit **12** may generate the clock signal SCK, the differential print data signals Dp**1** to Dpn, and the differential drive data signals Dd**1** to Ddn for stopping the operation of the drive circuit module **50**, and output the generated signals to the drive circuit module **50**. That is, the head control circuit **12** may stop the operations of the driving signal output circuits **52***a*-**1** to **52***a*-*m* and **52***b*-**1** to **52***b*-*m* and the print head **30** based on the temperature information signal Tt corresponding to the environmental temperature acquired by the temperature detection circuit **56**.

Further, the head control circuit **12** may notify the user of the information corresponding to the estimated temperature of the drive circuit module **50**, that is, the temperature information acquired by the temperature detection circuit **56**, through a notification section (not illustrated) such as a display. That is, the head control circuit **12** may notify the user of information based on the temperature information signal Tt corresponding to the environmental temperature acquired by the temperature detection circuit **56**.

As the temperature detection circuit **56** that detects the environmental temperature at the space temperature inside the drive circuit module **50**, for example, a thermistor element or an IC temperature sensor element can be used. That is, the temperature information signal Tt output by the temperature detection circuit **56** may include temperature information indicating the temperature of the drive circuit module **50** itself, and may include a voltage value that changes according to the temperature of the drive circuit module **50** or a current value as the temperature information.

Further, the voltage signals VHV and VMV propagating through the discharge control module **10** are input to the drive circuit module **50**. The voltage signal VHV propagates inside the drive circuit module **50**, is supplied to various configurations of the drive circuit module **50**, and is also supplied to the print head **30**. The voltage signal VMV propagates inside the drive circuit module **50**, is supplied to various configurations of the drive circuit module **50**, and is also supplied to the voltage conversion circuit **58**. The voltage conversion circuit **58** steps down the input voltage signal VMV to generate and output a voltage signal VDD. The voltage signal VDD output by the voltage conversion circuit **58** is used as a power supply voltage for various circuits included in the drive circuit module **50** and is also supplied to the print head **30**. The voltage signal VDD is, for example, a DC voltage such as 5 V or 3.3 V.

The voltage signal VDD output by the voltage conversion circuit **58** is not limited to one, and the voltage conversion circuit **58** may output a plurality of voltage signals VDD having different voltage values. Further, the voltage signal VMV may be supplied to the print head **30** together with the voltage signals VHV and VDD.

The abnormality detection circuit **54** detects an abnormality that occurred in the drive circuit module **50**, and generates an abnormality information signal Te and an abnormality notification signal De according to the detection result. The abnormality detection circuit **54** is a comparison device that compares whether or not the detection target is equal to or greater than a predetermined threshold value, and is configured to include, for example, a comparator.

The abnormality information signal Te output by the abnormality detection circuit **54** is input to the head control circuit **12**. When the input abnormality information signal Te includes information indicating an abnormality of the drive circuit module **50**, the head control circuit **12** generates the clock signal SCK for stopping the operation of the drive circuit module **50**, the differential print data signals Dp**1** to Dpn, and the differential drive data signals Dd**1** to Ddn and outputs the generated signals to the drive circuit module **50**. As a result, the operation of the drive circuit module **50** is stopped.

Further, the abnormality notification signal De output by the abnormality detection circuit **54** is input to the abnormality notification circuit **55**. The abnormality notification circuit **55** includes a light emitting element such as a light emitting diode. Then, the abnormality notification circuit **55** notifies the user whether or not an abnormality occurred in the drive circuit module **50** by turning on, turning off, or blinking the light emitting element based on the input abnormality notification signal De.

Here, an example of the operations of the abnormality detection circuit **54** and the abnormality notification circuit **55** will be described.

For example, when the abnormality detection circuit **54** detects that the voltage value of the voltage signal VHV is lower than the normal value, the abnormality detection circuit **54** determines that the voltage value of the voltage signal VHV is not normal, generates the abnormality notification signal De for calling attention to the user, and outputs the abnormality notification signal De to the abnormality notification circuit **55**. The abnormality notification circuit **55** causes the light emitting element to blink in order to notify that the voltage value of the voltage signal VHV decreased, based on the input abnormality notification signal De.

After that, when the voltage value of the voltage signal VHV further decreases and the abnormality detection circuit **54** detects that the voltage value of the voltage signal VHV is lower than a predetermined threshold value, the abnormality detection circuit **54** determines that the voltage value of the voltage signal VHV is abnormal, generates the abnormality notification signal De for notifying the user of the abnormality, and outputs the abnormality notification signal De to the abnormality notification circuit **55**. The abnormality notification circuit **55** turns on the light emitting element to notify that an abnormality occurred in the voltage value of the voltage signal VHV based on the input abnormality notification signal De. At this time, the abnormality detection circuit **54** generates the abnormality information signal Te including abnormality information indicating that the drive circuit module **50** is abnormal and the voltage value of the voltage signal VHV is abnormal, and outputs the abnormality information signal Te to the head control circuit **12**.

For example, when the abnormality detection circuit **54** detects that the voltage value of the voltage signal VDD used as the power supply voltage of the FPGA that configures the discharge control circuit **51** is lower than the normal value, the abnormality detection circuit **54** determines that the voltage value of the voltage signal VDD is not normal, generates the abnormality notification signal De for calling attention to the user, and outputs the abnormality notification signal De to the abnormality notification circuit **55**. The abnormality notification circuit **55** causes the light emitting element to blink in order to notify that the voltage value of the voltage signal VDD decreased, based on the input abnormality notification signal De.

After that, when the voltage value of the voltage signal VDD further decreases and the abnormality detection circuit **54** detects that the voltage value of the voltage signal VDD is lower than a predetermined threshold value, the abnormality detection circuit **54** determines that the voltage value of the voltage signal VDD is abnormal, generates the abnormality notification signal De for notifying the user of the abnormality, and outputs the abnormality notification signal De to the abnormality notification circuit **55**. The abnormality notification circuit **55** turns on the light emitting element to notify that an abnormality occurred in the voltage value of the voltage signal VDD based on the input abnormality notification signal De. At this time, the abnormality detection circuit **54** generates the abnormality information signal Te including abnormality information indicating that the drive circuit module **50** is abnormal and the voltage value of the voltage signal VDD is abnormal, and outputs the abnormality information signal Te to the head control circuit **12**.

Here, the number of light emitting elements included in the abnormality notification circuit **55** is not limited to one, and for example, the light emitting element for notifying the presence or absence of an abnormality of the voltage signal VHV and the light emitting element for notifying the presence or absence of an abnormality of the voltage signal VDD may be individually provided. Further, when the abnormality notification circuit **55** has a plurality of light emitting elements, the user may be notified of the presence or absence of an abnormality in the drive circuit module **50** by combining turning-on, turning-off, and blinking of the plurality of light emitting elements. Further, in the above description, as an example, it is described that the abnormality detection circuit **54** detects the presence or absence of an abnormality in the voltage value of the voltage signal VHV and the presence or absence of an abnormality in the voltage value of the voltage signal VDD, as the detection of the presence or absence of an abnormality in the drive circuit module **50**, but the abnormality detection circuit **54** may detect the presence or absence of heat generation abnormality of the drive circuit module **50** based on the temperature information signal Tt output by the temperature detection circuit **56** or may detect the presence or absence of voltage abnormality of the voltage signal VMV in place of or in addition to the detection of the presence or absence of an abnormality in the voltage values of the voltage signal VHV and the voltage signal VDD.

The fan driving signal Fp**1** output by the cooling fan drive circuit **14** is input to the cooling fan **59**. Then, the cooling fan **59** is driven by the input fan driving signal Fp**1** to generate an air flow in the drive circuit module **50**. The drive circuit module **50** is cooled by the air flow generated by the cooling fan **59**. Here, the head control circuit **12** may output the fan control signal Fc based on the temperature information signal Tt output by the temperature detection circuit **56**. As a result, the drive state of the cooling fan **59** is the result of temperature detection by the temperature detection circuit **56**, and is controlled according to the temperature state of the drive circuit module **50** which is the cooling target. As a result, the concern that the power consumption increases due to the excessive driving of the cooling fan **59** is reduced, and accordingly, the power consumption of the liquid discharge apparatus **1** is reduced, and the concern that a temperature abnormality occurs in the drive circuit module **50** is also reduced.

The print head **30** includes a restoration circuit **31** and discharge modules **32-1** to **32-*m***. The restoration circuit **31** operates using the voltage signals VHV and VDD or the DC voltage generated from the voltage signals VHV and VDD as the power supply voltage. The restoration circuit **31** restores the differential print data signal Dpt of the differential signal output by the discharge control circuit **51** to a single-ended signal. Specifically, the clock signal SCK and the differential print data signal Dpt are input to the restoration circuit **31**. The restoration circuit **31** restores the differential print data signal Dpt input based on the clock signal SCK to a single-ended signal, and deserializes the restored signal to generate the latch signal LAT, the change signal CH, and the print data signals SI**1** to SIm. Then, the restoration circuit **31** outputs the clock signal SCK, the generated latch signal LAT, the change signal CH, and the print data signals SI**1** to SIm to the corresponding discharge modules **32-1** to **32-*m***.

The discharge module **32-1** includes a driving signal selection circuit **200** and a plurality of discharge sections **600**.

The latch signal LAT, the change signal CH, the print data signal SI**1**, the clock signal SCK, and the driving signals COMA**1** and COMB**1**, which are output by the restoration circuit **31**, are input to the driving signal selection circuit **200**. The driving signal selection circuit **200** operates using the voltage signals VHV and VDD or the DC voltage generated from the voltage signals VHV and VDD as the power supply voltage, and accordingly, in each of the periods defined by the latch signal LAT and the change signal CH, based on the print data signal SI**1**, the driving signal selection circuit **200** selects or deselects the signal waveform included in the driving signal COMA**1** or selects or deselects the signal waveform included in the driving signal COMB**1** to generate and output the driving signal VOUT corresponding to each of the plurality of discharge sections **600**. That is, when the discharge module **32-1** has p discharge sections **600**, the driving signal selection circuit **200** generates p driving signals VOUT corresponding to each of the p discharge sections **600**, and outputs the generate the p driving signals VOUT to the corresponding discharge sections **600**.

Each of the plurality of discharge sections **600** includes the piezoelectric element **60**. The corresponding driving signal VOUT output by the driving signal selection circuit **200** is supplied to one end of the piezoelectric element **60**. In addition, the reference voltage signal VBS is commonly supplied to the other end of the plurality of piezoelectric elements **60** included in each of the plurality of discharge sections **600**. The plurality of piezoelectric elements **60** included in each of the plurality of discharge sections **600** are displaced by the potential difference between the driving signal VOUT and the reference voltage signal VBS. Accordingly, the ink having an amount that corresponds to the displacement of the piezoelectric element **60** is discharged from the corresponding discharge section **600**. The ink discharged from the discharge section **600** lands on the medium P, and accordingly, an image is formed on the medium P. In addition, the details of the operation of the driving signal selection circuit **200** that outputs the driving signal VOUT will be described later.

Here, the discharge modules **32-2** to **32-*m*** included in the print head **30** have the same configuration as the discharge module **32-1** except that the input signals are different, and execute the same operation. Therefore, the detailed description of the discharge modules **32-2** to **32-*m*** will be omitted. That is, each of the discharge modules **32-2** to **32-*m*** includes the driving signal selection circuit **200** and the plurality of discharge sections **600**. Then, the driving signal selection circuits **200** included in each of the discharge modules **32-2** to **32-*m*** selects or deselects the signal waveforms included in the corresponding driving signals COMA**2** to COMAm or selects or deselects the signal waveforms included in the corresponding driving signals COMB**2** to COMBm based on the corresponding print data signals SI**2** to SIm in each of the periods defined by the input latch signal LAT and the change signal CH to output the driving signal VOUT corresponding to each of the plurality of discharge sections **600**. As a result, an amount of ink corresponding to the potential difference between the input driving signal VOUT and the reference voltage signal VBS is discharged from each of the plurality of discharge sections **600** included in each of the discharge modules **32-2** to **32-*m***.

In other words, the print head **30** has discharge modules **32-1** to **32-*m***. The discharge module **32-1** includes the discharge section **600** having the piezoelectric element **60** that is displaced by receiving the driving signal VOUT based on the driving signals COMA**1** and COMB**1** and discharges an ink by the displacement of the piezoelectric element **60**; and the driving signal selection circuit **200** that switches whether or not to supply the driving signals COMA**1** and COMB**1** to the piezoelectric element **60**. The discharge module **32**-*m* includes the discharge section **600** having the piezoelectric element **60** that is displaced by receiving the driving signal VOUT based on the driving signals COMAm and COMBm and discharges an ink by the displacement of the piezoelectric element **60**; and the driving signal selection circuit **200** that switches whether or not to supply the driving signals COMAm and COMBm to the piezoelectric element **60**.

Therefore, in the following description, when it is not necessary to distinguish the discharge modules **32**-**1** to **32**-*m* from each other, the discharge modules **32**-**1** to **32**-*m* may be simply referred to as a discharge module **32**. Further, it may be described that the print data signal SI as the print data signals SI**1** to SIm, the driving signal COMA as the driving signals COMA**1** to COMAm, and the driving signal COMB as the driving signals COMB**1** to COMBm are input to the discharge module **32**. That is, the driving signal selection circuits **200** included in each of the discharge modules **32** selects or deselects the signal waveform included in the driving signal COMA or selects or deselects the signal waveform included in the driving signal COMB based on the print data signal SI in each of the periods defined by the latch signal LAT and the change signal CH to output the driving signal VOUT corresponding to each of the plurality of discharge sections **600**.

As described above, the liquid discharge module **20**-**1** includes the drive circuit module **50** and the print head **30**, and operates based on the clock signal SCK, the differential print data signal Dp**1**, the differential drive data signal Dd**1**, the fan driving signal Fp**1**, and the voltage signals VHV and VMV output by the discharge control module **10** to discharge an amount of ink defined by the differential print data signal Dp**1** and the differential drive data signal Dd**1** to the medium P at the timing defined by the differential print data signal Dp**1** and the differential drive data signal Dd**1**.

Here, the liquid discharge modules **20**-**2** to **20**-*n* have the same configuration as the liquid discharge module **20**-**1** except that the input signals are different, and execute the same operations. Therefore, the detailed description of the liquid discharge modules **20**-**2** to **20**-*n* will be omitted. That is, each of the liquid discharge modules **20**-**2** to **20**-*n* includes the drive circuit module **50** and the print head **30**, and operates based on the clock signal SCK, the corresponding differential print data signals Dp**2** to Dpn, the corresponding differential drive data signals Dd**2** to Ddn, the corresponding fan driving signals Fp**2** to Fpn, and the voltage signals VHV and VMV output by the discharge control module **10** to discharge an amount of ink defined by the corresponding differential print data signals Dp**2** to Dpn and the corresponding differential drive data signals Dd**2** to Ddn to the medium P at the timing defined by the corresponding differential print data signals Dp**2** to Dpn and the corresponding differential drive data signals Dd**2** to Ddn.

As described above, the liquid discharge apparatus **1** includes the print head **30** that discharges an ink, the drive circuit module **50** that is electrically coupled to the print head **30**, and the control unit **2** and the head control circuit **12** that controls the operations of the print head **30** and the drive circuit module **50**. The head unit **3**, which includes the liquid discharge apparatus **1** and includes the discharge control module **10**, the print head **30**, and the drive circuit module **50**, drives the voltage signals VHV and VMV input from the control unit **2** as power supply voltages, and discharges the ink at a timing based on the print data signal pDATA to form an image corresponding to the print data signal pDATA and an image corresponding to the image data DATA on the medium P.

1.3 Functional Configuration of Driving Signal Output Circuit

Next, the configuration and operation of the driving signal output circuit **52** that outputs the driving signal COM will be described. FIG. **3** is a view illustrating a configuration of the driving signal output circuit **52**. The driving signal output circuit **52** includes an integrated circuit **500**, an amplifier circuit **550**, a demodulator circuit **560**, feedback circuits **570** and **572**, and other electronic components.

The integrated circuit **500** includes a plurality of terminals including a terminal Id, a terminal Bst, a terminal Hdr, a terminal Sw, a terminal Gvd, a terminal Ldr, a terminal Gnd, a terminal Vbs, a terminal Vfb, and a terminal Ifb. The integrated circuit **500** is electrically coupled to an externally provided substrate (not illustrated) via the plurality of terminals. In addition, the integrated circuit **500** includes a digital to analog converter (DAC) **511**, a modulator circuit **510**, a gate drive circuit **520**, and a reference power supply circuit **590**. The reference power supply circuit **590** generates a voltage signal DAC HV and a voltage signal DAC LV and supplies the voltage signals DAC HV and DAC LV to the DAC **511**. In addition, the digital reference driving signal dO that defines the signal waveform of the driving signal COM is input to the DAC **511**. The DAC **511** converts the input reference driving signal dO into a reference driving signal aO that is an analog signal of the voltage value between the voltage value of the voltage signal DAC_HV and the voltage value of the voltage signal DAC_LV, and outputs the reference driving signal aO to the modulator circuit **510**. That is, the maximum value of the voltage amplitude of the reference driving signal aO is defined by the voltage signal DAC_HV, and the minimum value is defined by the voltage signal DAC_LV. The signal obtained by amplifying the reference driving signal aO output by the DAC **511** corresponds to the driving signal COM. That is, the reference driving signal aO corresponds to a target signal before amplification of the driving signal COM, and the reference driving signals dO and aO are signals defining the signal waveforms of the driving signal COM.

The modulator circuit **510** generates a modulation signal Ms obtained by modulating the reference driving signal aO, and outputs the modulation signal Ms to the gate drive circuit **520**. The modulator circuit **510** includes adders **512** and **513**, a comparator **514**, an inverter **515**, an integral attenuator **516**, and an attenuator **517**.

The integral attenuator **516** attenuates and integrates the driving signal COM input via the terminal Vfb and outputs the driving signal COM to the input end on the − side of the adder **512**. The reference driving signal aO is input to the input end on the + side of the adder **512**. The adder **512** outputs the voltage obtained by subtracting and integrating the voltage input to the input end on the − side from the voltage input to the input end on the + side, to the input end on the + side of the adder **513**.

The attenuator **517** outputs a voltage obtained by attenuating the high frequency component of the driving signal COM input via the terminal Ifb to the input end on the − side of the adder **513**. The voltage output from the adder **512** is input to the input end on the + side of the adder **513**. The adder **513** generates a voltage signal Os obtained by subtracting the voltage input to the input end on the − side from the voltage input to the input end on the + side, and outputs the voltage signal Os to the comparator **514**.

The comparator **514** outputs the modulation signal Ms obtained by pulse-modulating the voltage signal Os input from the adder **513**. Specifically, the comparator **514** generates and outputs the modulation signal Ms that is an H level when the voltage value of the voltage signal Os input from the adder **513** is equal to or greater than a predetermined threshold value Vth**1** when the voltage value is increased, and that is an L level when the voltage value of the voltage signal Os falls below a predetermined threshold value Vth**2** when the voltage value is lowered. Here, the threshold values Vth**1** and Vth**2** are set in the relationship of threshold value Vth**1** threshold value Vth**2**.

The modulation signal Ms output by the comparator **514** is input to a gate driver **521** included in the gate drive circuit **520**, and is also input to a gate driver **522** included in the gate drive circuit **520** via the inverter **515**. That is, a signal having a relationship in which the logic levels are exclusive is input to the gate driver **521** and the gate driver **522**. Here, the relationship in which the logic levels are exclusive includes that the logic levels of the signals input to the gate driver **521** and the gate driver **522** do not simultaneously be the H level. Therefore, the modulator circuit **510** may include a timing control circuit for controlling the timing of the modulation signal Ms input to the gate driver **521** in place of or in addition to the inverter **515** and the signal in which the logic level of the modulation signal Ms input to the gate driver **522** is inverted.

The gate drive circuit **520** includes the gate driver **521** and the gate driver **522**. The gate driver **521** level-shifts the modulation signal Ms output from the comparator **514** to generate an amplification control signal Hgd and output the amplification control signal Hgd from the terminal Hdr.

Specifically, the voltage is supplied to the higher side of the power supply voltage of the gate driver **521** via the terminal Bst, and the voltage is supplied to the lower side via the terminal Sw. The terminal Bst is coupled to one end of a capacitor C**5** and the cathode of the diode D**1** for preventing a reverse flow. The terminal Sw is coupled to the other end of the capacitor C**5**. Further, the anode of the diode D**1** is coupled to the terminal Gvd. A voltage signal Vm, which is a DC voltage of, for example, 7.5 V, output by a power supply circuit (not illustrated) is supplied to the terminal Gvd. That is, the voltage signal Vm is supplied to the anode of the diode D**1**. Therefore, the potential difference between the terminal Bst and the terminal Sw is approximately equal to the voltage value of the voltage signal Vm. As a result, the gate driver **521** generates the amplification control signal Hgd having a voltage value larger than that of the terminal Sw by the voltage value of the voltage signal Vm according to the input modulation signal Ms, and outputs the amplification control signal Hgd from the terminal Hdr.

The gate driver **522** operates on the lower potential side than that of the gate driver **521**. The gate driver **522** level-shifts the signal in which the logic level of the modulation signal Ms output from the comparator **514** is inverted by the inverter **515** to generate the amplification control signal Lgd and output the amplification control signal Lgd from the terminal Ldr.

Specifically, the voltage signal Vm is supplied to the higher side of the power supply voltage of the gate driver **522**, and a ground potential GND is supplied to the lower side via the terminal Gnd. The gate driver **522** outputs the amplification control signal Lgd having a voltage value larger than that of the terminal Gnd by the voltage value of the voltage signal Vm from the terminal Ldr according to the signal in which the logic level of the input modulation signal Ms is inverted. Here, the ground potential GND is a reference potential of the driving signal output circuit **52**, and is, for example, 0 V.

The amplifier circuit **550** includes a transistor M**1** and a transistor M**2**.

The transistor M**1** is a surface mount-type field effect transistor (FET), and a voltage signal VHV is supplied to the drain of the transistor M**1** as a power supply voltage for amplification of the amplifier circuit **550**. In addition, the gate of the transistor M**1** is electrically coupled to one end of a resistor R**1** and the other end of the resistor R**1** is electrically coupled to the terminal Hdr of the integrated circuit **500**. That is, the amplification control signal Hgd is input to the gate of the transistor M**1**. In addition, the source of the transistor M**1** is electrically coupled to the terminal Sw of the integrated circuit **500**.

The transistor M**2** is the surface mount-type FET, and the drain of the transistor M**2** is electrically coupled to the terminal Sw of the integrated circuit **500**. That is, the drain of the transistor M**2** and the source of the transistor M**1** are electrically coupled to each other. The gate of the transistor M**2** is electrically coupled to one end of a resistor R**2**, and the other end of the resistor R**2** is electrically coupled to the terminal Ldr of the integrated circuit **500**. That is, the amplification control signal Lgd is input to the gate of the transistor M**2**. In addition, the ground potential GND is supplied to the source of the transistor M**2**.

When the drain and the source of the transistor M**1** are controlled to be non-conductive and the drain and the source of the transistor M**2** are controlled to be conductive, the potential of the node to which the terminal Sw is coupled is the ground potential GND. Therefore, the voltage signal Vm is supplied to the terminal Bst. On the other hand, when the drain and the source of the transistor M**1** are controlled to be conductive and the drain and the source of the transistor M**2** are controlled to be non-conductive, the potential of the node to which the terminal Sw is coupled is the voltage value of the voltage signal VHV. Therefore, a voltage having a potential of the sum of the voltage value of the voltage signal VHV and the voltage value of the voltage signal Vm is supplied to the terminal Bst. That is, using the capacitor C**5** as a floating power supply, the potential of the terminal Sw changes to the ground potential GND or the voltage value of the voltage signal VHV according to the operations of the transistor M**1** and the transistor M**2**, and accordingly, the gate driver **521** that drives the transistor M**1** generates the amplification control signal Hgd where the L level is the voltage value of the voltage signal VHV and the H level is the voltage value of the sum of the voltage value of the voltage signal VHV and the voltage value of the voltage signal Vm and output the amplification control signal Hgd to the gate of the transistor M**1**.

On the other hand, the gate driver **522** that drives the transistor M**2** generates the amplification control signal Lgd of the voltage value where the L level is the ground potential GND and the H level is the voltage value of the voltage signal Vm, regardless of the operations of the transistor M**1** and the transistor M**2** and outputs the amplification control signal Lgd to the gate of the transistor M**2**.

The amplifier circuit **550** configured as described above generates an amplified modulation signal AMs obtained by amplifying the modulation signal Ms based on the voltage signal VHV at a coupling point between the source of the transistor M**1** and the drain of the transistor M**2**. The amplifier circuit **550** outputs the generated amplified modulation signal AMs to the demodulator circuit **560**.

Here, a capacitor C**7** is provided in the propagation path through which the voltage signal VHV input to the amplifier circuit **550** propagates. Specifically, one end of the capacitor C**7** is a propagation path through which the voltage signal VHV propagates, and is electrically coupled to the drain of the transistor M**1**, and the ground potential GND is supplied to the other end of the capacitor C**7**. As a result, the concern that the voltage value of the voltage signal VHV input to the amplifier circuit **550** fluctuates is reduced, the concern that noise is superimposed on the voltage signal VHV is reduced, and as a result, the waveform accuracy of the amplified modulation signals AMs output by the amplifier circuit **550** is improved. Therefore, an electrolytic capacitor having a high withstand voltage and a large capacity is used. The capacitor C**7** may be provided to correspond to one driving signal output circuit **52**, or may be provided to correspond to the plurality of driving signal output circuits **52**.

The demodulator circuit **560** demodulates the amplified modulation signal AMS output by the amplifier circuit **550** to generate the driving signal COM and output the driving signal COM from the driving signal output circuit **52**. The demodulator circuit **560** includes an inductor L**1** and a capacitor C**1**. One end of the inductor L**1** is coupled to one end of the capacitor C**1**. The amplified modulation signal AMs is input to the other end of the inductor L**1**. In addition, the ground potential GND is supplied to the other end of the capacitor C**1**. That is, in the demodulator circuit **560**, the inductor L**1** and the capacitor C**1** configure a low pass filter. The demodulator circuit **560** demodulates the amplified modulation signal AMs by smoothing the amplified modulation signal AMs with the low pass filter, and outputs the demodulated signal as the driving signal COM. That is, the driving signal output circuit **52** outputs the driving signal COM from one end of the inductor L**1** included in the demodulator circuit **560** and one end of the capacitor C**1**.

The feedback circuit **570** includes a resistor R**3** and a resistor R**4**. The driving signal COM is supplied to one end of the resistor R**3**, and the other end is coupled to the terminal Vfb and one end of the resistor R**4**. The voltage signal VHV is supplied to the other end of the resistor R**4**. Accordingly, the driving signal COM that passes through the feedback circuit **570** is fed back to the terminal Vfb by the voltage value of the voltage signal VHV in a pulled-up state.

The feedback circuit **572** includes capacitors C**2**, C**3**, and C**4** and resistors R**5** and R**6**. The driving signal COM is input to one end of the capacitor C**2**, and the other end is coupled to one end of the resistor R**5** and one end of the resistor R**6**. The ground potential GND is supplied to the other end of the resistor R**5**. As a result, the capacitor C**2** and the resistor R**5** function as a high pass filter. In addition, the other end of the resistor R**6** is coupled to one end of the capacitor C**4** and one end of the capacitor C**3**. The ground potential GND is supplied to the other end of the capacitor C**3**. As a result, the resistor R**6** and the capacitor C**3** function as a low pass filter. That is, the feedback circuit **572** includes a high pass filter and a low pass filter, and functions as a band pass filter through which a signal in a predetermined frequency range included in the driving signal COM passes.

The other end of the capacitor C**4** is coupled to the terminal Ifb of the integrated circuit **500**. Accordingly, a signal, in which the DC component is cut among the high frequency components of the driving signal COM that passed through the feedback circuit **572** that functions as a band pass filter, is fed back to the terminal Ifb.

The driving signal COM is a signal obtained by smoothing the amplified modulation signal AMs based on the reference driving signal dO by the demodulator circuit **560**. In addition, the driving signal COM is integrated and subtracted via the terminal Vfb, and then fed back to the adder **512**. Accordingly, the driving signal output circuit **52** self-oscillates at a frequency determined by the feedback delay and the feedback transfer function. However, the feedback path via the terminal Vfb has a large delay amount. Therefore, it may not be possible to raise the frequency of self-oscillation to such an extent that the accuracy of the driving signal COM can be sufficiently secured only by feedback via the terminal Vfb. Therefore, by providing a path for feeding back the high frequency component of the driving signal COM via the terminal Ifb separately from the path via the terminal Vfb, the delay in the entire circuit is reduced. As a result, the frequency of the voltage signal Os can be raised to such an extent that the accuracy of the driving signal COM can be sufficiently secured as compared with the case where the path via the terminal Ifb does not exist.

Further, the integrated circuit **500** includes a reference voltage signal output circuit **530**. The reference voltage signal output circuit **530** outputs the reference voltage signal VBS. The reference voltage signal output circuit **530** is generated by, for example, stepping down or boosting the voltage signal Vm based on the reference potential, using the band gap reference voltage generated in the integrated circuit **500** as the reference potential. Then, the reference voltage signal output circuit **530** outputs the generated reference voltage signal VBS from the driving signal output circuit **52** via the terminal Vbs.

As described above, the driving signal output circuit **52** generates the driving signal COM by performing digital/analog conversion of the input reference driving signal dO and then class-D-amplifying the analog signal, outputs the generated driving signal COM, and generates and outputs the reference voltage signal VBS. The reference voltage signal output circuit **530** that generates the reference voltage signal VBS may have a configuration different from that of the driving signal output circuit **52**, but has the same configuration as the driving signal output circuit **52** and is incorporated in one integrated circuit **500**. Accordingly, the circuit size of the driving signal output circuit **52** and the drive circuit module **50** including the driving signal output circuit **52** can be reduced.

That is, the driving signal output circuit **52** included in the liquid discharge apparatus **1** of the present embodiment, that is, each of the driving signal output circuits **52***a*-**1** to **52***a*-**4** and **52***b*-**1** to **52***b*-**4** includes the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1**. Then, the driving signal output circuits **52***a*-*m* and **52***b*-*m* output the driving signals COMAm and COMBm that displace the piezoelectric element **60** in order to discharge the ink from the discharge module **32**-*m* of the print head **30**, to the print head **30**.

Further, the reference voltage signal VBS supplied to the other end of the piezoelectric element **60** included in each of the discharge modules **32**-**1** to **32**-*m* is output from the integrated circuit **500** included in the driving signal output circuit **52***a*-**1**. That is, the driving signal output circuit **52***a*-**1** includes the reference voltage signal output circuit **530** that outputs the reference voltage signal VBS to the print head **30**, and at least a part of the reference voltage signal output circuit **530** is included in the integrated circuit **500** in the driving signal output circuit **52***a*-**1**.

1.4 Functional Configuration of Driving Signal Selection Circuit

Next, the configuration and operation of the driving signal selection circuit **200** will be described. In describing the configuration and operation of the driving signal selection circuit **200**, first, an example of the signal waveforms of the driving signals COMA and COMB input to the driving signal selection circuit **200**, and an example of the signal waveform of the driving signal VOUT output from the driving signal selection circuit **200** are described.

FIG. **4** is a view illustrating an example of the signal waveforms of the driving signals COMA and COMB. As illustrated in FIG. **4**, the driving signal COMA has a signal waveform in which a trapezoidal waveform Adp**1** arranged in a period t**1** from the rise of the latch signal LAT to the rise of the change signal CH, and a trapezoidal waveform Adp**2** arranged in a period t**2** from the rise of the change signal CH to the rise of the latch signal LAT are continuous to each other. Further, the trapezoidal waveform Adp**1** is a signal waveform for discharging a predetermined amount of ink from the discharge section **600** when supplied to the piezoelectric element **60** included in the discharge section **600**, and the trapezoidal waveform Adp**2** is a signal waveform for discharging an amount of ink larger than a predetermined amount from the discharge section **600** when supplied to the piezoelectric element **60** included in the discharge section **600**. Here, in the following description, when the trapezoidal waveform Adp**1** is supplied to the piezoelectric element **60** included in the discharge section **600**, the amount of ink discharged from the discharge section **600** is referred to as a small amount, and when the trapezoidal waveform Adp**2** is supplied to the piezoelectric element **60** included in the discharge section **600**, the amount of ink discharged from the discharge section **600** is referred to as a medium amount.

As illustrated in FIG. **4**, the driving signal COMB has a signal waveform in which a trapezoidal waveform Bdp**1** arranged in the period t**1** and a trapezoidal waveform Bdp**2** arranged in the period t**2** are continuous to each other. Further, the trapezoidal waveform Bdp**1** is a signal waveform for not discharging the ink from the discharge section **600** when supplied to the piezoelectric element **60** included in the discharge section **600**, and the trapezoidal waveform Bdp**2** is a signal waveform for discharging a small amount of ink from the discharge section **600** when supplied to the piezoelectric element **60** included in the discharge section **600**. Here, the trapezoidal waveform Bdp**1** is a signal waveform for preventing an increase in ink viscosity by vibrating the ink in the vicinity of the nozzle opening portion included in the discharge section **600** to such an extent that the ink is not discharged. In the following description, when the trapezoidal waveform Bdp**1** is supplied to the piezoelectric element **60** included in the discharge section **600**, an operation of vibrating the ink in the vicinity of the nozzle opening portion may be referred to as micro-vibration.

Here, as illustrated in FIG. **4**, the voltage values at the start timing and end timing of each of the trapezoidal waveforms Adp**1**, Adp**2**, Bdp**1**, and Bdp**2** are all common to a voltage Vc. In other words, each of the trapezoidal waveforms Adp**1**, Adp**2**, Bdp**1**, and Bdp**2** starts at the voltage Vc and ends at the voltage Vc. Then, a cycle tp including the period t**1** and the period t**2** corresponds to a printing cycle for forming new dots on the medium P.

Although FIG. **4** illustrates a case where the trapezoidal waveform Adp**1** and the trapezoidal waveform Bdp**2** have the same signal waveform, the trapezoidal waveform Adp**1** and the trapezoidal waveform Bdp**2** may have different signal waveforms. In addition, it is described that a small amount of ink is discharged from the common discharge section **600** when the trapezoidal waveform Adp**1** is supplied to the piezoelectric element **60** included in the discharge section **600** and when the trapezoidal waveform Bdp**2** is supplied to the piezoelectric element **60** included in the discharge section **600**, but the present disclosure is not limited thereto. In other words, the signal waveforms of the driving signals COMA and COMB are not limited to the signal waveforms illustrated in FIG. **4**, and combinations of various signal waveforms may be used depending on the nature of the ink discharged from the discharge section **600**, the material of the medium P on which the discharged ink lands, and the like.

Further, in FIG. **4**, a case where the timing at which the trapezoidal waveform Adp**1** and the trapezoidal waveform Adp**2** included in the driving signal COMA are switched, and the timing at which the trapezoidal waveform Bdp**1** and the trapezoidal waveform Bdp**2** included in the driving signal COMB are switched are defined by one change signal CH is exemplified. However, the change signal CH that defines the timing at which the trapezoidal waveform Adp**1** and the trapezoidal waveform Adp**2** included in the driving signal COMA are switched, and the change signal CH that defines the timing at which the trapezoidal waveform Bdp**1** and the trapezoidal waveform Bdp**2** included in the driving signal COMB are switched, may be different signals.

FIG. **5** is a view illustrating an example of the signal waveform of the driving signal VOUT when the size of the dots formed on the medium P is any of a large dot LD, a medium dot MD, a small dot SD, and non-recording ND.

As illustrated in FIG. **5**, the driving signal VOUT when the large dot LD is formed on the medium P is a signal waveform in which the trapezoidal waveform Adp**1** arranged in the period t**1** in the cycle tp and the trapezoidal waveform Adp**2** arranged in the period t**2** in the cycle tp are continuous to each other. When the driving signal VOUT is supplied to the piezoelectric element **60** included in the discharge section **600**, a small amount of ink and a medium amount of ink are discharged from the corresponding discharge section **600**. Therefore, each ink lands on the medium P and coalesces to form the large dot LD on the medium P in the cycle tp.

The driving signal VOUT when the medium dot MD is formed on the medium P is a signal waveform in which the trapezoidal waveform Adp**1** arranged in the period t**1** in the cycle tp and the trapezoidal waveform Bdp**2** arranged in the period t**2** in the cycle tp are continuous to each other. When the driving signal VOUT is supplied to the piezoelectric element **60** included in the discharge section **600**, a small amount of ink is discharged two times from the corresponding discharge section **600**. Therefore, each ink lands on the medium P and coalesces to form the medium dot MD on the medium P in the cycle tp.

The driving signal VOUT when the small dot SD is formed on the medium P is a signal waveform in which the trapezoidal waveform Adp**1** arranged in the period t**1** in the cycle tp and a constant signal waveform arranged in the period t**2** in the cycle tp at the voltage Vc are continuous to each other. When the driving signal VOUT is supplied to the piezoelectric element **60** included in the discharge section **600**, a small amount of ink is discharged one time from the corresponding discharge section **600**. Therefore, the ink lands on the medium P to form the small dot SD on the medium P in the cycle tp.

The driving signal VOUT that corresponds to the non-recording ND that does not form dots on the medium P is a signal waveform in which the trapezoidal waveform Bdp**1** arranged in the period **t1** in the cycle tp and a constant signal waveform arranged in the period **t2** in the cycle tp at the voltage Vc are continuous to each other. When the driving signal VOUT is supplied to the piezoelectric element **60** included in the discharge section **600**, the ink in the vicinity of the nozzle opening portion of the corresponding discharge section **600** micro-vibrates only, and no ink is discharged from the discharge section **600**. Therefore, dots are not formed on the medium P in the cycle tp.

Here, in the constant signal waveform at the voltage Vc in the driving signal VOUT, when none of the trapezoidal waveforms Adp**1**, Adp**2**, Bdp**1**, and Bdp**2** is selected as the driving signal VOUT, the voltage Vc immediately before the trapezoidal waveforms Adp**1**, Adp**2**, Bdp**1**, and Bdp**2** corresponds to the voltage value held by the capacitive component of the piezoelectric element **60** included in the discharge section **600**. In other words, when none of the trapezoidal waveforms Adp**1**, Adp**2**, Bdp**1**, and Bdp**2** is selected as the driving signal VOUT, the voltage Vc supplied immediately before is supplied to the piezoelectric element **60** included in the discharge section **600** as the driving signal VOUT.

Here, as illustrated in FIG. **5**, the driving signal selection circuit **200** selects or deselects the trapezoidal waveforms Adp**1** and Adp**2** included in the driving signal COMA and the trapezoidal waveforms Bdp**1** and Bdp**2** included in the driving signal COMB to generate the driving signal VOUT individually corresponding to each of the plurality of discharge sections **600** and output the driving signal VOUT to the piezoelectric element **60** included in the corresponding discharge section **600**.

FIG. **6** is a diagram illustrating a functional configuration of the driving signal selection circuit **200**. As illustrated in FIG. **6**, the driving signal selection circuit **200** includes a selection control circuit **210** and a plurality of selection circuits **230**. FIG. **6** illustrates the plurality of discharge sections **600** to which the driving signal VOUT output from the driving signal selection circuit **200** is supplied. In the following description, the discharge module **32** including the driving signal selection circuit **200** and the plurality of discharge sections **600** will be described as having p discharge sections **600** as the plurality of discharge sections **600**.

The print data signal SI, the clock signal SCK, the latch signal LAT, and the change signal CH are input to the selection control circuit **210**. In the selection control circuit **210**, sets of a register **212**, a latch circuit **214**, and a decoder **216** are provided corresponding to each of the p discharge sections **600**. In other words, the selection control circuit **210** includes at least the same number of sets of the register **212**, the latch circuit **214**, and the decoder **216** as that of the p discharge sections **600**.

The print data signal SI is a signal synchronized with the clock signal SCK, which is a signal having a total of 2p bits serially including 2-bit print data [SIH, SIL] for selecting one of the large dot LD, the medium dot MD, the small dot SD, and the non-recording ND with respect to each of the p discharge sections **600**. The print data signal SI is held in the register **212** for each print data [SIH, SIL] included in the print data signal SI, corresponding to the p discharge sections **600**.

Specifically, in the selection control circuit **210**, the registers **212** are vertically coupled to each other to configure a p-stage shift register. Then, the print data [SIH, SIL] serially input as the print data signal SI is sequentially transferred to the register **212** in the subsequent stage according to the clock signal SCK. Then, when the supply of the clock signal SCK is stopped, the print data [SIH, SIL] corresponding to each of the p discharge sections **600** is held in the register **212** corresponding to each of the p discharge sections **600**. In the following description, in order to distinguish the p registers **212** that configure the shift register, the registers **212** may be referred to as 1st stage, 2nd stage, . . . , p-th stage from the upstream to the downstream where the print data signal SI propagates.

Each of the p latch circuits **214** is provided corresponding to the p registers **212**. Each of the latch circuits **214** latches the print data [SIH, SIL] held in each of the p registers **212** all at once at the rise of the latch signal LAT, and outputs the print data [SIH, SIL] to the corresponding decoder **216**.

FIG. **7** is a table illustrating an example of the decoding contents in the decoder **216**. The decoder **216** generates and outputs selection signals S**1** and S**2** by decoding the print data [SIH, SIL] latched by the latch circuit **214** with the contents illustrated in FIG. **7**. For example, when the input print data [SIH, SIL] is [**1**, **0**], the decoder **216** outputs logic levels of the selection signal S**1** to the selection circuit **230** as the H and L levels in the periods t**1** and t**2**, and outputs logic levels of the selection signal S**2** to the selection circuit **230** as L and H levels in the periods t**1** and t**2**.

The selection circuit **230** is provided corresponding to each of the p discharge sections **600**. In other words, the driving signal selection circuit **200** has p selection circuits **230** that are at least the same in number as the p discharge sections **600**. FIG. **8** is a view illustrating a configuration of the selection circuit **230** that corresponds to one discharge section **600**. As illustrated in FIG. **8**, the selection circuit **230** has inverters **232***a* and **232***b*, which are NOT circuits, and transfer gates **234***a* and **234***b*.

While the selection signal S**1** is input to a positive control end which is not marked with a circle at the transfer gate **234***a*, the selection signal S**1** is logically inverted by the inverter **232***a* and is input to a negative control end marked with a circle at the transfer gate **234***a*. The driving signal COMA is supplied to the input end of the transfer gate **234***a*. While the selection signal S**2** is input to the positive control end which is not marked with a circle at the transfer gate **234***b*, the selection signal S**2** is logically inverted by the inverter **232***b* and is input to the negative control end marked with a circle at the transfer gate **234***b*. The driving signal COMB is supplied to the input end of the transfer gate **234***b*. Then, the output end of the transfer gate **234***a* and the output end of the transfer gate **234***b* are commonly coupled. A signal at the coupling end to which the output end of the transfer gate **234***a* and the output end of the transfer gate **234***b* are commonly coupled is output as the driving signal VOUT.

Specifically, the input end and the output end of the transfer gate **234***a* are made conductive when the selection signal S**1** is the H level, and the input end and the output end of the transfer gate **234***a* are made non-conductive when the selection signal S**1** is the L level. In addition, the input end and the output end of the transfer gate **234***b* are made conductive when the selection signal S**2** is the H level, and the input end and the output end of the transfer gate **234***b* are made non-conductive when the selection signal S**2** is the L level. That is, the selection circuit **230** switches the conduction state between the input ends and the output ends of the transfer gates **234***a* and **234***b* based on the selection signals S**1** and S**2**, to select or deselect the signal waveforms of the driving signals COMA and COMB supplied to the input ends of the transfer gates **234***a* and **234***b*, and output the driving signal VOUT to the coupling end at which the output end of the transfer gate **234***a* and the output end of the transfer gate **234***b* are commonly coupled.

The operation of the driving signal selection circuit **200** will be described with reference to FIG. **9**. FIG. **9** is a diagram for describing the operation of the driving signal selection circuit **200**. The print data [SIH, SIL] included in the print data signal SI is serially input in synchronization with the clock signal SCK. Then, the print data [SIH, SIL] is sequentially transferred by the register **212** that configures the shift register corresponding to the p discharge sections **600** in synchronization with the clock signal SCK. After that, when the supply of the clock signal SCK is stopped, the print data [SIH, SIL] are held in each of the registers **212** corresponding to each of the p discharge sections **600**. The print data [SIH, SIL] included in the print data signal SI is input in the order corresponding to the discharge sections **600** at the p-th stage, . . . , 2nd stage, and 1st stage of the register **212** that configures the shift register.

When the latch signal LAT rises, each of the latch circuits **214** latches the print data [SIH, SIL] held in the register **212** all at once. In addition, in FIG. **9**, LS**1**, LS**2**, . . . , and LSp indicate the print data [SIH, SIL] latched by the latch circuits **214** that correspond to the registers **212** at the 1st stage, 2nd stage, . . . , and p-th stage.

The decoder **216** outputs the logic levels of the selection signals S**1** and S**2** in each of the periods t**1** and t**2** with the contents illustrated in FIG. **7**, according to the size of the dot defined by the latched print data [SIH, SIL].

Specifically, when the input print data [SIH, SIL] is [1, 1], the decoder **216** sets the logic level of the selection signal S**1** to the H and H levels in the periods t**1** and t**2**, and sets the logic level of the selection signal S**2** to the L and L levels in the periods t**1** and t**2**. In this case, the selection circuit **230** selects the trapezoidal waveform Adp**1** in the period t**1** and selects the trapezoidal waveform Adp**2** in the period t**2**. As a result, at the output end of the selection circuit **230**, the driving signal VOUT that corresponds to the large dot LD illustrated in FIG. **5** is generated.

In addition, when the input print data [SIH, SIL] is [1, 0], the decoder **216** sets the logic level of the selection signal S**1** to the H and L levels in the periods t**1** and t**2**, and sets the logic level of the selection signal S**2** to the L and H levels in the periods t**1** and t**2**. In this case, the selection circuit **230** selects the trapezoidal waveform Adp**1** in the period t**1** and selects the trapezoidal waveform Bdp**2** in the period t**2**. As a result, at the output end of the selection circuit **230**, the driving signal VOUT that corresponds to the medium dot MD illustrated in FIG. **5** is generated.

In addition, when the input print data [SIH, SIL] is [0, 1], the decoder **216** sets the logic level of the selection signal S**1** to the H and L levels in the periods t**1** and t**2**, and sets the logic level of the selection signal S**2** to the L and L levels in the periods t**1** and t**2**. In this case, the selection circuit **230** selects the trapezoidal waveform Adp**1** in the period t**1** and selects none of the trapezoidal waveforms Adp**2** and Bdp**2** in the period t**2**. As a result, at the output end of the selection circuit **230**, the driving signal VOUT that corresponds to the small dot SD illustrated in FIG. **5** is generated.

In addition, when the input print data [SIH, SIL] is [0, 0], the decoder **216** sets the logic level of the selection signal S**1** to the L and L levels in the periods t**1** and t**2**, and sets the logic level of the selection signal S**2** to the H and L levels in the periods t**1** and t**2**. In this case, the selection circuit **230** selects the trapezoidal waveform Bdp**1** in the period t**1** and selects none of the trapezoidal waveforms Adp**2** and Bdp**2** in the period t**2**. As a result, at the output end of the selection circuit **230**, the driving signal VOUT that corresponds to the non-recording ND illustrated in FIG. **5** is generated.

As described above, the driving signal selection circuit **200** selects the signal waveforms of the driving signal COMA and the driving signal COMB based on the print data signal SI, the clock signal SCK, the latch signal LAT, and the change signal CH, to generate and output the driving signal VOUT.

2. Structure of Head Unit

2.1 Structure of Head Unit

Next, the structure of the head unit **3** in the liquid discharge apparatus **1** will be described. FIG. **10** is a side view illustrating a structure of the carriage **8** in which the head unit **3** is mounted. FIG. **11** is a perspective view illustrating a peripheral structure of the carriage **8** in which the head unit **3** is mounted. Here, in the following description, the X axis, the Y axis, and the Z axis that are orthogonal to each other will be illustrated and described. Further, in the following description, the starting point side of the arrow along the X axis in the drawing may be referred to as the −X side, and the tip end side thereof may be referred to as the +X side. The starting point side of the arrow along the Y axis in the drawing may be referred to as the −Y side, and the tip end side thereof may be referred to as the +Y side. The starting point side of the arrow along the Z axis in the drawing may be referred to as the −Z side, and the tip end side thereof may be referred to as the +Z side. Further, in the following description, a plane composed of the X axis and the Y axis may be referred to as an XY plane, a plane composed of the X axis and the Z axis may be referred to as an XZ plane, and a plane composed of the Y axis and the Z axis may be referred to as a YZ plane.

As illustrated in FIGS. **10** and **11**, the carriage **8** includes a carriage main body **81**, a carriage cover **82**, and an accommodation case **83**. The carriage main body **81** includes a placement section **85** and a fixing section **86**. The placement section **85** is a plate-shaped member extending along the XY plane, and the fixing section **86** is a plate-shaped member that extends along the YZ plane from the end portion of the placement section **85** on the −Y side toward the −Z side. That is, the carriage main body **81** has an L-shaped cross section when viewed along the X axis. The carriage cover **82** is positioned on the −Z side of the carriage main body **81** and is detachably attached to the carriage main body **81**. At this time, the carriage main body **81** and the carriage cover **82** form a closed space. The accommodation case **83** has a substantially rectangular shape including an accommodation space that can accommodate various configurations inside, and on the −Y side of the carriage main body **81**, the end portion of the accommodation case **83** on the +Y side is fixed to the end portion of the fixing section **86** on the −Z side.

Further, a carriage support section **87** is formed on a surface on the −Y side of the fixing section **86** included in the carriage main body **81**. A guide rail **72** formed on the +Y side of the carriage guide shaft **7** is fitted to the carriage support section **87**, and accordingly, the carriage support section **87** is movably supported by the carriage guide shaft **7**. As a result, the carriage **8** can move along the carriage guide shaft **7**.

In the internal space of the carriage **8** configured as described above, and in the closed space formed by the carriage main body **81** and the carriage cover **82** and the accommodation space formed inside the accommodation case **83**, the discharge control module **10**, a plurality of liquid discharge modules **20**, a plurality of FFC cables **21** corresponding to the plurality of liquid discharge modules **20**, and an FFC cable **22** are accommodated. Here, the liquid discharge apparatus **1** of the present embodiment will be described as including five liquid discharge modules **20**. That is, five liquid discharge modules **20**, five FFC cables **21**, and five FFC cables **22** are accommodated in the internal space of the carriage **8** of the present embodiment. The number of liquid discharge modules **20** included in the liquid discharge apparatus **1** is not limited to five.

The discharge control module **10** is accommodated in the accommodation space formed inside the accommodation case **83**. The discharge control module **10** includes a control circuit substrate **100** and an integrated circuit **110** mounted on the control circuit substrate **100**. In addition, the integrated circuit **110** configures a part or all of the above-described head control circuit **12**.

The five FFC cables **21** and the five FFC cables **22** are provided corresponding to the five liquid discharge modules **20**. Specifically, one end of each of the five FFC cables **21** and one end of each of the five FFC cables **22** are electrically coupled to the control circuit substrate **100**. Further, the other end of each of the five FFC cables **21** and the other end of each of the five FFC cables **22** are electrically coupled to the corresponding liquid discharge module **20**. That is, the other end of the FFC cable **21** and the other end of the FFC cable **22** are electrically coupled to each of the five liquid discharge modules **20**. As such FFC cables **21** and **22**, for example, a flexible flat cable (FFC) can be used.

The five liquid discharge modules **20** include the drive circuit module **50** and the print head **30**, and are accommodated in the closed space formed by the carriage main body **81** and the carriage cover **82**. The five liquid discharge modules **20** are mounted on the placement sections **85** at equal intervals along the X axis.

The other end of the FFC cable **21** and the other end of the FFC cable **22** are electrically coupled to the drive circuit module **50** on the −Z side of the drive circuit module **50** included in the corresponding liquid discharge module **20**. Further, the print head **30** is positioned on the +Z side of the drive circuit module **50**. The print heads **30** are mounted on the placement sections **85** at equal intervals along the X axis. At this time, the plurality of discharge sections **600** included in the print head **30** are exposed from the −Z side surface of the placement section **85**. As a result, the ink discharged from the plurality of discharge sections **600** included in the print head **30** is obstructed by the carriage **8** and is discharged to the medium P.

Further, in the liquid discharge module **20**, the print head **30** and the drive circuit module **50** are electrically coupled by a connector CN**1**. As the connector CN**1**, it is preferable to use a board-to-board (BtoB) connector.

The BtoB connector can electrically couple a configuration in which one of the two connectors is provided and a configuration in which the other of the two connectors is provided to each other by directly fitting the two connectors without using a cable. Therefore, without adding a new configuration, a configuration in which one of the two connectors is provided and a configuration in which the other of the two connectors is provided can be electrically coupled to each other, and the relative arrangement relationship between the configurations can be determined.

Specifically, when the BtoB connector is used as the connector CN**1** that electrically couples the print head **30** and the drive circuit module **50**, the relative arrangement relationship between the print head **30** and the drive circuit module **50** is fixed. Therefore, the carriage **8** may secure a region for fixing at least one of the print head **30** and the drive circuit module **50**. That is, the mounting area of the print head **30** and the drive circuit module **50** on the carriage **8** can be reduced. As a result, the print head **30** and the drive circuit module **50** can be arranged at a high density, and the size of the carriage **8** can be reduced. Further, by electrically coupling the print head **30** and the drive circuit module **50** using the BtoB connector as the connector CN**1**, the influence of the impedance that can occur in the cable is eliminated, and as a result, the accuracy of signals propagated between the print head **30** and the drive circuit module **50** is improved. Therefore, the discharge accuracy of the ink discharged from the print head **30** is improved.

The print data signal pDATA and the voltage signals VHV and VMV output by the control unit **2** propagate through a cable (not illustrated) to the head unit **3** configured as described above, and are input to the discharge control module **10**. The discharge control module **10** generates the clock signal SCK, the differential print data signal Dp, and the differential drive data signal Dd corresponding to each of the five liquid discharge modules **20** based on the input print data signal pDATA, the voltage signals VHV and VMV, and the like, and generates the fan driving signal Fp corresponding to the liquid discharge module **20**. The discharge control module **10** outputs the generated clock signal SCK, the differential print data signal Dp, the differential drive data signal Dd, the fan driving signal Fp, and the voltage signals VHV and VMV to the FFC cables **21** and **22**.

The clock signal SCK, the differential print data signal Dp, the differential drive data signal Dd, and the fan driving signal Fp output by the discharge control module **10**, and the voltage signals VHV and VMV propagate through the FFC cables **21** and **22** and are input to the drive circuit module **50** included in the liquid discharge module **20**. The drive circuit module **50** operates based on the input clock signal SCK, the differential print data signal Dp, and the differential drive data signal Dd, and the voltage signals VHV and VMV, to generate the clock signal SCK, the differential print data signal Dpt, and the plurality of driving signals COM for controlling the operation of the print head **30**, and supply the generated signals to the print head **30** via the connector CN**1**. As a result, the ink is discharged from the discharge section **600** included in the print head **30**.

2.2 Structure of Liquid Discharge Module

2.2.1 Schematic Structure of Liquid Discharge Module

Next, a specific example of the structure of the liquid discharge module **20** included in the head unit **3** will be described. FIG. **12** is an exploded perspective view illustrating an example of a structure of the liquid discharge module **20**. As illustrated in FIG. **12**, the liquid discharge module **20** includes the print head **30** that discharges a liquid, and the drive circuit module **50** that is electrically coupled to the print head **30**. Here, it is described that the print head **30** of the present embodiment includes the discharge modules **32-1** to **32-4** as the four discharge modules **32**, but the number of discharge modules **32** included in the print head **30** is not limited to four. The positional relationship between the discharge modules **32-1** to **32-4** is not limited to the positional relationship illustrated in FIG. **12**.

As illustrated in FIG. **12**, the drive circuit module **50** includes a relay substrate **150**, a drive circuit substrate **700**, an opening plate **160**, heat sinks **170** and **180**, and heat conductive members **175** and **185**.

The relay substrate **150** is a plate-shaped member extending along the XY plane. The other ends of the FFC cables **21** and **22** are electrically coupled to the surface of the relay substrate **150** on the −Z side. A connector CN2*a* is provided on the surface of the relay substrate **150** on the +Z side. Further, on the relay substrate **150**, a through-hole **158** that penetrates the relay substrate **150** in the direction along the Z axis is formed. The cooling fan **59** is attached to the through-hole **158**. That is, the cooling fan **59** is fixed to the relay substrate **150** to generate an air flow in the direction along the Z axis.

The drive circuit substrate **700** is positioned on the +Z side of the relay substrate **150** and includes rigid wiring members **710**, **730**, **750**, and **770**. The rigid wiring members **710**, **730**, **750**, and **770** included in the drive circuit substrate **700** are electrically coupled to each other. In the rigid wiring members **710**, **730**, **750**, and **770** included in the drive circuit substrate **700**, various circuits such as the above-described discharge control circuit **51**, the driving signal output circuit **52**, the capacitor **53**, the abnormality detection circuit **54**, the abnormality notification circuit **55**, the temperature detection circuit **56**, and the voltage conversion circuit **58**, and the connectors CN1*a* and CN2*b* are mounted.

The rigid wiring member **710** is a plate-shaped member extending along the YZ plane, and the end portion on the −Z side is positioned along the end portion on the +X side of the relay substrate **150**. The rigid wiring member **730** is a plate-shaped member extending along the YZ plane, and the end portion on the −Z side is positioned along the end portion of the relay substrate **150** on the −X side. That is, the rigid wiring member **710** is positioned on the +X side of the rigid wiring member **730**, and the rigid wiring member **710** and the rigid wiring member **730** are positioned facing each other along the X axis.

Further, the rigid wiring member **750** is a plate-shaped member extending along the XZ plane, the end portion on the −Z side is positioned along the end portion of the relay substrate **150** on the +Y side, the end portion on the +X side is positioned along the end portion of the rigid wiring member **710** on the +Y side, and the end portion on the −X side is positioned along the end portion of the rigid wiring member **730** on the +Y side. That is, the rigid wiring member **750** is positioned to intersect both the rigid wiring member **710** and the rigid wiring member **730**.

The rigid wiring member **770** is a plate-shaped member extending along the XY plane, the end portion on the +X side is positioned along the end portion on the +Z side of the rigid wiring member **710**, the end portion on the −X side is positioned along the end portion of the rigid wiring member **730** on the +Z side, and the end portion on the +Y side is positioned along the end portion of the rigid wiring member **750** on the +Z side. That is, the rigid wiring member **770** is positioned to intersect the rigid wiring member **710**, the rigid wiring member **730**, and the rigid wiring member **750**.

As described above, in the drive circuit substrate **700**, the rigid wiring member **710** and the rigid wiring member **730** are positioned facing each other in the direction along the X axis, and the rigid wiring members **750** and **770** are positioned to cover at least a part of the space generated between the rigid wiring member **710** and the rigid wiring member **730**.

The connector CN2*b* is a surface of the rigid wiring member **710** on the −X side, and is provided along the end portion of the rigid wiring member **710** on the −Z side. That is, the connector CN2*b* is provided in the vicinity of the relay substrate **150**. The connector CN2*b* is fitted to the connector CN2*a* provided on surface of the relay substrate **150** on the +Z side to electrically couple the drive circuit substrate **700** including the rigid wiring member **710**, and the relay substrate **150**. That is, the connector CN2*a* and the connector CN2*b* configure the BtoB connector that electrically couples the drive circuit substrate **700** and the relay substrate **150** by being directly fitted to each other. In the following description, the BtoB connector including the connector CN2*a* and the connector CN2*b* may be referred to as a connector CN**2**.

The connector CN1*a* is provided on the surface of the rigid wiring member **770** on the +Z side. The drive circuit substrate **700** is electrically coupled to the print head **30** via the connector CN1*a*. That is, the connector CN1*a* corresponds to one of the connectors CN**1** which are BtoB connectors that electrically couple the drive circuit substrate **700** and the print head **30**.

The heat sink **170** is positioned on the −X side of the rigid wiring member **730** and is attached to the rigid wiring member **730** via the heat conductive member **175**. The heat sink **170** and the heat conductive member **175** absorb the heat generated in the rigid wiring member **730** and release the heat into the atmosphere. As a result, the heat sink **170** cools various circuits provided on the rigid wiring member **730**. As the heat sink **170**, a metal such as copper, a copper alloy, aluminum, and an aluminum alloy is used from the viewpoints of heat conductivity performance, processability of the material, availability of the material, and the like. In addition, as the heat conductive member **175**, a gel sheet or a rubber sheet containing, for example, silicone or acrylic resin and having thermal conductivity, which is a substance with flame retardant and electrical insulating properties, is used from the viewpoint of improving the heat absorption efficiency of the heat sink **170** by increasing the adhesion between the heat sink **170** and the rigid wiring member **730** and ensuring the insulation performance between the heat sink **170** and the rigid wiring member **730**, which are metal.

The heat sink **180** is positioned on the +X side of the rigid wiring member **710** and is attached to the rigid wiring member **710** via the heat conductive member **185**. The heat sink **180** and the heat conductive member **185** absorb the heat generated in the rigid wiring member **710** and release the heat into the atmosphere. As a result, the heat sink **180** cools various circuits provided on the rigid wiring member **710**. As the heat sink **180**, a metal such as copper, a copper alloy, aluminum, and an aluminum alloy is used from the viewpoints of heat conductivity performance, processability of the material, availability of the material, and the like. In addition, as the heat conductive member **185**, a gel sheet or a rubber sheet containing, for example, silicone or acrylic resin and having thermal conductivity, which is a substance with flame retardant and electrical insulating properties, is used from the viewpoint of improving the heat absorption efficiency of the heat sink **180** by increasing the adhesion between the heat sink **180** and the rigid wiring member **710** and ensuring the insulation performance between the heat sink **180** and the rigid wiring member **710**, which are metal.

The opening plate **160** is a plate-shaped member extending along the XZ plane, the end portion on the +X side is positioned along the end portion of the rigid wiring member **710** on the −Y side, the end portion on the −X side is positioned along the end portion of the rigid wiring member **730** on the −Y side, the end portion on the +Z side is positioned along the end portion of the rigid wiring member **770** on the −Y side, and the end portion on the −Z side is positioned along the end portion of the relay substrate **150** on the −Y side. That is, the opening plate **160** is positioned to cover at least a part of the space generated between the rigid wiring member **710** and the rigid wiring member **730** positioned facing each other along the X axis.

The print head **30** is positioned on the +Z side of the drive circuit module **50** and has the discharge modules **32-1** to

32-4 and the connector CN1*b*. The discharge modules **32-1** to **32-4** are positioned on the +Z side of the print head **30**, and at least a part thereof is provided to be exposed from the surface of the print head **30** on the +Z side. At this time, of the four discharge modules **32**, the discharge modules **32-1** and **32-2** are positioned side by side such that the discharge module **32-1** is on the −Y side and the discharge module **32-2** is on the +Y side along the Y axis. Of the four discharge modules **32**, the discharge modules **32-3** and **32-4** are positioned side by side such that the discharge module **32-3** is on the −Y side and the discharge modules **32-4** is on the +Y side along the Y axis on the +X side of the discharge modules **32-1** and **32-2** described above. That is, the discharge modules **32-1** and **32-2** of the four discharge modules **32** are positioned side by side along the end portion of the print head **30** on the −X side, and the discharge modules **32-3** and **32-4** of the four discharge modules **32** are positioned side by side along the end portion of the print head **30** on the +X side.

The connector CN1*b* is positioned on the −Z side of the print head **30**, and is provided such that at least a part thereof is exposed from the surface of the print head **30** on the −Z side. The connector CN1*a* included in the drive circuit module **50** is fitted to the connector CN1*b*. As a result, the drive circuit substrate **700** and the print head **30** are electrically coupled. That is, the connector CN1*b* corresponds to the other of the connector CN1 which is a BtoB connector that electrically couples the drive circuit substrate **700** and the print head **30**, and the connector CN1*a* and the connector CN1*b* configure the connector CN1 which is a BtoB connector.

2.2.2 Structure of Print Head

A more specific structure of the liquid discharge module **20** configured as described above will be described. First, a specific structure of the print head **30** included in the liquid discharge module **20** will be described. FIG. **13** is a perspective view illustrating an example of an internal structure of the print head **30**. In FIG. **13**, the head cover **350** included in the print head **30** is illustrated by a broken line, and the internal configuration of the head cover **350** is illustrated by a solid line. That is, FIG. **13** illustrates a state where the head cover **350** included in the print head **30** is removed.

As illustrated in FIG. **13**, the print head **30** has a head holder **310** and the head cover **350**. A flange **315** is provided at the end portion of the head holder **310** on the −Y side, and a flange **316** is provided at the end portion of the head holder **310** on the +Y side. The head holder **310** is exposed from the +Z side of the placement section **85** of the carriage main body **81**. At this time, the print head **30** is supported by the carriage main body **81** in a state where the flanges **315** and **316** are supported by the placement section **85** and the plurality of discharge sections **600** are exposed from the −Z side surface of the placement section **85**. The flanges **315** and **316** may be fixed to the placement section **85** by a screw or the like (not illustrated).

The head cover **350** is positioned on the −Z side of the head holder **310** and has an accommodation space inside. The head cover **350** functions as a protection member that protects various configurations of the print head **30** from ink mist and impact by accommodating various configurations of the print head **30** in the accommodation space.

A flow path member **340**, a head substrate **360**, head relay substrates **370** and **380**, and FPC **372**, **374**, **376**, **382**, **384**, and **386** are accommodated in the accommodation space of the head cover **350**.

In the flow path member **340**, an ink flow path (not illustrated) for supplying the ink supplied from the liquid container **9** to the plurality of discharge sections **600** is formed. The head substrate **360** is positioned on the −Z side of the flow path member **340** and extends along the XY plane. The connector CN1*b* is provided on the surface of the head substrate **360** on the −Z side. At least a part of the connector CN1*b* is exposed to the outside of the print head **30** by inserting a through-hole (not illustrated) formed in the head cover **350**.

The head relay substrate **370** is positioned on the −X side of the flow path member **340** and extends along the YZ plane. The head relay substrate **370** is electrically coupled to the head substrate **360** via the FPC **372**. Further, one end of the FPC **374** and one end of the FPC **376** are coupled to the head relay substrate **370**. The other end of the FPC **374** is electrically coupled to the discharge module **32-1** and the other end of the FPC **376** is electrically coupled to the discharge module **32-2**.

The head relay substrate **380** is positioned on the +X side of the flow path member **340** and extends along the YZ plane. The head relay substrate **380** is electrically coupled to the head substrate **360** via the FPC **382**. Further, one end of the FPC **384** and one end of the FPC **386** are coupled to the head relay substrate **380**. The other end of the FPC **384** is electrically coupled to the discharge module **32-3**, and the other end of the FPC **386** is electrically coupled to the discharge module **32-4**.

Various signals output by the drive circuit module **50** are input to the print head **30** configured as described above via the connector CN1*b*. The signal input via the connector CN1*b* is branched by the head substrate **360** and the head relay substrates **370** and **380**, and then supplied to each of the discharge modules **32-1** to **32-4**. Here, the restoration circuit **31** included in the print head **30** is provided on, for example, the head substrate **360**.

FIG. **14** is an exploded perspective view of the print head **30** when the print head **30** is viewed from the +Z side along the Z axis. As illustrated in FIG. **14**, the head holder **310** of the print head **30** is provided with a reinforcing plate **320**, a fixing plate **330**, and the discharge modules **32-1** to **32-4**.

The head holder **310** is made of a conductive material, such as metal having a higher strength than that of the reinforcing plate **320**. On the surface of the head holder **310** on the +Z side, four accommodation sections **318** for accommodating each of the discharge modules **32-1** to **32-4** are provided.

The four accommodation sections **318** have a recessed shape that opens on the +Z side, and individually accommodate the discharge modules **32-1** to **32-4** fixed by the fixing plate **330**. At this time, the opening of the accommodation section **318** is sealed by the fixing plate **330**. In other words, the discharge modules **32-1** to **32-4** are individually accommodated on the inside of a space formed by the accommodation section **318** and the fixing plate **330**. The accommodation section **318** may be individually provided corresponding to each of the discharge modules **32-1** to **32-4**, and may have a shape for collectively accommodating the discharge modules **32-1** to **32-4**.

The reinforcing plate **320** and the fixing plate **330** are laminated in this order from the −Z side to the +Z side along the Z axis on the surface of the head holder **310** provided with the accommodation section **318**.

The fixing plate **330** is configured of a plate-shaped member formed of a conductive material, such as metal. Further, on the fixing plate **330**, an opening **335**, through which a nozzle **651** included in the plurality of discharge sections **600** included in each of the discharge modules **32-1** to **32-4** is exposed, is provided penetrating along the Z axis.

The openings **335** are individually provided corresponding to each of the discharge modules **32-1** to **32-4**.

The reinforcing plate **320** is preferably made of a material having a higher strength than that of the fixing plate **330**. On the reinforcing plate **320**, an opening **325** corresponding to each of the discharge modules **32-1** to **32-4** joined to the fixing plate **330** and having an inner diameter larger than the outer periphery of each of the discharge modules **32-1** to **32-4** is provided to penetrate along the Z axis. Each of the discharge modules **32-1** to **32-4** through which the opening **325** of the reinforcing plate **320** is inserted is joined to the fixing plate **330**.

Further, the discharge modules **32-1** to **32-4** included in the print head **30** are arranged in a staggered manner on the surface of the head holder **310** on the +Z side. In each of the discharge modules **32-1** to **32-4**, two rows of nozzles **651** included in the discharge section **600** for discharging ink are provided along the X axis in a state of being arranged side by side along the Y axis.

Here, the structure of the discharge section **600** including the nozzle **651** will be described. FIG. **15** is a view illustrating an example of a configuration of the discharge section **600** of the discharge module **32**. FIG. **15** illustrates a nozzle plate **632**, a reservoir **641**, and a supply port **661** in addition to the discharge section **600**.

As illustrated in FIG. **15**, the discharge section **600** includes the piezoelectric element **60**, a vibrating plate **621**, a cavity **631**, and the nozzle **651**. The piezoelectric element **60** includes a piezoelectric body **601** and electrodes **611** and **612**. The piezoelectric element **60** is configured such that the electrodes **611** and **612** are positioned to interpose the piezoelectric body **601**. The piezoelectric element **60** is driven such that the center part is displaced in the up-down direction according to the potential difference between the voltage supplied to the electrode **611** and the voltage supplied to the electrode **612**.

Specifically, the driving signal VOUT based on the driving signal COM is supplied to the electrode **611**, and the reference voltage signal VBS is supplied to the electrode **612**. When the voltage value of the driving signal VOUT supplied to the electrode **611** changes, the potential difference between the driving signal VOUT supplied to the electrode **611** and the reference voltage signal VBS supplied to the electrode **612** changes, and the piezoelectric element **60** is driven such that the center part is displaced in the up-down direction.

The vibrating plate **621** is positioned below the piezoelectric element **60** in FIG. **15**. In other words, the piezoelectric element **60** is formed on the upper surface of the vibrating plate **621** in FIG. **15**. The vibrating plate **621** is displaced in the up-down direction as the piezoelectric element **60** is driven in the up-down direction.

The cavity **631** is positioned below the vibrating plate **621** in FIG. **15**. Ink is supplied to the cavity **631** from the reservoir **641**. Ink stored in a liquid container **9** is introduced into the reservoir **641** via the supply port **661**. In other words, the inside of the cavity **631** is filled with the ink stored in the liquid container **9**. The internal volume of the cavity **631** expands or contracts as the vibrating plate **621** is displaced in the up-down direction. That is, the vibrating plate **621** functions as a diaphragm that changes the internal volume of the cavity **631**, and the cavity **631** functions as a pressure chamber of which the internal pressure changes as the vibrating plate **621** is displaced in the up-down direction.

The nozzle **651** is an opening provided on the nozzle plate **632** and communicates with the cavity **631**. When the internal volume of the cavity **631** changes, the ink filled the inside of the cavity **631** is discharged from the nozzle **651** according to the change in the internal volume.

In the discharge section **600** configured as described above, when the piezoelectric element **60** is driven to bend in the upward direction, the vibrating plate **621** is displaced in the upward direction. Accordingly, the internal volume of the cavity **631** expands, and as a result, the ink stored in the reservoir **641** is drawn into the cavity **631**. On the other hand, when the piezoelectric element **60** is driven to bend in the downward direction, the vibrating plate **621** is displaced in the downward direction.

Accordingly, the internal volume of the cavity **631** contracts, and as a result, the ink having an amount corresponding to the degree of contraction of the internal volume of the cavity **631** is discharged from the nozzles **651**. That is, an amount of ink corresponding to the voltage value of the driving signal VOUT is discharged from each of the plurality of discharge sections **600** included in the discharge module **32** of the print head **30**.

The piezoelectric element **60** may be driven by being supplied with the driving signal VOUT corresponding to the driving signal COM, and may not be limited to the structure illustrated in FIG. **15** as long as ink can be discharged from the nozzles **651** when the piezoelectric element **60** is driven.

As described above, the print head **30** includes the discharge modules **32-1** to **32-4** and the connector CN1*b* that is electrically coupled to the drive circuit module **50**. The discharge module **32-1** includes the discharge section **600** having the piezoelectric element **60** that receives and displaces the driving signal VOUT where the voltage value based on the driving signals COMA**1** and COMB**1** supplied to the electrode **611** changes, and the reference voltage signal VBS where the voltage value supplied to the electrode **612** is constant, and discharges a liquid by the displacement of the piezoelectric element **60**. The discharge module **32-2** includes the discharge section **600** having the piezoelectric element **60** that receives and displaces the driving signal VOUT where the voltage value based on the driving signals COMA**2** and COMB**2** supplied to the electrode **611** changes, and the reference voltage signal VBS where the voltage value supplied to the electrode **612** is constant, and discharges a liquid by the displacement of the piezoelectric element **60**. The discharge module **32-3** includes the discharge section **600** having the piezoelectric element **60** that receives and displaces the driving signal VOUT where the voltage value based on the driving signals COMA**3** and COMB**3** supplied to the electrode **611** changes, and the reference voltage signal VBS where the voltage value supplied to the electrode **612** is constant, and discharges a liquid by the displacement of the piezoelectric element **60**. The discharge module **32-4** includes the discharge section **600** having the piezoelectric element **60** that receives and displaces the driving signal VOUT where the voltage value based on the driving signals COMA**4** and COMB**4** supplied to the electrode **611** changes, and the reference voltage signal VBS where the voltage value supplied to the electrode **612** is constant, and discharges a liquid by the displacement of the piezoelectric element **60**.

2.2.3 Structure of Drive Circuit Module Included in Liquid Discharge Module

Next, the structure of the drive circuit module **50** included in the liquid discharge module **20** will be described. As illustrated in FIG. **12**, the drive circuit module **50** includes the relay substrate **150**, the drive circuit substrate **700**, the opening plate **160**, the heat sinks **170** and **180**, and the heat conductive members **175** and **185**.

2.2.3.1 Structure of Drive Circuit Substrate

First, the structure of the drive circuit substrate **700** will be described. FIG. **16** is a view illustrating a planar structure of the drive circuit substrate **700**. Here, in the following description, the x**1** axis, the y**1** axis, and the z**1** axis, which are axes independent of the above-described X axis, the Y axis, and the Z axis and are orthogonal to each other, will be illustrated and described. Further, in the following description, the starting point side of the arrow along the x**1** axis in the drawing may be referred to as the −x**1** side, and the tip end side thereof may be referred to as the +x**1** side. The starting point side of the arrow along the y**1** axis in the drawing may be referred to as the −y**1** side, and the tip end side thereof may be referred to as the +y**1** side. The starting point side of the arrow along the z**1** axis in the drawing may be referred to as the −z**1** side, and the tip end side thereof may be referred to as the +z**1** side. Further, the plane composed of the x**1** axis and the y**1** axis may be referred to as the x**1**y**1** plane, the plane composed of the x**1** axis and z**1** axis may be referred to as the x**1**z**1** plane, and the plane composed of the y**1** axis and the z**1** axis may be referred to as the y**1**z**1** plane.

As described above, the drive circuit substrate **700** has rigid wiring members **710**, **730**, **750**, and **770**. The rigid wiring members **710**, **730**, and **750** are positioned side by side in the order of the rigid wiring member **710**, the rigid wiring member **750**, and the rigid wiring member **730** along the y**1** axis from the −y**1** side to the +y**1** side. Further, the rigid wiring member **770** is positioned on the −x**1** side of the rigid wiring members **710**, **750**, and **730** positioned side by side, specifically, on the −x**1** side of the rigid wiring member **730**.

The rigid wiring member **710** includes a surface **723** on the +z**1** side, a surface **724** on the −z**1** side, sides **711** and **712**, and sides **713** and **714** longer than the sides **711** and **712**. In a state where the sides **711** and **712** extend along the y**1** axis and face each other in the direction along the x**1** axis, the side **711** is positioned on the +x**1** side and the side **712** is positioned on the −x**1** side. Further, in a state where the sides **713** and **714** intersect both the sides **711** and **712**, extend along the x**1** axis, and face each other in the direction along the y**1** axis, the side **713** is positioned on the −y**1** side, and the side **714** is positioned on the +y**1** side. That is, the rigid wiring member **710** includes the side **711** and the side **712** positioned facing each other, the side **713** and the side **714** intersecting the side **711** and the side **712** and positioned facing each other, and the surface **723**. In other words, the rigid wiring member **710** is a substantially rectangular plate-shaped member that includes the surface **723**, the surface **724** opposite to the surface **723**, and the side **711**, and extends along the x**1**y**1** plane.

The rigid wiring member **730** includes a surface **743** on the +z**1** side, a surface **744** on the −z**1** side, sides **731** and **732**, and sides **733** and **734** longer than the sides **731** and **732**, and is positioned on the +y**1** side of the rigid wiring member **710**. In a state where the sides **731** and **732** extend along the y**1** axis and face each other in the direction along the x**1** axis, the side **731** is positioned on the +x**1** side and the side **732** is positioned on the −x**1** side. Further, in a state where the sides **733** and **734** intersect both the sides **731** and **732**, extend along the x**1** axis, and face each other in the direction along the y**1** axis, the side **733** is positioned on the −y**1** side, and the side **734** is positioned on the +y**1** side. That is, the rigid wiring member **730** includes the side **731** and the side **732** positioned facing each other, the side **733** and the side **734** intersecting the side **731** and the side **732** and positioned facing each other, and the surface **743**. In other words, the rigid wiring member **730** is a substantially rectangular plate-shaped member that includes the surface **743**, the surface **744** opposite to the surface **743**, and the side **731**, and extends along the x**1**y**1** plane.

The rigid wiring member **750** includes a surface **763** on the +z**1** side, a surface **764** on the −z**1** side, sides **751** and **752**, and sides **753** and **754** longer than the sides **751** and **752**, and is positioned between the rigid wiring member **710** and the rigid wiring member **730** in the direction along the y**1** axis. In a state where the sides **751** and **752** extend along the y**1** axis and face each other in the direction along the x**1** axis, the side **751** is positioned on the +x**1** side and the side **752** is positioned on the −x**1** side. Further, in a state where the sides **753** and **754** intersect both the sides **751** and **752**, extend along the x**1** axis, and face each other in the direction along the y**1** axis, the side **753** is positioned on the −y**1** side, and the side **754** is positioned on the +y**1** side. That is, the rigid wiring member **750** includes the side **751** and the side **752** positioned facing each other, the side **753** and the side **754** intersecting the side **751** and the side **752** and positioned facing each other, and the surface **763**. In other words, the rigid wiring member **750** is a substantially rectangular plate-shaped member that includes the surface **763**, the surface **764** opposite to the surface **763**, and the side **751**, and extends along the x**1**y**1** plane.

The rigid wiring member **770** includes a surface **783** on the +z**1** side, a surface **784** on the −z**1** side, sides **771** and **772**, and sides **773** and **774** shorter than the sides **771** and **772**, and is positioned on the −x**1** side of the rigid wiring member **730** in the direction along the x**1** axis. In a state where the sides **771** and **772** extend along the y**1** axis and face each other in the direction along the x**1** axis, the side **771** is positioned on the +x**1** side and the side **772** is positioned on the −x**1** side. Further, in a state where the sides **773** and **774** intersect both the sides **771** and **772**, extend along the x**1** axis, and face each other in the direction along the y**1** axis, the side **773** is positioned on the −y**1** side, and the side **774** is positioned on the +y**1** side. That is, the rigid wiring member **770** includes the side **771** and the side **772** positioned facing each other, the side **773** and the side **774** intersecting the side **771** and the side **772** and positioned facing each other, and the surface **783**. In other words, the rigid wiring member **770** is a substantially rectangular plate-shaped member that includes the surface **783**, the surface **784** opposite to the surface **783**, and the side **771**, and extends along the x**1**y**1** plane.

Each of such rigid wiring members **710**, **730**, **750**, and **770** configures a so-called multi-layer rigid substrate including a base material in which a plurality of hard composite materials such as glass and epoxy are laminated in the direction along the z**1** axis, and a plurality of wiring layers in which a wiring pattern positioned between the layers of the base material and propagating various signals are formed.

Here, as illustrated in FIG. **16**, in the drive circuit substrate **700**, the side **711**, the side **731**, and the side **751** are positioned substantially linearly along the y**1** axis, and the side **712**, the side **732**, and the side **752** are positioned substantially linearly along the y**1** axis. That is, the lengths of the sides **713** and **714** included in the rigid wiring member **710** along the x**1** axis, the lengths of the sides **733** and **734** included in the rigid wiring member **730** along the x**1** axis, and the lengths of the sides **753** and **754** included in the rigid wiring member **750** along the x**1** axis are substantially equal. Further, the lengths of the sides **711** and **712** in the direction along the y**1** axis and the lengths of the sides **731** and **732** in the direction along the y**1** axis are substantially equal. The lengths of the sides **751** and **752** in the direction along the y**1** axis are shorter than the lengths of the sides **711** and **712** in the direction along the y**1** axis and the lengths of the sides **731** and **732** included in the rigid wiring member **730** in the direction along the y**1** axis. That is, the size of the rigid wiring member **710** when the drive circuit substrate **700** is viewed along the z**1** axis is substantially equal to the size of the rigid wiring member **730** when the drive circuit substrate **700** is viewed along the z**1** axis. The size of the rigid wiring member **750** when the drive circuit substrate **700** is viewed along the z**1** axis is smaller than the size of the rigid wiring member **710** when the drive circuit substrate **700** is viewed along the z**1** axis, and the size of the rigid wiring member **730** when the drive circuit substrate **700** is viewed along the z**1** axis.

Further, in the drive circuit substrate **700**, the side **733** and the side **773** are positioned substantially linearly along the x**1** axis, and the side **734** and the side **774** are positioned substantially linearly along the x**1** axis. That is, the lengths of the sides **731** and **732** included in the rigid wiring member **730** along the y**1** axis and the lengths of the sides **771** and **772** included in the rigid wiring member **770** along the y**1** axis are substantially equal. Further, the lengths of the sides **773** and **774** in the direction along the x**1** axis are shorter than the lengths of the sides **733** and **734** in the direction along the x**1** axis, and are substantially equal to the lengths of the sides **751** and **752** in the direction along the y**1** axis. That is, the size of the rigid wiring member **770** when the drive circuit substrate **700** is viewed along the z**1** axis is smaller than the sizes of the rigid wiring members **710**, **730**, and **750**. That is, the size of the rigid wiring member **770** when the drive circuit substrate **700** is viewed along the z**1** axis is smaller than the size of the rigid wiring member **710** when the drive circuit substrate **700** is viewed along the z**1** axis, and is smaller than the size of the rigid wiring member **730** when the drive circuit substrate **700** is viewed along the z**1** axis.

The rigid wiring members **710**, **730**, **750**, and **770** configured as described above are electrically coupled to each other by a flexible wiring member **790**. That is, the rigid wiring members **710**, **730**, **750**, and **770** are electrically coupled to each other. Therefore, the arrangement of the rigid wiring members **710**, **730**, **750**, and **770** and the flexible wiring member **790** that electrically couples the rigid wiring members **710**, **730**, **750**, and **770** will be described.

FIG. **17** is a cross-sectional view when the drive circuit substrate **700** is cut along the line XVII-XVII illustrated in FIG. **16**. FIG. **18** is a cross-sectional view when the drive circuit substrate **700** is cut along the line XVIII-XVIII illustrated in FIG. **16**.

Here, in the following description, the flexible wiring member **790** will be divided into seven regions **701** to **707** as illustrated in FIGS. **17** and **18** for the description. Further, as illustrated in FIGS. **17** and **18**, the flexible wiring member **790** includes a surface **791** on the +z**1** side and a surface **792** on the −z**1** side. That is, the flexible wiring member **790** will be described as including the surface **791**, the surface **792** opposite to the surface **791**, and the regions **701** to **707**.

As illustrated in FIG. **17**, the regions **701** to **705** of the flexible wiring member **790** are positioned side by side along the y**1** axis from the −y**1** side to the +y**1** side in the order of the region **701**, the region **702**, the region **703**, the region **704**, and the region **705**. That is, the region **702** is positioned between the region **701** and the region **703**, the region **704** is positioned between the region **703** and the region **705**, and therefore the region **702**, **703**, and **704** is positioned between the region **701** and the region **705**.

The rigid member **721** which is a part of the rigid wiring member **710** is laminated on the surface **791** of the region **701**, and the rigid member **722** which is a different part of the rigid wiring member **710** is laminated on the surface **792** of the region **701**. That is, the rigid wiring member **710** includes the rigid member **721** and the rigid member **722**. The rigid member **721** includes the surface **723** corresponding to the front surface of the rigid wiring member **710** on the +z**1** side. The rigid member **721** is laminated on the surface **791** of the region **701** of the flexible wiring member **790** such that the surface **723** extends along the surface **791** of the flexible wiring member **790**. Further, the rigid member **722** includes the surface **724** corresponding to the front surface of the rigid wiring member **710** on the −z**1** side. The rigid member **722** is laminated on the surface **792** of the region **701** of the flexible wiring member **790** such that the surface **724** extends along the surface **792** of the flexible wiring member **790**.

The rigid member **761** which is a part of the rigid wiring member **750** is laminated on the surface **791** of the region **703**, and the rigid member **762** which is a different part of the rigid wiring member **750** is laminated on the surface **792** of the region **703**. That is, the rigid wiring member **750** includes the rigid member **761** and the rigid member **762**. The rigid member **761** includes the surface **763** corresponding to the front surface of the rigid wiring member **750** on the +z**1** side. The rigid member **761** is laminated on the surface **791** of the region **703** of the flexible wiring member **790** such that the surface **763** extends along the surface **791** of the flexible wiring member **790**. The rigid member **762** includes the surface **764** corresponding to the front surface of the rigid wiring member **750** on the −z**1** side. The rigid member **762** is laminated on the surface **792** of the region **703** of the flexible wiring member **790** such that the surface **764** extends along the surface **792** of the flexible wiring member **790**.

The rigid member **741** which is a part of the rigid wiring member **730** is laminated on the surface **791** of the region **705**, and the rigid member **742** which is a different part of the rigid wiring member **730** is laminated on the surface **792** of the region **705**. That is, the rigid wiring member **730** includes the rigid member **741** and the rigid member **742**. The rigid member **741** includes the surface **743** corresponding to the front surface of the rigid wiring member **730** on the +z**1** side. The rigid member **741** is laminated on the surface **791** of the region **705** of the flexible wiring member **790** such that the surface **743** extends along the surface **791** of the flexible wiring member **790**. The rigid member **742** includes the surface **744** corresponding to the front surface of the rigid wiring member **730** on the −z**1** side. The rigid member **742** is laminated on the surface **792** of the region **705** of the flexible wiring member **790** such that the surface **744** extends along the surface **792** of the flexible wiring member **790**.

A hard composite material such as glass or epoxy is not provided in the region **702** and the region **704**. That is, the region **702** is a region positioned between the rigid wiring member **710** and the rigid wiring member **750** for separating the rigid wiring member **710** and the rigid wiring member **750**. The region **704** is a region positioned between the rigid wiring member **750** and the rigid wiring member **730** for separating the rigid wiring member **750** and the rigid wiring member **730**.

Further, as illustrated in FIG. **18**, the regions **705** to **707** of the flexible wiring member **790** are positioned side by side along the x1 axis from the +x1 side to the −x1 side in the order of the region **705**, the region **706**, and the region **707**. That is, the region **706** is positioned between the regions **705** and the region **707**, and between the regions **701**, **702**, **703**, **704**, and **705** and the region **707**.

The rigid member **781** which is a part of the rigid wiring member **770** is laminated on the surface **791** of the region **707**, and the rigid member **782** which is a different part of the rigid wiring member **770** is laminated on the surface **792** of the region **707**. That is, the rigid wiring member **770** includes the rigid member **781** and the rigid member **782**. The rigid member **781** includes the surface **783** corresponding to the front surface of the rigid wiring member **770** on the +z1 side. The rigid member **781** is laminated on the surface **791** of the region **707** of the flexible wiring member **790** such that the surface **783** extends along the surface **791** of the flexible wiring member **790**. The rigid member **782** includes the surface **784** corresponding to the front surface of the rigid wiring member **770** on the −z1 side. The rigid member **782** is laminated on the surface **792** of the region **707** of the flexible wiring member **790** such that the surface **784** extends along the surface **792** of the flexible wiring member **790**.

Similar to the regions **702** and **704**, the region **706** is not provided with a hard composite material such as glass or epoxy. That is, the region **706** is a region positioned between the rigid wiring member **730** and the rigid wiring member **770** for separating the rigid wiring member **730** and the rigid wiring member **770**.

In the drive circuit substrate **700** configured as described above, the flexible wiring member **790** configures at least one of the wiring layers of each of the rigid wiring members **710**, **730**, **750**, and **770**. As a result, the flexible wiring member **790** electrically couples each of the rigid wiring members **710**, **730**, **750**, and **770**, and propagates the signals generated by each of the rigid wiring members **710**, **730**, **750**, and **770**. That is, the flexible wiring member **790** includes at least one layer among the plurality of wiring layers included in the rigid wiring member **710**, at least one layer among the plurality of wiring layers included in the rigid wiring member **730**, at least one layer among the plurality of wiring layers included in the rigid wiring member **750**, and at least one layer among the plurality of wiring layers included in the rigid wiring member **770**, and accordingly each of the rigid wiring members **710**, **730**, **750**, and **770** are electrically coupled. The flexible wiring member **790** is a so-called flexible substrate having flexibility, which includes one or a plurality of wiring layers in which wiring patterns through which various signals propagate are formed on a base material in which one or a plurality of plastic films, polyimides, and the like are laminated.

That is, the drive circuit substrate **700** is a so-called rigid flexible substrate including, as a plurality of rigid substrates, a plurality of rigid substrates, which are rigid wiring members **710**, **730**, **750**, and **770**, and includes the rigid members **721**, **722**, **741**, **742**, **761**, **762**, **781**, and **782**; and the flexible wiring member **790** as a flexible substrate more flexible than the rigid wiring members **710**, **730**, **750**, and **770**.

In the liquid discharge apparatus **1** of the present embodiment, the drive circuit substrate **700** described above has a substantially box shape and is electrically coupled to the print head **30**. As a result, the mounting area of the drive circuit substrate **700** in the liquid discharge apparatus **1** is reduced, the drive circuit substrates **700** can be densely arranged, and as a result, the size of the liquid discharge apparatus **1** is reduced.

FIG. **19** is a view illustrating an example of a structure of the drive circuit substrate **700** having a substantially box shape. As illustrated in FIG. **19**, in the drive circuit substrate **700**, when the flexible wiring member **790** is bent, each of the rigid wiring members **710**, **730**, **750**, and **770** configures one surface of the drive circuit substrate **700** having a substantially box shape.

Specifically, the region **702** of the flexible wiring member **790** is bent at a substantially right angle such that the surface **723** of the rigid wiring member **710** and the surface **763** of the rigid wiring member **750** configure the inner surface of the drive circuit substrate **700** having a substantially box shape, and the surface **724** of the rigid wiring member **710** and the surface **764** of the rigid wiring member **750** configure the outer surface of the drive circuit substrate **700** having a substantially box shape. Further, the region **704** of the flexible wiring member **790** is bent at a substantially right angle such that the surface **763** of the rigid wiring member **750** and the surface **743** of the rigid wiring member **730** configure the inner surface of the drive circuit substrate **700** having a substantially box shape, and the surface **764** of the rigid wiring member **750** and the surface **744** of the rigid wiring member **730** configure the outer surface of the drive circuit substrate **700** having a substantially box shape. Further, the region **706** of the flexible wiring member **790** is bent at a substantially right angle such that the surface **743** of the rigid wiring member **730** and the surface **783** of the rigid wiring member **770** configure the inner surface of the drive circuit substrate **700** having a substantially box shape, and the surface **744** of the rigid wiring member **730** and the surface **784** of the rigid wiring member **770** configure the outer surface of the drive circuit substrate **700** having a substantially box shape.

That is, in the drive circuit substrate **700** having a substantially box shape in the liquid discharge apparatus **1** of the present embodiment, the surface **723** of the rigid wiring member **710**, the surface **763** of the rigid wiring member **750**, the surface **743** of the rigid wiring member **730**, and the surface **783** of the rigid wiring member **770** configure the inner surface of the substantially box shape, and the surface **724** of the rigid wiring member **710**, the surface **764** of the rigid wiring member **750**, the surface **744** of the rigid wiring member **730**, and the surface **784** of the rigid wiring member **770** configure the outer surface of the substantially box shape. At this time, the rigid wiring member **710** and the rigid wiring member **730** are positioned such that the surface **723** of the rigid wiring member **710** and the surface **743** of the rigid wiring member **730** face each other when the flexible wiring member **790** is bent in the regions **702** and **704**. The rigid wiring member **750** is positioned such that the normal direction of the surface **763** of the rigid wiring member **750** intersects both the normal direction of the surface **723** of the rigid wiring member **710** and the normal direction of the surface **743** of the rigid wiring member **730** when the flexible wiring member **790** is bent in the regions **702** and **704**. The rigid wiring member **770** is positioned such that the normal direction of the surface **783** of the rigid wiring member **770** intersects both the normal direction of the surface **723** of the rigid wiring member **710** and the normal direction of the surface **743** of the rigid wiring member **730** when the flexible wiring member **790** is bent in the region **706**.

That is, the rigid member **721** and the rigid member **741** are positioned such that the surface **723** of the rigid member **721** and the surface **743** of the rigid member **741** face each other when the flexible wiring member **790** is bent in the regions **702** and **704**. The rigid member **761** is positioned such that the normal direction of the surface **763** of the rigid member **761** intersects both the normal direction of the surface **723** of the rigid member **721** and the normal direction of the surface **743** of the rigid member **741** when the flexible wiring member **790** is bent in the regions **702** and **704**. The rigid member **781** is positioned such that the normal direction of the surface **783** of the rigid member **781** intersects both the normal direction of the surface **723** of the rigid member **721** and the normal direction of the surface **743** of the rigid member **741** when the flexible wiring member **790** is bent in the region **706**.

It should be noted that the fact that the drive circuit substrate **700** has a substantially box shape is not limited to a case where all the surfaces of the substantially box shape are configured with a rigid substrate of the rigid flexible substrate. That is, the shape formed by the drive circuit substrate **700** may be regarded as a box shape, and one or a plurality of surfaces may be open as illustrated in FIG. **19**.

Here, in the following description, the drive circuit substrate **700** having a substantially box shape is used for the description, the x**2** axis, the y**2** axis, and the z**2** axis which are axes independent of the above-described the x**1** axis, the y**1** axis, and the z**1** axis and are orthogonal to each other will be illustrated and described. Further, in the following description, the starting point side of the arrow along the x**2** axis in the drawing may be referred to as the −x**2** side, and the tip end side thereof may be referred to as the +x**2** side. The starting point side of the arrow along the y**2** axis in the drawing may be referred to as the −y**2** side, and the tip end side thereof may be referred to as the +y**2** side. The starting point side of the arrow along the z**2** axis in the drawing may be referred to as the −z**2** side, and the tip end side thereof may be referred to as the +z**2** side. The plane composed of the x**2** axis and the y**2** axis may be referred to as the x**2***y***2** plane. The plane composed of the x**2** axis and z**2** axis may be referred to as the x**2***z***2** plane. The plane composed of the y**2** axis and the z**2** axis may be referred to as the y**2***z***2** plane. Here, in the drive circuit substrate **700** having a substantially box shape, the surface **723** of the rigid member **721** and the surface **743** of the rigid member **741** are positioned facing each other along the x**2** axis, the normal direction of the surface **723** of the rigid member **721** is the direction from the −x**2** side to the +x**2** side along the x**2** axis, the normal direction of the surface **743** of the rigid member **741** is the direction from the +x**2** side to the −x**2** side along the x**2** axis, the normal direction of the surface **763** of the rigid member **761** is the direction from the +y**2** side to the −y**2** side along the y**2** axis, and the normal direction of the surface **783** of the rigid member **781** is the direction from the −z**2** side to the +z**2** side along the z**2** axis.

Further, in the following description, the drive circuit substrate **700** in an expanded state as illustrated in FIGS. **16**, **17**, and **18** may be referred to as the drive circuit substrate **700** in an expanded state, and the drive circuit substrate **700** assembled in a substantially box shape as illustrated in FIG. **19** may be referred to as the drive circuit substrate **700** in an assembled state.

2.2.3.2 Component Arrangement on Drive Circuit Substrate

Next, component arrangement of electronic components that configure various circuits on the drive circuit substrate **700** will be described. FIG. **20** is a diagram illustrating an example of component arrangement in the drive circuit substrate **700** in an expanded state.

As illustrated in FIG. **20**, the rigid wiring member **710** includes a plurality of circuit components including the driving signal output circuits **52***a***-1**, **52***b***-1**, **52***a***-2**, and **52***b***-2**, the discharge control circuit **51** configured with the FPGA, a capacitor C7*a*, and the connectors CN2*b* and CN3*a*.

The driving signal output circuit **52***a***-1** includes the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1**, and is provided on the surface **723** of the rigid wiring member **710** of the drive circuit substrate **700**. At this time, the transistors M**1** and M**2** included in the driving signal output circuit **52***a***-1** are positioned side by side in the order of the transistor M**1** and the transistor M**2** along the direction from the side **713** to the side **714**, the integrated circuit **500** included in the driving signal output circuit **52***a***-1** is positioned on the side **711** side of the transistors M**1** and M**2** positioned side by side, and the inductor L**1** included in the driving signal output circuit **52***a***-1** is positioned on the side **712** side of the transistors M**1** and M**2** positioned side by side.

The driving signal output circuit **52***b***-1** includes the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1**, and is provided on the side **714** side of the driving signal output circuit **52***a***-1** on the surface **723** of the rigid wiring member **710** of the drive circuit substrate **700**. At this time, the transistors M**1** and M**2** included in the driving signal output circuit **52***b***-1** are positioned side by side in the order of the transistor M**1** and the transistor M**2** along the direction from the side **713** to the side **714**, the integrated circuit **500** included in the driving signal output circuit **52***b***-1** is positioned on the side **711** side of the transistors M**1** and M**2** positioned side by side, and the inductor L**1** included in the driving signal output circuit **52***b***-1** is positioned on the side **712** side of the transistors M**1** and M**2** positioned side by side.

The driving signal output circuit **52***a***-2** includes the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1**, and is provided on the side **714** side of the driving signal output circuit **52***b***-1** on the surface **723** of the rigid wiring member **710** of the drive circuit substrate **700**. At this time, the transistors M**1** and M**2** included in the driving signal output circuit **52***a***-2** are positioned side by side in the order of the transistor M**1** and the transistor M**2** along the direction from the side **713** to the side **714**, the integrated circuit **500** included in the driving signal output circuit **52***a***-2** is positioned on the side **711** side of the transistors M**1** and M**2** positioned side by side, and the inductor L**1** included in the driving signal output circuit **52***a***-2** is positioned on the side **712** side of the transistors M**1** and M**2** positioned side by side.

The driving signal output circuit **52***b***-2** includes the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1**, and is provided on the side **714** side of the driving signal output circuit **52***a***-2** on the surface **723** of the rigid wiring member **710** of the drive circuit substrate **700**. At this time, the transistors M**1** and M**2** included in the driving signal output circuit **52***b***-2** are positioned side by side in the order of the transistor M**1** and the transistor M**2** along the direction from the side **713** to the side **714**, the integrated circuit **500** included in the driving signal output circuit **52***b***-2** is positioned on the side **711** side of the transistors M**1** and M**2** positioned side by side, and the inductor L**1** included in the driving signal output circuit **52***b***-2** is positioned on the side **712** side of the transistors M**1** and M**2** positioned side by side.

That is, the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52***a***-1** are provided on the surface **723** to be arranged in the order of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** along the direction from the side **711** to the side **712**. The integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52***b***-1** are provided on the surface **723** to be arranged in the order of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** along the direction from the side **711** to the side **712**. The integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52***a***-2** are provided on the surface **723** to be arranged in the order of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** along the direction from the side **711** to the side **712**. The integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52***b***-2** are provided on the surface **723** to be arranged in the order of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** along the direction from the side **711** to the side **712**.

The driving signal output circuits **52***a***-1**, **52***a***-2**, **52***b***-1**, and **52***b***-2** are positioned to be directed from the side **713** to the side **714** on the surface **723** of the rigid wiring member **710** of the drive circuit substrate **700**, and to be arranged adjacent to each other in the order of the driving signal output circuit **52***a***-1**, the driving signal output circuit **52***b***-1**, the driving signal output circuit **52***a***-2**, and the driving signal output circuit **52***b***-2**.

In this case, all the electronic components that configure the driving signal output circuits **52***a***-1**, **52***a***-2**, **52***b***-1**, and **52***b***-2** are provided on the surface **723** of the rigid wiring member **710**. In this case, the electronic components that configure the driving signal output circuits **52***a***-1**, **52***a***-2**, **52***b***-1**, and **52***b***-2** are not provided on the surface **724** of the rigid wiring member **710**.

Further, the driving signal output circuits **52***a***-1**, **52***b***-1**, **52***a***-2**, and **52***b***-2** are arranged in a staggered manner from the side **713** to the side **714**. Specifically, in the direction from the side **711** to the side **712**, the driving signal output circuit **52***a***-1** and the driving signal output circuit **52***a***-2** are arranged at substantially the same position, the driving signal output circuit **52***b***-1** and the driving signal output circuit **52***b***-2** are arranged at substantially the same position, the driving signal output circuit **52***a***-1** and the driving signal output circuits **52***b***-1** and **52***b***-2** are arranged at different positions, and the driving signal output circuit **52***a***-2** and the driving signal output circuits **52***b***-1** and **52***b***-2** are arranged at different positions.

Specifically, the driving signal output circuit **52***a***-1** is arranged overlapping with at least a part of the driving signal output circuit **52***b***-1**, at least a part of the driving signal output circuit **52***a***-2**, and at least a part of the driving signal output circuit **52***b***-2**, when viewed along the direction from the side **713** to the side **714**. The integrated circuit **500** included in the driving signal output circuit **52***a***-1** is arranged not overlapping with the integrated circuit **500** included in the driving signal output circuit **52***b***-1** and the integrated circuit **500** included in the driving signal output circuit **52***b***-2**, but overlapping with at least a part of the integrated circuit **500** included in the driving signal output circuit **52***a***-2**, when viewed along the direction from the side **713** to the side **714**.

In this case, when the transistors M**1** and M**2** included in the driving signal output circuit **52***a***-1** may be arranged not overlapping with the transistors M**1** and M**2** included in the driving signal output circuit **52***b***-1** and the transistors M**1** and M**2** included in the driving signal output circuit **52***b***-2**, but overlapping with at least a part of the transistors M**1** and M**2** included in the driving signal output circuit **52***a***-2**, when viewed along the direction from the side **713** to the side **714**. Further, when the inductor L**1** included in the driving signal output circuit **52***a***-1** may be arranged not overlapping with the inductor L**1** included in the driving signal output circuit **52***b***-1** and the inductor L**1** included in the driving signal output circuit **52***b***-2**, but overlapping with at least a part of the inductor L**1** included in the driving signal output circuit **52***a***-2**, when viewed along the direction from the side **713** to the side **714**.

Similarly, the driving signal output circuit **52***b***-1** is arranged overlapping with at least a part of the driving signal output circuit **52***a***-1**, at least a part of the driving signal output circuit **52***a***-2**, and at least a part of the driving signal output circuit **52***b***-2**, when viewed along the direction from the side **713** to the side **714**. The integrated circuit **500** included in the driving signal output circuit **52***b***-1** is arranged not overlapping with the integrated circuit **500** included in the driving signal output circuit **52***a***-1** and the integrated circuit **500** included in the driving signal output circuit **52***a***-2**, but overlapping with at least a part of the integrated circuit **500** included in the driving signal output circuit **52***b***-2**, when viewed along the direction from the side **713** to the side **714**.

In this case, when the transistors M**1** and M**2** included in the driving signal output circuit **52***b***-1** may be arranged not overlapping with the transistors M**1** and M**2** included in the driving signal output circuit **52***a***-1** and the transistors M**1** and M**2** included in the driving signal output circuit **52***a***-2**, but overlapping with at least a part of the transistors M**1** and M**2** included in the driving signal output circuit **52***b***-2**, when viewed along the direction from the side **713** to the side **714**. Further, when the inductor L**1** included in the driving signal output circuit **52***b***-1** may be arranged not overlapping with the inductor L**1** included in the driving signal output circuit **52***a***-1** and the inductor L**1** included in the driving signal output circuit **52***a***-2**, but overlapping with at least a part of the inductor L**1** included in the driving signal output circuit **52***b***-2**, when viewed along the direction from the side **713** to the side **714**.

Here, the fact that the driving signal output circuit **52***a***-1**, the driving signal output circuit **52***b***-1**, the driving signal output circuit **52***a***-2**, and the driving signal output circuit **52***b***-2** are arranged overlapping with each other at least partially when viewed along the direction from the side **713** to the side **714**, means that at least one of the electronic components included in the driving signal output circuit **52***a***-1**, at least one of the electronic components included in the driving signal output circuit **52***b***-1**, at least one of the electronic components included in the driving signal output circuit **52***a***-2**, and at least one of the electronic components included in the driving signal output circuit **52***b***-2** overlap with each other when viewed along the direction from the side **713** to the side **714**. For example, a case where at least one of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52***a***-1**, at least one of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52***b***-1**, at least one of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52***a***-2**, and at least one of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52***b***-2** overlap with each other when viewed along the direction from the side **713** to the side **714**, is included.

The capacitor C**7***a* is positioned on the side **711** side of the driving signal output circuits **52***a***-1**, **52***b***-1**, **52***a***-2**, and **52***b***-2** provided side by side from the side **713** to the side **714** on the surface **723** of the rigid wiring member **710**. The capacitor C**7***a* corresponds to the above-described capacitor C**7** corresponding to the driving signal output circuits **52***a*-**1**, **52***b*-**1**, **52***a*-**2**, and **52***b*-**2**, the concern that the voltage value of the voltage signal VHV supplied to each of the driving signal output circuits **52***a*-**1**, **52***b*-**1**, **52***a*-**2**, and **52***b*-**2** fluctuates is reduced, and the concern that noise is superimposed on the voltage signal VHV is reduced.

The discharge control circuit **51** configured by the FPGA is positioned on the side **711** side of the driving signal output circuits **52***a*-**1**, **52***b*-**1**, **52***a*-**2**, and **52***b*-**2** provided side by side from the side **713** to the side **714** and on the side **714** side of the capacitor C**7***a*, on the surface **723** of the rigid wiring member **710**.

The connector CN**2***b* includes a plurality of terminals TM**2***b*, and is positioned on the side **711** side of the capacitor C**7***a* provided on the surface **723** of the rigid wiring member **710** and the discharge control circuit **51**. At this time, the connector CN**2***b* is positioned such that the plurality of terminals TM**2***b* are arranged in parallel along the side **711** of the rigid wiring member **710**.

The connector CN**3***a* includes a plurality of terminals TM**3***a*, and is positioned on the side **712** side of the capacitor C**7***a* provided on the surface **723** of the rigid wiring member **710** and the discharge control circuit **51**. At this time, the connector CN**3***a* is positioned such that the plurality of terminals TM**3***a* are arranged in parallel along the side **712** of the rigid wiring member **710**.

The rigid wiring member **730** includes driving signal output circuits **52***a*-**3**, **52***b*-**3**, **52***a*-**4**, and **52***b*-**4**, a capacitor C**7***b*, abnormality detection circuits **54***a* and **54***b* as an abnormality detection circuit **54**, and abnormality notification circuits **55***a* and **55***b* as an abnormality notification circuit **55**.

The driving signal output circuit **52***a*-**3** includes the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1**, and is provided on the surface **743** of the rigid wiring member **730** of the drive circuit substrate **700**. At this time, the transistors M**1** and M**2** included in the driving signal output circuit **52***a*-**3** are positioned side by side in the order of the transistor M**1** and the transistor M**2** along the direction from the side **733** to the side **734**, the integrated circuit **500** included in the driving signal output circuit **52***a*-**3** is positioned on the side **731** side of the transistors M**1** and M**2** positioned side by side, and the inductor L**1** included in the driving signal output circuit **52***a*-**3** is positioned on the side **732** side of the transistors M**1** and M**2** positioned side by side.

The driving signal output circuit **52***b*-**3** includes the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1**, and is provided on the side **734** side of the driving signal output circuit **52***a*-**3** on the surface **743** of the rigid wiring member **730** of the drive circuit substrate **700**. At this time, the transistors M**1** and M**2** included in the driving signal output circuit **52***b*-**3** are positioned side by side in the order of the transistor M**1** and the transistor M**2** along the direction from the side **733** to the side **734**, the integrated circuit **500** included in the driving signal output circuit **52***b*-**3** is positioned on the side **731** side of the transistors M**1** and M**2** positioned side by side, and the inductor L**1** included in the driving signal output circuit **52***b*-**3** is positioned on the side **732** side of the transistors M**1** and M**2** positioned side by side.

The driving signal output circuit **52***a*-**4** includes the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1**, and is provided on the side **734** side of the driving signal output circuit **52***b*-**1** on the surface **743** of the rigid wiring member **730** of the drive circuit substrate **700**. At this time, the transistors M**1** and M**2** included in the driving signal output circuit **52***a*-**4** are positioned side by side in the order of the transistor M**1** and the transistor M**2** along the direction from the side **733** to the side **734**, the integrated circuit **500** included in the driving signal output circuit **52***a*-**4** is positioned on the side **731** side of the transistors M**1** and M**2** positioned side by side, and the inductor L**1** included in the driving signal output circuit **52***a*-**4** is positioned on the side **732** side of the transistors M**1** and M**2** positioned side by side.

The driving signal output circuit **52***b*-**4** includes the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1**, and is provided on the side **734** side of the driving signal output circuit **52***a*-**4** on the surface **743** of the rigid wiring member **730** of the drive circuit substrate **700**. At this time, the transistors M**1** and M**2** included in the driving signal output circuit **52***b*-**4** are positioned side by side in the order of the transistor M**1** and the transistor M**2** along the direction from the side **733** to the side **734**, the integrated circuit **500** included in the driving signal output circuit **52***b*-**4** is positioned on the side **731** side of the transistors M**1** and M**2** positioned side by side, and the inductor L**1** included in the driving signal output circuit **52***b*-**4** is positioned on the side **732** side of the transistors M**1** and M**2** positioned side by side.

That is, the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52***a*-**3** are provided on the surface **743** to be arranged in the order of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** along the direction from the side **731** to the side **732**. The integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52***b*-**3** are provided on the surface **743** to be arranged in the order of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** along the direction from the side **731** to the side **732**. The integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52***a*-**4** are provided on the surface **743** to be arranged in the order of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** along the direction from the side **731** to the side **732**. The integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52***b*-**4** are provided on the surface **743** to be arranged in the order of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** along the direction from the side **731** to the side **732**.

The driving signal output circuits **52***a*-**3**, **52***a*-**4**, **52***b*-**3**, and **52***b*-**4** are positioned to be directed from the side **733** to the side **734** on the surface **743** of the rigid wiring member **730** of the drive circuit substrate **700**, and to be arranged adjacent to each other in the order of the driving signal output circuit **52***a*-**3**, the driving signal output circuit **52***b*-**3**, the driving signal output circuit **52***a*-**4**, and the driving signal output circuit **52***b*-**4**.

In this case, all the electronic components that configure the driving signal output circuits **52***a*-**3**, **52***a*-**4**, **52***b*-**3**, and **52***b*-**4** are provided on the surface **743** of the rigid wiring member **730**. In other words, the electronic components that configure the driving signal output circuits **52***a*-**3**, **52***a*-**4**, **52***b*-**3**, and **52***b*-**4** are not provided on the surface **744** of the rigid wiring member **730**.

Further, the driving signal output circuits **52***a*-**3**, **52***b*-**3**, **52***a*-**4**, and **52***b*-**4** are arranged in a staggered manner from the side **733** to the side **734**. Specifically, in the direction from the side **731** to the side **732**, the driving signal output circuit **52**a-**3** and the driving signal output circuit **52**a-**4** are arranged at substantially the same position, the driving signal output circuit **52**b-**3** and the driving signal output circuit **52**b-**4** are arranged at substantially the same position, the driving signal output circuit **52**a-**3** and the driving signal output circuits **52**b-**3** and **52**b-**4** are arranged at different positions, and the driving signal output circuit **52**a-**4** and the driving signal output circuits **52**b-**3** and **52**b-**4** are arranged at different positions.

Specifically, the driving signal output circuit **52**a-**3** is arranged overlapping with at least a part of the driving signal output circuit **52**b-**3**, at least a part of the driving signal output circuit **52**a-**4**, and at least a part of the driving signal output circuit **52**b-**4**, when viewed along the direction from the side **733** to the side **734**. The integrated circuit **500** included in the driving signal output circuit **52**a-**3** is arranged not overlapping with the integrated circuit **500** included in the driving signal output circuit **52**b-**3** and the integrated circuit **500** included in the driving signal output circuit **52**b-**4**, but overlapping with at least a part of the integrated circuit **500** included in the driving signal output circuit **52**a-**4**, when viewed along the direction from the side **733** to the side **734**.

In this case, when the transistors M**1** and M**2** included in the driving signal output circuit **52**a-**3** may be arranged not overlapping with the transistors M**1** and M**2** included in the driving signal output circuit **52**b-**3** and the transistors M**1** and M**2** included in the driving signal output circuit **52**b-**4**, but overlapping with at least a part of the transistors M**1** and M**2** included in the driving signal output circuit **52**a-**4**, when viewed along the direction from the side **733** to the side **734**. Further, when the inductor L**1** included in the driving signal output circuit **52**a-**3** may be arranged not overlapping with the inductor L**1** included in the driving signal output circuit **52**b-**3** and the inductor L**1** included in the driving signal output circuit **52**b-**4**, but overlapping with at least a part of the inductor L**1** included in the driving signal output circuit **52**a-**4**, when viewed along the direction from the side **733** to the side **734**.

Similarly, the driving signal output circuit **52**b-**3** is arranged overlapping with at least a part of the driving signal output circuit **52**a-**3**, at least a part of the driving signal output circuit **52**a-**4**, and at least a part of the driving signal output circuit **52**b-**4**, when viewed along the direction from the side **733** to the side **734**. The integrated circuit **500** included in the driving signal output circuit **52**b-**3** is arranged not overlapping with the integrated circuit **500** included in the driving signal output circuit **52**a-**3** and the integrated circuit **500** included in the driving signal output circuit **52**a-**4**, but overlapping with at least a part of the integrated circuit **500** included in the driving signal output circuit **52**b-**4**, when viewed along the direction from the side **733** to the side **734**.

In this case, the transistors M**1** and M**2** included in the driving signal output circuit **52**b-**3** may be arranged not overlapping with the transistors M**1** and M**2** included in the driving signal output circuit **52**a-**3** and the transistors M**1** and M**2** included in the driving signal output circuit **52**a-**4**, but overlapping with at least a part of the transistors M**1** and M**2** included in the driving signal output circuit **52**b-**4**, when viewed along the direction from the side **733** to the side **734**. Further, the inductor L**1** included in the driving signal output circuit **52**b-**3** may be arranged not overlapping with the inductor L**1** included in the driving signal output circuit **52**a-**3** and the inductor L**1** included in the driving signal output circuit **52**a-**4**, but overlapping with at least a part of the inductor L**1** included in the driving signal output circuit **52**b-**2**, when viewed along the direction from the side **733** to the side **734**.

Here, the fact that the driving signal output circuit **52**a-**3**, the driving signal output circuit **52**b-**3**, the driving signal output circuit **52**a-**4**, and the driving signal output circuit **52**b-**4** are arranged overlapping with each other at least partially when viewed along the direction from the side **733** to the side **734**, means that at least one of the electronic components included in the driving signal output circuit **52**a-**3**, at least one of the electronic components included in the driving signal output circuit **52**b-**3**, at least one of the electronic components included in the driving signal output circuit **52**a-**4**, and at least one of the electronic components included in the driving signal output circuit **52**b-**4** overlap with each other when viewed along the direction from the side **733** to the side **734**. For example, a case where at least one of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52**a-**3**, at least one of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52**b-**3**, at least one of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52**a-**4**, and at least one of the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1** included in the driving signal output circuit **52**b-**4** overlap with each other when viewed along the direction from the side **733** to the side **734**, is included.

The capacitor C**7**b is positioned on the side **731** side of the driving signal output circuits **52**a-**3**, **52**b-**3**, **52**a-**4**, and **52**b-**4** provided side by side from the side **733** to the side **734** on the surface **743** of the rigid wiring member **730**. The capacitor C**7**b corresponds to the above-described capacitor C**7** corresponding to the driving signal output circuits **52**a-**3**, **52**b-**3**, **52**a-**4**, and **52**b-**4**, the concern that the voltage value of the voltage signal VHV supplied to each of the driving signal output circuits **52**a-**3**, **52**b-**3**, **52**a-**4**, and **52**b-**4** fluctuates is reduced, and the concern that noise is superimposed on the voltage signal VHV is reduced.

The abnormality detection circuits **54**a and **54**b are positioned on the side **731** side of the driving signal output circuits **52**a-**3**, **52**b-**3**, **52**a-**4**, and **52**b-**4** provided side by side from the side **733** to the side **734** and on the side **734** side of the capacitor C**7**b, on the surface **743** of the rigid wiring member **730**. The abnormality detection circuit **54**a detects whether or not the voltage value of the voltage signal VHV is normal, and the abnormality detection circuit **54**b detects whether or not the voltage value of the voltage signal VDD generated based on the voltage signal VMV is normal.

The abnormality notification circuits **55**a and **55**b are positioned on the side **731** side of the driving signal output circuits **52**a-**3**, **52**b-**3**, **52**a-**4**, and **52**b-**4** provided side by side from the side **733** to the side **734**, in the vicinity of the abnormality detection circuits **54**a and **54**b, on the surface **744** of the rigid wiring member **730**. The abnormality notification circuit **55**a is turned on, is turned off, or blinks based on the result of an abnormality detection in the abnormality detection circuit **54**a. The abnormality notification circuit **55**b is turned on, is turned off, or blinks based on the result of an abnormality detection in the abnormality detection circuit **54**b.

The rigid wiring member **750** is provided with the temperature detection circuit **56** and the voltage conversion circuit **58**.

The temperature detection circuit **56** is positioned at substantially the center of the rigid wiring member **750** on the surface **763** of the rigid wiring member **750**. Specifically, the temperature detection circuit **56** is provided to overlap with the intersection between a virtual line in which at least a part of the distance from the side **751** and the distance from the side **752** are equal, and a virtual line in which the distance from the side **753** and the distance from the side **754** are equal. The temperature detection circuit **56** detects the environmental temperature of the drive circuit module **50**, generates a temperature information signal Tt including temperature information corresponding to the environmental temperature, and outputs the temperature information signal Tt to the head control circuit **12**. The temperature detection circuit **56** is required to comprehensively detect temperature information of the plurality of circuits provided on the drive circuit substrate **700**.

In the liquid discharge apparatus **1** of the present embodiment, the temperature detection circuit **56** is provided on the rigid wiring member **750** different from the rigid wiring members **710** and **730** provided with the driving signal output circuit **52** having a large heat generation amount, and further, is positioned at substantially the center of the rigid wiring member **750**. As a result, the contribution of the driving signal output circuit **52** having a large amount of heat generation is reduced, and as a result, the acquisition accuracy of the environmental temperature in the entire drive circuit module **50** is improved.

The voltage conversion circuit **58** is positioned on the side **751** side of the temperature detection circuit **56** on the surface **763** of the rigid wiring member **750**. Then, the voltage conversion circuit **58** generates and outputs the voltage signal VDD by converting the voltage value of the voltage signal VMV. The voltage signal VDD is used in various configurations provided on the drive circuit substrate **700**, and has a voltage value smaller than that of the voltage signals VHV and VMV. Therefore, the voltage signal VDD is easily affected by noise. By providing the voltage conversion circuit **58** that outputs the voltage signal VDD in the rigid wiring member **750** positioned between the rigid wiring member **710** provided with a plurality of circuits including the driving signal output circuits **52***a*-**1**, **52***b*-**1**, **52***a*-**2**, and **52***b*-**2**, and the rigid wiring member **730** provided with a plurality of circuits including the driving signal output circuits **52***a*-**3**, **52***b*-**3**, **52***a*-**4**, and **52***b*-**4**, the wiring length through which the voltage signal VDD propagates can be shortened, and as a result, the concern that the voltage value of the voltage signal VDD fluctuates is reduced, and the concern that noise is superimposed on the voltage signal VDD is also reduced.

The rigid wiring member **770** is provided with the capacitor **53**, a connector CN3*b*, and the connector CN1*a*.

The connector CN3*b* includes a plurality of terminals TM3*b*. The connector CN3*b* is positioned such that the plurality of terminals TM3*b* are arranged in parallel along the side **772** on the surface **783** of the rigid wiring member **770**.

The capacitor **53** is positioned on the surface **783** of the rigid wiring member **770**. The capacitor **53** stabilizes the voltage value of the reference voltage signal VBS output by the driving signal output circuit **52***a*-**1**.

The connector CN1*a* is positioned on the surface **784** of the rigid wiring member **770**. When the connector CN1*a* is fitted to the connector CN1*b* included in the print head **30**, various signals generated by the drive circuit substrate **700** are supplied to the print head **30**.

As described above, on the surface **723** of the rigid wiring member **710** of the drive circuit substrate **700**, which is the surface **723** of the rigid member **721**, the driving signal output circuits **52***a*-**1**, **52***b*-**1**, **52***a*-**2**, and **52***b*-**2**, the discharge control circuit **51** configured by the above-described FPGA, the capacitors C7*a*, and the connectors CN2*b* and CN3*a* are provided. On the surface **743** of the rigid wiring member **730**, which is the surface **743** of the rigid member **741**, the driving signal output circuits **52***a*-**3**, **52***b*-**3**, **52***a*-**4**, and **52***b*-**4**, the capacitors C7*b*, and the abnormality detection circuits **54***a* and **54***b* are provided. On the surface **744** of the rigid wiring member **730**, which is the surface **744** of the rigid member **742**, the abnormality notification circuits **55***a* and **55***b* are provided. On the surface **763** of the rigid wiring member **750**, which is the surface **763** of the rigid member **761**, the temperature detection circuit **56** and the voltage conversion circuit **58** are provided. On the surface **783** of the rigid wiring member **770**, which is the surface **783** of the rigid member **781**, the capacitor **53** and the connector CN3*b* are provided. On the surface **784** of the rigid wiring member **770**, which is the surface **784** of the rigid member **782**, the connector CN1*a* are provided.

Here, an example of the wiring pattern formed on the drive circuit substrate **700** configured as described above, which is the wiring pattern through which the voltage signals VHV, VMV, and VDD that function as power supply voltages of various circuits provided on the drive circuit substrate **700** propagate, and the wiring pattern through which the driving signals COMA**1** to COMA**4** and COMB**1** to COMB**4** generated by the drive circuit substrate **700**, and the reference voltage signal VBS propagate, will be described. FIG. **21** is a diagram illustrating an example of the wiring pattern through which the voltage signals VHV, VMV, and VDD propagate. As described above, the voltage signals VHV and VMV propagating through the drive circuit substrate **700** are output by the power supply voltage output circuit **18** included in the control unit **2**. The voltage signals VHV and VMV are input to the drive circuit substrate **700** via the connector CN2*b*.

The voltage signal VHV input via the connector CN2*b* propagates through the wirings wh**1** to why provided in the flexible wiring member **790** of the drive circuit substrate **700**, the wiring wh**6** provided on the rigid wiring member **710**, and the wiring wh**7** provided on the rigid wiring member **730**, and is input to the various configurations provided on the drive circuit substrate **700** and the driving signal selection circuit **200** included in the print head **30**.

One end of the wiring wh**1** is electrically coupled to the terminal TM2*b* of the connector CN2*b*, the wiring wh**1** extends to the −x**1** side along the x**1** axis, and the other end is electrically coupled to the wiring wh**2**.

The wiring wh**2** is continuously provided over the regions **701**, **702**, **703**, **704**, and **705**. That is, the flexible wiring member **790** includes the driving signal selection circuit **200** and the wiring wh**2** through which the voltage signal VHV supplied to the driving signal output circuit **52** propagates, and the wiring wh**2** is continuously provided over the regions **701**, **702**, **703**, **704**, and **705**. At this time, the wiring wh**2** is preferably provided linearly along the y**1** axis over the regions **701**, **702**, **703**, **704**, and **705**. The voltage signal VHV propagating through the wiring wh**2** branches in each of the regions **701**, **703**, and **705**, and is supplied to various circuits provided on the rigid wiring members **710**, **730**, and **750** through through-holes (not illustrated).

For example, the wiring wh**2** branches into the wiring wh**3** in the region **701**. The wiring wh**3** is supplied to the capacitor C7*a* provided on the rigid wiring member **710** through a through-hole (not illustrated). The voltage signal VHV supplied to the capacitor C7*a* propagates through the wiring wh6 provided on the rigid wiring member **710** and is supplied to each of the driving signal output circuits **52***a***-1**, **52***a***-2**, **52***b***-1**, and **52***b***-2**.

Further, for example, the wiring wh**2** branches into the wiring wh**4** in the region **705**. The wiring wh**4** is supplied to the capacitor C7*b* provided on the rigid wiring member **730** through a through-hole (not illustrated). The voltage signal VHV supplied to the capacitor C7*b* propagates through the wiring wh**7** provided on the rigid wiring member **730** and is supplied to each of the driving signal output circuits **52***a***-3**, **52***a***-4**, **52***b***-3**, and **52***b***-4**.

Further, for example, the wiring wh**2** branches into the wiring wh**5** in the region **705**. The wiring wh**5** propagates through the regions **706** and **707** and is supplied to the terminal TM**1***a* of the connector CN**1***a* provided on the rigid wiring member **770** through a through-hole (not illustrated). Accordingly, the voltage signal VHV is supplied to the driving signal selection circuit **200** included in the print head **30**.

As described above, the voltage signal VHV is input to the drive circuit substrate **700** via the wiring wh**1**, propagates through the wiring wh**2**, and is supplied to various circuit configurations of the drive circuit substrate **700** and the print head **30**. Therefore, since the voltage signal VHV, which is supplied to various circuit configurations of the drive circuit substrate **700** and the print head **30**, propagates through the wiring wh**2**, a large amount of current is generated. By continuously providing the wiring wh**2** in the flexible wiring member **790** over the regions **701**, **702**, **703**, **704**, and **705**, it is not necessary to provide a via wiring or the like, and thus, the concern that impedance fluctuation in the wiring wh**2** occurs is reduced. As a result, the concern that the voltage value of the voltage signal VHV propagating through the wiring wh**2** fluctuates is reduced, and the operational stability of various circuits operating using the voltage signal VHV as the power supply voltage is also improved.

Further, by providing the wiring wh**2** linearly over the regions **701**, **702**, **703**, **704**, and **705**, the concern that the current density is biased at the bent portion of the wiring wh**2** is reduced. As a result, the concern that the voltage value of the voltage signal VHV propagating through the wiring wh**2** fluctuates is further reduced, and the operational stability of various circuits operating using the voltage signal VHV as the power supply voltage is further improved. In addition to the wirings wh**3**, wh**4**, and why, a plurality of branch wirings may be electrically coupled to the wiring wh**2**.

Further, the voltage signal VMV input via the connector CN**2***b* propagates through wirings wm**1** to wm**3** provided in the flexible wiring member **790** of the drive circuit substrate **700** and is input to various configurations provided in the drive circuit substrate **700**.

One end of the wiring wm**1** is electrically coupled to the terminal TM**2***b* of the connector CN**2***b*, the wiring wm**1** extends to the **−x1** side along the **x1** axis, and the other end is electrically coupled to the wiring wm**2**.

The wiring wm**2** is continuously provided over the regions **701**, **702**, **703**, **704**, and **705**. At this time, the wiring wm**2** is preferably provided linearly along the **y1** axis over the regions **701**, **702**, **703**, **704**, and **705**. The voltage signal VMV propagating through the wiring wm**2** branches in each of the regions **701**, **703**, and **705**, and is supplied to various circuits provided on the rigid wiring members **710**, **730**, and **750** through through-holes (not illustrated). For example, the wiring wm**2** branches into the wiring wm**3** in the region **703**. The wiring wm**3** is supplied to the voltage conversion circuit **58** through a through-hole (not illustrated). Then, the voltage conversion circuit **58** generates and outputs the voltage signal VDD based on the supplied voltage signal VMV.

As described above, the voltage signal VMV is input to the drive circuit substrate **700** via the wiring wm**1**, propagates through the wiring wm**2**, and is supplied to various circuit configurations of the drive circuit substrate **700**. Therefore, since the voltage signal VMV, which is supplied to various circuit configurations of the drive circuit substrate **700**, propagates through the wiring wm**2**, a large amount of current is generated. By continuously providing the wiring wm**2** in the flexible wiring member **790** over the regions **701**, **702**, **703**, **704**, and **705**, it is not necessary to provide a via wiring or the like, and thus, the concern that impedance fluctuation in the wiring wm**2** occurs is reduced. As a result, the concern that the voltage value of the voltage signal VMV propagating through the wiring wm**2** fluctuates is reduced, and the operational stability of various circuits operating using the voltage signal VMV as the power supply voltage is also improved.

Further, by providing the wiring wm**2** linearly over the regions **701**, **702**, **703**, **704**, and **705**, the concern that the current density is biased at the bent portion of the wiring wm**2** is reduced. As a result, the concern that the voltage value of the voltage signal VMV propagating through the wiring wm**2** fluctuates is further reduced, and the operational stability of various circuits operating using the voltage signal VMV as the power supply voltage is further improved.

Further, the voltage signal VDD output by the voltage conversion circuit **58** propagates through wirings wd**1** and wd**2** provided in the flexible wiring member **790** of the drive circuit substrate **700** and is input to various configurations provided in the drive circuit substrate **700**.

One end of the wiring wd**1** is electrically coupled to the voltage conversion circuit **58**, the wiring wd**1** extends to the **+x1** side along the **x1** axis, and the other end is electrically coupled to the wiring wd**2**.

The wiring wd**2** is continuously provided over the regions **701**, **702**, **703**, **704**, and **705**. At this time, the wiring wd**2** is preferably provided linearly along the **y1** axis over the regions **701**, **702**, **703**, **704**, and **705**. The voltage signal VDD propagating through the wiring wd**2** branches in each of the regions **701**, **703**, and **705**, and is supplied to various circuits provided on the rigid wiring members **710**, **730**, and **750** through through-holes (not illustrated).

For example, the wiring wd**2** branches into a wiring wd**3** in the region **701**. The wiring wd**3** is supplied to the FPGA including the discharge control circuit **51** via a through-hole (not illustrated). The discharge control circuit **51** operates based on the supplied voltage signal VDD.

As described above, the voltage signal VDD is input to the drive circuit substrate **700** via the wiring wd**1**, propagates through the wiring wd**2**, and is supplied to various circuit configurations of the drive circuit substrate **700**. Therefore, since the voltage signal VDD, which is supplied to various circuit configurations of the drive circuit substrate **700**, propagates through the wiring wd**2**, a large amount of current is generated. By continuously providing such wiring wd**2** in the flexible wiring member **790** over the regions **701**, **702**, **703**, **704**, and **705**, it is not necessary to provide via wiring or the like, and therefore, the concern that impedance fluctuation in the wiring wd**2** occurs is reduced. As a result, the concern that the voltage value of the voltage signal VDD propagating through the wiring wd**2** fluctuates is reduced, and the operational stability of various circuits operating using the voltage signal VDD as the power supply voltage is also improved.

Further, by providing the wiring wd**2** linearly over the regions **701**, **702**, **703**, **704**, and **705**, the concern that the current density is biased at the bent portion of the wiring wd**2** is reduced. As a result, the concern that the voltage value of the voltage signal VDD propagating through the wiring wd**2** fluctuates is further reduced, and the operational stability of various circuits operating using the voltage signal VDD as the power supply voltage is further improved.

Next, an example of a wiring pattern in which the driving signals COMA**1** to COMA**4** and COMB**1** to COMB**4** generated by the drive circuit substrate **700** and the reference voltage signal VBS propagate will be described. FIG. **22** is a diagram illustrating an example of a wiring pattern in which the driving signal COM and the reference voltage signal VBS propagate.

The driving signal COMA**1** output by the driving signal output circuit **52***a***-1** propagates through a wiring wca**1** and is input to the terminal TM**1***a* of the connector CN**1***a*. Further, the driving signal COMB**1** output by the driving signal output circuit **52***b***-1** propagates through a wiring wcb**1** and is input to the terminal TM**1***a* of the connector CN**1***a*. The driving signal COMA**1** and the driving signal COMB**1** are input to the driving signal selection circuit **200** included in the discharge module **32-1** via the corresponding terminal TM**1***a* of the connector CN**1***a*.

Similarly, the driving signal COMA**2** output by the driving signal output circuit **52***a***-2** propagates through a wiring wca**2**, and is input to the driving signal selection circuit **200** included in the discharge module **32-2** via the terminal TM**1***a* of the connector CN**1***a*. The driving signal COMB**2** output by the driving signal output circuit **52***b***-2** propagates through a wiring wcb**2**, and is input to the driving signal selection circuit **200** included in the discharge module **32-2** via the terminal TM**1***a* of the connector CN**1***a*. Similarly, the driving signal COMA**3** output by the driving signal output circuit **52***a***-3** propagates through a wiring wca**3**, and is input to the driving signal selection circuit **200** included in the discharge module **32-3** via the terminal TM**1***a* of the connector CN**1***a*. The driving signal COMB**3** output by the driving signal output circuit **52***b***-3** propagates through a wiring wcb**3**, and is input to the driving signal selection circuit **200** included in the discharge module **32-3** via the terminal TM**1***a* of the connector CN**1***a*. Similarly, the driving signal COMA**4** output by the driving signal output circuit **52***a***-4** propagates through a wiring wca**4**, and is input to the driving signal selection circuit **200** included in the discharge module **32-4** via the terminal TM**1***a* of the connector CN**1***a*. The driving signal COMB**4** output by the driving signal output circuit **52***b***-4** propagates through a wiring wcb**4**, and is input to the driving signal selection circuit **200** included in the discharge module **32-4** via the terminal TM**1***a* of the connector CN**1***a*.

The reference voltage signal VBS output by the reference voltage signal output circuit **530** included in the integrated circuit **500** included in the driving signal output circuit **52***a***-1** propagates through a wiring wb**1** and is input to a wiring wb**2** to which the capacitor **53** is electrically coupled. The reference voltage signal VBS input to the capacitor **53** propagates through a wiring wb**4** and a wiring wb**6**, and is supplied to the electrode **612** of the piezoelectric element **60** included in the discharge module **32-1** via the terminal TM**1***a* of the connector CN**1***a*. In addition, the reference voltage signal VBS input to the capacitor **53** propagates through the wiring wb**4** and a wiring wb**5**, and is supplied to the electrode **612** of the piezoelectric element **60** included in the discharge module **32-2** via the terminal TM**1***a* of the connector CN**1***a*. In addition, the reference voltage signal VBS input to the capacitor **53** propagates through the wiring wb**3** and a wiring wb**7**, and is supplied to the electrode **612** of the piezoelectric element **60** included in the discharge module **32-3** via the terminal TM**1***a* of the connector CN**1***a*. In addition, the reference voltage signal VBS input to the capacitor **53** propagates through the wiring wb**3** and a wiring wb**8**, and is supplied to the electrode **612** of the piezoelectric element **60** included in the discharge module **32-4** via the terminal TM**1***a* of the connector CN**1***a*. That is, the reference voltage signal VBS is input to the capacitor **53**, then branches, and is supplied to the electrode **612** of the piezoelectric element **60** included in each of the discharge modules **32-1** to **32-4**.

At this time, between a part of the wiring wca**1** through which the driving signal COMA**1** supplied to the discharge module **32-1** propagates and a part of the wiring wcb**1** through which the driving signal COMB**1** supplied to the discharge module **32-1** propagates, the wiring wb**6** through which the reference voltage signal VBS supplied to the discharge module **32-1** propagates is positioned. Between a different part of the wiring wca**1** through which the driving signal COMA**1** supplied to the discharge module **32-1** propagates and a different part of the wiring wcb**1** through which the driving signal COMB**1** supplied to the discharge module **32-1** propagates, the wiring wg through which the ground signal propagates is positioned.

Similarly, between a part of the wiring wca**2** through which the driving signal COMA**2** supplied to the discharge module **32-2** propagates and a part of the wiring wcb**2** through which the driving signal COMB**2** supplied to the discharge module **32-2** propagates, the wiring wb**5** through which the reference voltage signal VBS supplied to the discharge module **32-2** propagates is positioned. Between a different part of the wiring wca**2** through which the driving signal COMA**2** supplied to the discharge module **32-2** propagates and a different part of the wiring wcb**2** through which the driving signal COMB**2** supplied to the discharge module **32-2** propagates, the wiring wg through which the ground signal propagates is positioned.

Similarly, between a part of the wiring wca**3** through which the driving signal COMA**3** supplied to the discharge module **32-3** propagates and a part of the wiring wcb**3** through which the driving signal COMB**3** supplied to the discharge module **32-3** propagates, the wiring wb**7** through which the reference voltage signal VBS supplied to the discharge module **32-3** propagates is positioned. Between a different part of the wiring wca**3** through which the driving signal COMA**3** supplied to the discharge module **32-3** propagates and a different part of the wiring wcb**3** through which the driving signal COMB**3** supplied to the discharge module **32-3** propagates, the wiring wg through which the ground signal propagates is positioned.

Similarly, between a part of the wiring wca**4** through which the driving signal COMA**4** supplied to the discharge module **32-4** propagates and a part of the wiring wcb**4** through which the driving signal COMB**4** supplied to the discharge module **32-4** propagates, the wiring wb**8** through which the reference voltage signal VBS supplied to the discharge module **32-4** propagates is positioned. Between a different part of the wiring wca**4** through which the driving signal COMA**4** supplied to the discharge module **32-4** propagates and a different part of the wiring wcb**4** through which the driving signal COMB**4** supplied to the discharge module **32-4** propagates, the wiring wg through which the ground signal propagates is positioned.

That is, the drive circuit substrate **700** includes the wiring wca**1** that electrically couples the driving signal output circuit **52***a*-**1** and the terminal TM**1***a* of the connector CN**1***a*, the wiring wcb**1** that electrically couples the driving signal output circuit **52***b*-**1** and the terminal TM**1***a* of the connector CN**1***a*, the wiring wca**2** that electrically couples the driving signal output circuit **52***a*-**2** and the terminal TM**1***a* of the connector CN**1***a*, the wiring wcb**2** that electrically couples the driving signal output circuit **52***b*-**2** and the terminal TM**1***a* of the connector CN**1***a*, the wiring wca**3** that electrically couples the driving signal output circuit **52***a*-**3** and the terminal TM**1***a* of the connector CN**1***a*, the wiring wcb**3** that electrically couples the driving signal output circuit **52***b*-**3** and the terminal TM**1***a* of the connector CN**1***a*, the wiring wca**4** that electrically couples the driving signal output circuit **52***a*-**4** and the terminal TM**1***a* of the connector CN**1***a*, the wiring wcb**4** that electrically couples the driving signal output circuit **52***b*-**4** and the terminal TM**1***a* of the connector CN**1***a*, the wiring wb**1** that electrically couples the reference voltage signal output circuit **530** and the capacitor **53**, the wiring wb**6** that electrically couples the capacitor **53** and the connector CN**3***a* and branches from the wiring wb**1**, and through which the reference voltage signal VBS supplied to the electrode **612** of the piezoelectric element **60** included in the discharge module **32-1** propagates, the wiring wb**5** that electrically couples the capacitor **53** and the connector CN**3***a* and branches from the wiring wb**1**, and through which the reference voltage signal VBS supplied to the electrode **612** of the piezoelectric element **60** included in the discharge module **32-2** propagates, the wiring wb**7** that electrically couples the capacitor **53** and the connector CN**3***a* and branches from the wiring wb**1**, and through which the reference voltage signal VBS supplied to the electrode **612** of the piezoelectric element **60** included in the discharge module **32-3** propagates, the wiring wb**8** that electrically couples the capacitor **53** and the connector CN**3***a* and branches from the wiring wb**1**, and through which the reference voltage signal VBS supplied to the electrode **612** of the piezoelectric element **60** included in the discharge module **32-4** propagates, and the wiring wg through which the ground signal propagates.

A part of the wiring wca**1** is provided adjacent to the wiring wb**6** and a different part is provided adjacent to the wiring wg, a part of the wiring wcb**1** is provided adjacent to the wiring wb**6** and a different part is provided adjacent to the wiring wg, a part of the wiring wca**2** is provided adjacent to the wiring wb**5** and a different part is provided adjacent to the wiring wg, a part of the wiring wcb**2** is provided adjacent to the wiring wb**5** and a different part is provided adjacent to the wiring wg, a part of the wiring wca**3** is provided adjacent to the wiring wb**7** and a different part is provided adjacent to the wiring wg, a part of the wiring wcb**3** is provided adjacent to the wiring wb**7** and a different part is provided adjacent to the wiring wg, a part of the wiring wca**4** is provided adjacent to the wiring wb**8** and a different part is provided adjacent to the wiring wg, and a part of the wiring wcb**4** is provided adjacent to the wiring wb**8** and a different part is provided adjacent to the wiring wg.

With the above configuration, the current generated by supplying the driving signals COMA**1** and COMB**1** to the discharge module **32-1** is fed back via the wiring wb**6** that supplies the reference voltage signal VBS to the discharge module **32-1**. Therefore, the magnetic field generated by the current generated by supplying the driving signals COMA**1** and COMB**1** to the discharge module **32-1** is canceled by the magnetic field generated by the current fed back through the wiring wb**6** supplying the reference voltage signal VBS to the discharge module **32-1**. As a result, the waveform accuracy of the driving signals COMA**1** and COMB**1** supplied to the discharge module **32-1** is improved. Further, in a section where the wirings wca**1** and wcb**1** through which the driving signals COMA**1** and COMB**1** propagate to the discharge module **32-1** are not adjacent to the wiring wb**6** for supplying the reference voltage signal VBS to the discharge module **32-1**, by providing the wiring wg through which the ground signal propagates adjacent to the wirings wca**1** and wcb**1** through which the driving signals COMA**1** and COMB**1** propagate to the discharge module **32-1**, the concern that the noise is superimposed on the driving signals COMA**1** and COMB**1** supplied to the discharge module **32-1** is reduced, and the waveform accuracy of the driving signals COMA**1** and COMB**1** is further improved.

Similarly, the magnetic field generated by the current generated by supplying the driving signals COMA**2** and COMB**2** to the discharge module **32-2** is canceled by the magnetic field generated by the current fed back through the wiring wb**5** supplying the reference voltage signal VBS to the discharge module **32-2**, and thus the waveform accuracy of the driving signals COMA**2** and COMB**2** supplied to the discharge module **32-2** is improved. In a section where the wirings wca**2** and wcb**2** through which the driving signals COMA**2** and COMB**2** propagate are not adjacent to the wiring wb**5**, by providing the wiring wg adjacent to the wirings wca**2** and wcb**2**, the concern that noise is superimposed on the driving signals COMA**2** and COMB**2** is reduced, and the waveform accuracy of the driving signals COMA**2** and COMB**2** is further improved.

Similarly, the magnetic field generated by the current generated by supplying the driving signals COMA**3** and COMB**3** to the discharge module **32-3** is canceled by the magnetic field generated by the current fed back through the wiring wb**7** supplying the reference voltage signal VBS to the discharge module **32-3**, and thus the waveform accuracy of the driving signals COMA**3** and COMB**3** supplied to the discharge module **32-3** is improved. In a section where the wirings wca**3** and wcb**3** through which the driving signals COMA**3** and COMB**3** propagate are not adjacent to the wiring wb**7**, by providing the wiring wg adjacent to the wirings wca**3** and wcb**3**, the concern that noise is superimposed on the driving signals COMA**3** and COMB**3** is reduced, and the waveform accuracy of the driving signals COMA**3** and COMB**3** is further improved.

Similarly, the magnetic field generated by the current generated by supplying the driving signals COMA**4** and COMB**4** to the discharge module **32-4** is canceled by the magnetic field generated by the current fed back through the wiring wb**8** supplying the reference voltage signal VBS to the discharge module **32-4**, and thus the waveform accuracy of the driving signals COMA**4** and COMB**4** supplied to the discharge module **32-4** is improved. In a section where the wirings wca**4** and wcb**4** through which the driving signals COMA**4** and COMB**4** propagate are not adjacent to the wiring wb**8**, by providing the wiring wg adjacent to the wirings wca**4** and wcb**4**, the concern that noise is superimposed on the driving signals COMA**4** and COMB**4** is reduced, and the waveform accuracy of the driving signals COMA**4** and COMB**4** is further improved.

Next, component arrangement in an assembled state of the drive circuit substrate **700** provided with various circuits will be described. FIG. **23** is a diagram illustrating an example of component arrangement when the drive circuit substrate **700** in the assembled state is viewed from the **+x2** side along the x2 axis, and FIG. 24 is a diagram illustrating an example of the component arrangement when the drive circuit substrate 700 in the assembled state is viewed from the −y2 side along the y2 axis.

As described above, in the drive circuit substrate 700 in the assembled state, the surface 723 of the rigid wiring member 710 provided with the driving signal output circuits 52a-1, 52a-2, 52b-1, and 52b-2, and the surface 743 of the rigid wiring member 730 provided in the driving signal output circuit 52a-3, 52a-4, 52b-3, and 52b-4 are positioned facing each other in the direction along the x2 axis. At this time, as illustrated in FIG. 23, when the drive circuit substrate 700 in the assembled state is viewed along the x2 axis, the driving signal output circuit 52a-1 provided on the surface 723 of the rigid wiring member 710 and the driving signal output circuit 52b-4 provided on the surface 743 of the rigid wiring member 730 are arranged overlapping with each other at least partially, and the integrated circuit 500 included in the driving signal output circuit 52a-1 and the integrated circuit 500 included in the driving signal output circuit 52b-4 are arranged not overlapping with each other.

In this case, the transistors M1 and M2 included in the driving signal output circuit 52a-1 may be arranged not overlapping with the transistors M1 and M2 included in the driving signal output circuit 52b-4 when viewed along the direction along the x2 axis. Further, the inductor L1 included in the driving signal output circuit 52a-1 may be arranged not overlapping with the inductor L1 included in the driving signal output circuit 52b-4 when viewed along the direction along the x2 axis.

Here, the fact that the driving signal output circuit 52a-1 and the driving signal output circuit 52b-4 are arranged overlapping with each other at least partially when the drive circuit substrate 700 in the assembled state is viewed along the x2 axis, means that at least one of the electronic components included in the driving signal output circuit 52a-1 and at least one of the electronic components included in the driving signal output circuit 52b-4 overlap with each other when the drive circuit substrate 700 in the assembled state is viewed along the x2 axis. For example, a case where at least one of the integrated circuit 500, the transistors M1 and M2, and the inductor L1 included in the driving signal output circuit 52a-1 and at least one of the integrated circuit 500, the transistors M1 and M2, and the inductor L1 included in the driving signal output circuit 52b-4 overlap with each other, is included.

Similarly, when the drive circuit substrate 700 in the assembled state is viewed along the x2 axis, the driving signal output circuit 52b-1 provided on the surface 723 of the rigid wiring member 710 and the driving signal output circuit 52a-4 provided on the surface 743 of the rigid wiring member 730 are arranged overlapping with each other at least partially, and the integrated circuit 500 included in the driving signal output circuit 52b-1 and the integrated circuit 500 included in the driving signal output circuit 52a-4 are arranged not overlapping with each other.

In this case, the transistors M1 and M2 included in the driving signal output circuit 52b-1 may be arranged not overlapping with the transistors M1 and M2 included in the driving signal output circuit 52a-4 when viewed along the direction along the x2 axis. Further, the inductor L1 included in the driving signal output circuit 52b-1 may be arranged not overlapping with the inductor L1 included in the driving signal output circuit 52a-4 when viewed along the direction along the x2 axis.

Here, the fact that the driving signal output circuit 52b-1 and the driving signal output circuit 52a-4 are arranged overlapping with each other at least partially when the drive circuit substrate 700 in the assembled state is viewed along the x2 axis, means that at least one of the electronic components included in the driving signal output circuit 52b-1 and at least one of the electronic components included in the driving signal output circuit 52a-4 overlap with each other when the drive circuit substrate 700 in the assembled state is viewed along the x2 axis. For example, a case where at least one of the integrated circuit 500, the transistors M1 and M2, and the inductor L1 included in the driving signal output circuit 52b-1 and at least one of the integrated circuit 500, the transistors M1 and M2, and the inductor L1 included in the driving signal output circuit 52a-4 overlap with each other, is included.

Similarly, when the drive circuit substrate 700 in the assembled state is viewed along the x2 axis, the driving signal output circuit 52a-2 provided on the surface 723 of the rigid wiring member 710 and the driving signal output circuit 52b-3 provided on the surface 743 of the rigid wiring member 730 are arranged overlapping with each other at least partially, and the integrated circuit 500 included in the driving signal output circuit 52a-2 and the integrated circuit 500 included in the driving signal output circuit 52b-3 are arranged not overlapping with each other.

In this case, the transistors M1 and M2 included in the driving signal output circuit 52a-2 may be arranged not overlapping with the transistors M1 and M2 included in the driving signal output circuit 52b-3 when viewed along the direction along the x2 axis. Further, the inductor L1 included in the driving signal output circuit 52a-2 may be arranged not overlapping with the inductor L1 included in the driving signal output circuit 52b-3 when viewed along the direction along the x2 axis.

Here, the fact that the driving signal output circuit 52a-2 and the driving signal output circuit 52b-3 are arranged overlapping with each other at least partially when the drive circuit substrate 700 in the assembled state is viewed along the x2 axis, means that at least one of the electronic components included in the driving signal output circuit 52a-2 and at least one of the electronic components included in the driving signal output circuit 52b-3 overlap with each other when the drive circuit substrate 700 in the assembled state is viewed along the x2 axis. For example, a case where at least one of the integrated circuit 500, the transistors M1 and M2, and the inductor L1 included in the driving signal output circuit 52a-2 and at least one of the integrated circuit 500, the transistors M1 and M2, and the inductor L1 included in the driving signal output circuit 52b-3 overlap with each other, is included.

Similarly, when the drive circuit substrate 700 in the assembled state is viewed along the x2 axis, the driving signal output circuit 52b-2 provided on the surface 723 of the rigid wiring member 710 and the driving signal output circuit 52a-3 provided on the surface 743 of the rigid wiring member 730 are arranged overlapping with each other at least partially, and the integrated circuit 500 included in the driving signal output circuit 52b-2 and the integrated circuit 500 included in the driving signal output circuit 52a-3 are arranged not overlapping with each other.

In this case, the transistors M1 and M2 included in the driving signal output circuit 52b-2 may be arranged not overlapping with the transistors M1 and M2 included in the driving signal output circuit 52a-3 when viewed along the direction along the x2 axis. Further, the inductor L1 included in the driving signal output circuit 52b-2 may be arranged not overlapping with the inductor L1 included in the driving signal output circuit 52a-3 when viewed along the direction along the x2 axis.

Here, the fact that the driving signal output circuit 52b-2 and the driving signal output circuit 52a-3 are arranged overlapping with each other at least partially when the drive circuit substrate 700 in the assembled state is viewed along the x2 axis, means that at least one of the electronic components included in the driving signal output circuit 52b-2 and at least one of the electronic components included in the driving signal output circuit 52a-3 overlap with each other when the drive circuit substrate 700 in the assembled state is viewed along the x2 axis. For example, a case where at least one of the integrated circuit 500, the transistors M1 and M2, and the inductor L1 included in the driving signal output circuit 52b-2 and at least one of the integrated circuit 500, the transistors M1 and M2, and the inductor L1 included in the driving signal output circuit 52a-3 overlap with each other, is included.

Further, as illustrated in FIG. 23, in the drive circuit substrate 700 in the assembled state, the connector CN3a provided on the rigid wiring member 710 and the connector CN3b provided on the rigid wiring member 770 are fitted to each other, and accordingly, the rigid wiring member 710 is fixed to the rigid wiring member 770. As a result, the assembled state of the drive circuit substrate 700 having a substantially box shape is held by the connector CN3a and the connector CN3b. That is, the drive circuit substrate 700 has the connector CN3a provided on the rigid wiring member 710 and the connector CN3b provided on the rigid wiring member 770, the connector CN3a and the connector CN3b are fitted to each other, the rigid wiring member 710 is fixed to the rigid wiring member 770, and accordingly, the assembled state of the drive circuit substrate 700 is held. In other words, the connector CN3 including the connector CN3a and the connector CN3b functions as a holding member for holding the drive circuit substrate 700 in the assembled state.

As a result, the drive circuit substrate 700 does not need to be provided with a framework for holding the assembled state in a substantially box shape, and therefore, the mounting area of the drive circuit substrate 700 in the liquid discharge apparatus 1 can be further reduced, and it is possible to realize further dense arrangement of the drive circuit substrate 700 and further size reduction of the liquid discharge apparatus 1.

Further, the connector CN3a and the connector CN3b are fitted to each other to configure the connector CN3 which is a BtoB connector that electrically couples the rigid wiring member 710 and the rigid wiring member 770. That is, the rigid wiring member 710 and the rigid wiring member 770 are electrically coupled to each other via the connector CN3a and the connector CN3b. As a result, the signal generated by the circuit provided on the rigid wiring member 710 can be supplied to the rigid wiring member 770 via the connector CN3a and the connector CN3b without going through the rigid wiring members 730 and 750. Accordingly, the propagation path through which the signal generated by the circuit provided on the rigid wiring member 710 propagates to the rigid wiring member 770 can be shortened, and the concern that noise is superimposed on the signal is reduced. As a result, the accuracy of the signal is improved.

At this time, the signals propagating via the connector CN3a and the connector CN3b include the clock signal SCK, which is a part of the signal generated by the rigid wiring member 710 and is output by the discharge control circuit 51 configured with the FPGA, and the differential print data signal Dpt are preferable. In other words, the clock signal SCK and the differential print data signal Dpt preferably propagate to the print head 30 via the connector CN3a and the connector CN3b.

The clock signal SCK and the differential print data signal Dpt output by the discharge control circuit 51 configured with the FPGA are low voltage signals that are easily affected by noise, and are signals that control the operation of the print head 30. Therefore, a case where noise is superimposed is directly related to the discharge accuracy of the ink from the print head 30. By propagating the signals via the connector CN3a and the connector CN3b, the accuracy of the clock signal SCK and the differential print data signal Dpt input to the print head 30 is improved, and the ink discharge accuracy is improved.

2.2.3.3 Structure of Relay Substrate

Next, the structure of the relay substrate 150 included in the drive circuit module 50 will be described. FIG. 25 is a plan view illustrating an example of the structure of the relay substrate 150, and FIG. 26 is a side view illustrating an example of the structure of the relay substrate 150. As illustrated in FIGS. 25 and 26, the relay substrate 150 includes a surface 151, a surface 152 opposite to the surface 151, and sides 153, 154, 155, and 156. Further, in the relay substrate 150, the side 153 and the side 154 are positioned facing each other, the side 155 and the side 156 are positioned facing each other, the side 153 is positioned to intersect both the side 155 and the side 156, and the side 154 is positioned to intersect both the side 155 and the side 156.

The other end of the FFC cable 21 and the other end of the FFC cable 22 are electrically coupled to the surface 151 of the relay substrate 150. The FFC cable 21 propagates the voltage signal VHV and the voltage signal VMV supplied to the drive circuit substrate 700, and the FFC cable 22 propagates the clock signal SCK, the differential print data signal Dp, and the differential drive data signal Dd supplied to the drive circuit substrate 700. That is, the FFC cable 21 includes a plurality of signal wirings including a signal wiring propagating the voltage signal VHV and a signal wiring propagating the voltage signal VMV, and the FFC cable 22 includes a plurality of signal wiring including a signal wiring propagating the clock signal SCK, a signal wiring propagating the differential print data signal Dp, and a signal wiring propagating the differential drive data signal Dd. Here, the FFC cable 21 and the FFC cable 22 may be electrically coupled to the relay substrate 150 via an FFC connector (not illustrated), or may be electrically coupled to the relay substrate 150 by solder or the like.

The connector CN2a is provided on the surface 152 of the relay substrate 150. The connector CN2a is fitted to the connector CN2b provided on the drive circuit substrate 700. As a result, the relay substrate 150 and the drive circuit substrate 700 are electrically coupled. That is, the connector CN2a and the connector CN2b configure the connector CN2 which is a BtoB connector that directly electrically couples the relay substrate 150 and the drive circuit substrate 700 without using a cable.

The voltage signal VHV and the voltage signal VMV propagating through the FFC cable 21, the clock signal SCK propagating through the FFC cable 22, the differential print data signal Dp, and the differential drive data signal Dd are input to the relay substrate 150 configured as described above. The relay substrate 150 propagates the input voltage signal VHV, the voltage signal VMV, the clock signal SCK, the differential print data signal Dp, and the differential drive data signal Dd to the connector CN2a. Then, the voltage signal VHV, the voltage signal VMV, the clock signal SCK, the differential print data signal Dp, and the differential drive data signal Dd propagated to the connector CN2*a* are input to the drive circuit substrate **700** via the connector CN2*b*.

As described above, the plurality of signals propagated through the FFC cable **21** and the FFC cable **22** are input to the relay substrate **150**. The relay substrate **150** propagates the input signal and outputs the signal to the drive circuit substrate **700** via the connector CN2 which is a BtoB connector. That is, the relay substrate **150** propagates the signal input via the plurality of cables. The relay substrate **150** outputs the signal via the number of connectors smaller than the number of cables through which the signal propagates, preferably one connector.

As a result, even when the number of cables coupled to the liquid discharge module **20** increases, only by attaching and detaching the connector CN1*a* provided on the relay substrate **150** and the connector CN1*b* provided on the drive circuit substrate **700**, the drive circuit substrate **700** included in the liquid discharge module **20** and the print head **30** electrically coupled to the drive circuit substrate **700** can be easily attached to and detached from the liquid discharge apparatus **1**. As a result, workability at the time of replacement, maintenance, and assembly of the drive circuit substrate **700** and the print head **30** electrically coupled to the drive circuit substrate **700** is improved. As a result, the convenience of the liquid discharge apparatus **1** is improved.

Further, since the drive circuit substrate **700** and the print head **30** included in the liquid discharge module **20** can be easily attached and detached, it is possible to reduce the space to be secured when the attachment and detachment is performed. As a result, the liquid discharge modules **20** included in the liquid discharge apparatus **1** can be further densely arranged, and as a result, further size reduction of the liquid discharge apparatus **1** can be realized.

In the liquid discharge apparatus **1** configured as described above, among the connector CN2 which is a BtoB connector for electrically coupling the relay substrate **150** and the drive circuit substrate **700**, the connector CN2*a* provided on the relay substrate **150** is preferably a straight type connector, and the connector CN2*b* provided on the drive circuit substrate **700** is preferably a right-angle type connector. As a result, when attaching and detaching the connector CN2*a* of the relay substrate **150** to and from the connector CN2*b* of the drive circuit substrate **700**, the relay substrate **150** may be moved along the normal direction of the surface **152**, and a space to be secured at the time of attachment and detachment can be further reduced. As a result, the liquid discharge modules **20** included in the liquid discharge apparatus **1** can be further densely arranged, and further size reduction of the liquid discharge apparatus **1** can be realized.

In the relay substrate **150**, the number of times of attachment/detachment between the connector CN2*a* and the connector CN2*b* is preferably larger than the number of times of attachment/detachment of the FFC cable **21** electrically coupled to the relay substrate **150**, and preferably larger than the number of times of attachment/detachment of the FFC cable **22** electrically coupled to the relay substrate **150**.

Here, the number of times of attachment/detachment means the number of times of attachment/detachment that can satisfy the desired reliability for the electrical coupling, and is defined based on, for example, the wear condition of the terminal plating of the contact portion that may occur due to attachment and detachment, the exposed condition of the base of the terminal plating, and the like. Specifically, the number of times of attachment/detachment between the connector CN2*a* and the connector CN2*b* may be the number of times of insertion/removal defined based on the specifications of the connector CN2*a* and the connector CN2*b*. The number of times of attachment/detachment of the FFC cables **21** and **22** may be the number of times of insertion/removal of the FFC connector even when the FFC cables **21** and **22** are electrically coupled to the relay substrate **150** via the FFC connector, and may be the number of times of soldering based on soldering conditions of the FFC cables **21** and **22** even when the FFC cables **21** and **22** are directly electrically coupled to the relay substrate **150** by soldering or the like.

The relay substrate **150** of the present embodiment outputs a signal propagated via the FFC cables **21** and **22** from the connector CN2*a*, and accordingly, the liquid discharge module **20** can be attached and detached by attaching and detaching only the connector CN2*a*. By making the number of times of attachment/detachment of the connector CN2*a* is larger than the number of times of attachment/detachment of the FFC cables **21** and **22**, even when the relay substrate **150** is repeatedly attached and detached, the concern that the reliability of the electrical coupling of the relay substrate **150** and the drive circuit substrate **700** with the print head **30** is impaired is reduced. As a result, the operational stability of the liquid discharge module **20** and the reliability of the liquid discharge apparatus **1** are improved.

Further, the relay substrate **150** has the through-hole **158** that penetrates the surface **151** and the surface **152**. A part of the cooling fan **59** is inserted through the through-hole **158**. Accordingly, the cooling fan **59** is fixed to the relay substrate **150** in a state where at least a part of the cooling fan **59** is inserted through the through-hole **158**. That is, the relay substrate **150** and the cooling fan **59** are integrally configured. Therefore, when the relay substrate **150** is removed from the drive circuit substrate **700**, the cooling fan **59** is also separated from the drive circuit substrate **700** together with the relay substrate **150**, and when the relay substrate **150** is attached to the drive circuit substrate **700**, the cooling fan **59** is also attached to the drive circuit substrate **700** together with the relay substrate **150**.

As a result, even when the cooling fan **59** is used for cooling the drive circuit substrate **700**, the concern that the cooling fan **59** hinders the attachment and detachment of the relay substrate **150** from the drive circuit substrate **700** and the print head **30** is reduced. Although it is described that the cooling fan **59** of the present embodiment is inserted through the through-hole **158** formed in the relay substrate **150** to be fixed to the relay substrate **150**, but the cooling fan **59** may be fixed to the relay substrate **150** by a holding member (not illustrated) or the like that fixes the cooling fan **59** to the relay substrate **150**.

Further, when the cooling fan **59** is fixed to the relay substrate **150**, the fan driving signal Fp for driving the cooling fan **59** is preferably supplied to the cooling fan **59** without being supplied to the drive circuit substrate **700**. Specifically, the fan driving signal Fp for driving the cooling fan **59** propagate through the FFC cable **21** together with the voltage signals VHV and VMV, and is supplied to the relay substrate **150**. Then, the fan driving signal Fp propagates through the relay substrate **150** and is supplied to the cooling fan **59**. In other words, the FFC cable **21** includes a signal wiring that propagates the voltage signal VHV for driving the drive circuit substrate **700**, a signal wiring that propagates the voltage signal VMV for driving the drive circuit substrate **700**, and a signal wiring that propagates the fan driving signal Fp for driving the cooling fan **59**, and the signal wiring that propagates the fan driving signal Fp for driving the cooling fan **59** is electrically coupled to the relay substrate **150**, and the fan driving signal Fp propagates through the relay substrate **150** and is input to the cooling fan **59**.

When the relay substrate **150** and the cooling fan **59** are integrally configured, by propagating the fan driving signal Fp for driving the cooling fan **59** through the relay substrate **150** and supplying the fan driving signal Fp to the cooling fan **59**, there is no need to provide a wiring for propagating the fan driving signal Fp on the drive circuit substrate **700**, and as a result, the concern that the drive circuit substrate **700** becomes large is reduced. That is, the concern that the drive circuit substrate **700** becomes large can be reduced, and the detachability of the liquid discharge apparatus **1** can be maintained.

Although not illustrated, the fan driving signal Fp for driving the cooling fan **59** may be supplied to the cooling fan **59** without propagating through the relay substrate **150** in a state where the cooling fan **59** is fixed to the relay substrate **150**. Specifically, the fan driving signal Fp for driving the cooling fan **59** propagates through the FFC cable **21** together with the voltage signals VHV and VMV. At this time, the signal wiring for propagating the fan driving signal Fp branches from the FFC cable **21**, and the branched signal wiring is directly electrically coupled to the cooling fan **59**. Accordingly, the fan driving signal Fp is supplied to the cooling fan **59** without propagating through the relay substrate **150**. In other words, the FFC cable **21** may include a signal wiring that propagates the voltage signal VHV for driving the drive circuit substrate **700**, a signal wiring that propagates the voltage signal VMV for driving the drive circuit substrate **700**, and a signal wiring that propagates the fan driving signal Fp for driving the cooling fan **59**, the signal wiring that propagates the fan driving signal Fp for driving the cooling fan **59** may be electrically coupled to the cooling fan **59**, and the fan driving signal Fp is input to the cooling fan **59** without propagating through the relay substrate **150**.

When the relay substrate **150** and the cooling fan **59** are integrally configured, even when the fan driving signal Fp for driving the cooling fan **59** is directly supplied to the cooling fan **59** without propagating through the relay substrate **150**, there is no need to provide a wiring for propagating the fan driving signal Fp on the drive circuit substrate **700**, and as a result, the concern that the drive circuit substrate **700** becomes large is reduced. That is, even when the cooling fan **59** is used for cooling the drive circuit substrate **700**, the concern that the drive circuit substrate **700** becomes large can be reduced, and the detachability of the liquid discharge apparatus **1** can be maintained.

As described above, when the fan driving signal Fp for driving the cooling fan **59** propagates through the relay substrate **150** and is supplied to the cooling fan **59** when the relay substrate **150** and the cooling fan **59** are integrally configured, and when the fan driving signal Fp for driving the cooling fan **59** is directly supplied to the cooling fan **59** without propagating through the relay substrate **150** when the relay substrate **150** and the cooling fan **59** are integrally configured, the concern that the size of the drive circuit substrate **700** becomes large is reduced, and an effect that the detachability of the liquid discharge apparatus **1** can be maintained is achieved.

Further, when the relay substrate **150** and the cooling fan **59** are integrally configured, and when the fan driving signal Fp for driving the cooling fan **59** propagates through the relay substrate **150** and is supplied to the cooling fan **59**, by providing a predetermined circuit on the relay substrate **150**, it is possible to adjust the voltage value of the fan driving signal Fp and remove noise contained in the fan driving signal Fp. As a result, the driving accuracy of the cooling fan **59** can be improved, and the operational stability of various circuits included in the drive circuit substrate **700** is improved. As a result, the discharge accuracy of the ink from the print head **30** is improved.

On the other hand, when the relay substrate **150** and the cooling fan **59** are integrally configured, and when the fan driving signal Fp for driving the cooling fan **59** is directly supplied to the cooling fan **59** without propagating through the relay substrate **150**, there is no need to provide a wiring for propagating the fan driving signal Fp on the relay substrate **150**, and accordingly, the size of the relay substrate **150** can be reduced. As a result, the liquid discharge modules **20** can be further densely arranged, and the size of the liquid discharge apparatus **1** can be further reduced.

2.2.3.4 Structure of Drive Circuit Module

The structure of the drive circuit module **50** having the drive circuit substrate **700** and the relay substrate **150** configured as described above will be described. FIG. **27** is a view of the drive circuit module **50** viewed from the −x**2** side along the x**2** axis. FIG. **28** is a view of the drive circuit module **50** viewed from the +x**2** side along the x**2** axis. FIG. **29** is a view of the drive circuit module **50** viewed from the −y**2** side along the y**2** axis. FIG. **30** is a view of the drive circuit module **50** viewed from the +z**2** side along the z**2** axis. Here, FIGS. **27** to **30** show a part of the print head **30** to which the drive circuit module **50** is coupled in addition to the drive circuit module **50** by a broken line.

As illustrated in FIGS. **27** and **29**, the heat sink **180** is positioned on the outer surface side of the drive circuit substrate **700** on the −x2 side and on the surface **724** side of the rigid wiring member **710** included in the drive circuit substrate **700**. The heat sink **180** is attached to the rigid wiring member **710**. At this time, as illustrated in FIG. **29**, the heat conductive member **185** is positioned between the heat sink **180** and the surface **724** of the rigid wiring member **710**. As a result, the adhesion between the heat sink **180** and the surface **724** is improved, heat generated in the rigid wiring member **710** including the surface **724** can be efficiently released, and the insulation performance between the heat sink **180** and the surface **724** can be improved. That is, the heat sink **180** is positioned closer to the surface **724** than the surface **723** of the rigid wiring member **710** and closer to the rigid member **722** than the rigid members **721**, **741**, and **742** in the direction along the x**2** axis, and is attached to the rigid wiring member **710**. The heat conductive member **185** is positioned between the heat sink **180** and the surface **724** of the rigid wiring member **710** and is in contact with both the heat sink **180** and the surface **724** of the rigid wiring member **710**. The heat sink **180** and the heat conductive member **185** release the heat generated in various circuits provided on the rigid wiring member **710** into the atmosphere.

Here, when the drive circuit module **50** is viewed from the −x**2** side to the +x**2** side along the x**2** axis, at least a part of the heat sink **180** and the heat conductive member **185** is positioned overlapping with the driving signal output circuits **52***a*-**1**, **52***b*-**1**, **52***a*-**2**, and **52***b*-**2** provided on the rigid wiring member **710**. The driving signal output circuits **52***a*-**1**, **52***b*-**1**, **52***a*-**2**, and **52***b*-**2** are circuits having a large heat generation amount among the circuits provided on the rigid wiring member **710**, the heat sink **180** and the heat conductive member **185** are positioned overlapping with the driving signal output circuits **52***a*-**1**, **52***b*-**1**, **52***a*-**2**, and

52*b*-2, and accordingly, the heat generated in the rigid wiring member **710** can be efficiently released into the atmosphere.

Further, as illustrated in FIGS. **28** and **29**, the heat sink **170** is positioned on the outer surface side of the drive circuit substrate **700** on the +x**2** side and on the surface **744** side of the rigid wiring member **730** included in the drive circuit substrate **700**. The heat sink **170** is attached to the rigid wiring member **730**. At this time, as illustrated in FIG. **29**, the heat conductive member **175** is positioned between the heat sink **170** and the surface **744** of the rigid wiring member **730**. As a result, the adhesion between the heat sink **170** and the surface **744** is improved, heat generated in the rigid wiring member **730** including the surface **744** can be efficiently released, and the insulation performance between the heat sink **170** and the surface **744** can be improved.

That is, the heat sink **170** is positioned closer to the surface **744** than the surface **743** of the rigid wiring member **730** and closer to the rigid member **742** than the rigid members **721**, **722**, and **741** in the direction along the x**2** axis, and is attached to the rigid wiring member **730**. The heat conductive member **175** is positioned between the heat sink **170** and the surface **744** of the rigid wiring member **730** and is in contact with both the heat sink **170** and the surface **744** of the rigid wiring member **730**. The heat sink **170** and the heat conductive member **175** release the heat generated in various circuits provided on the rigid wiring member **730** into the atmosphere.

Here, when the drive circuit module **50** is viewed from the +x**2** side to the −x**2** side along the x**2** axis, at least a part of the heat sink **170** and the heat conductive member **175** is positioned overlapping with the driving signal output circuits **52***a*-**3**, **52***b*-**3**, **52***a*-**4**, and **52***b*-**4** provided on the rigid wiring member **730**. The driving signal output circuits **52***a*-**3**, **52***b*-**3**, **52***a*-**4**, and **52***b*-**4** are circuits having a large heat generation amount among the circuits provided on the rigid wiring member **730**, the heat sink **170** and the heat conductive member **175** are positioned overlapping with the driving signal output circuits **52***a*-**3**, **52***b*-**3**, **52***a*-**4**, and **52***b*-**4**, and accordingly, the heat generated in the rigid wiring member **730** can be efficiently released into the atmosphere.

Further, the abnormality notification circuits **55***a* and **55***b* are positioned on the surface **744** of the rigid wiring member **730** where the heat sink **170** and the heat conductive member **175** are positioned. In other words, the abnormality notification circuits **55***a* and **55***b* are surfaces **744** of the rigid wiring member **730** and are provided on the rigid member **742**.

Here, as described above, the abnormality notification circuit **55***a* is turned on, is turned off, or blinks based on the result of the abnormality detection in the abnormality detection circuit **54***a*, and the abnormality detection circuit **54***a* detects whether or not the voltage value of the voltage signal VHV is normal. Further, the abnormality notification circuit **55***b* is turned on, is turned off, or blinks based on the result of an abnormality detection in the abnormality detection circuit **54***b*, and the abnormality detection circuit **54***b* detects whether or not the voltage value of the voltage signal VDD generated based on the voltage signal VMV is normal. That is, the abnormality notification circuit **55***a* detects the presence or absence of an abnormality in the voltage values of the voltage signal VHV that functions as the power supply voltage of the driving signal output circuits **52***a*-**1** to **52***a*-**4** and **52***b*-**1** to **52***b*-**4** and the print head **30**, and the abnormality notification circuit **55***b* detects the presence or absence of an abnormality in the power supply voltage supplied to the FPGA that configures the discharge control circuit **51**. Therefore, the heat sink **170** and the heat conductive member **175** are attached to the rigid wiring member **730** such that the user can visually recognize the state where the abnormality notification circuits **55***a* and **55***b* are turned on. The abnormality detection circuits **54***a* and **54***b* may detect various abnormalities of the drive circuit module **50** in addition to the abnormalities of the voltage signals VHV and VDD described above, and the abnormality notification circuits **55***a* and **55***b* may notify various abnormalities of the drive circuit module **50** in addition to the abnormalities of the voltage signals VHV and VDD described above.

Specifically, as illustrated in FIGS. **28** and **29**, the heat sink **170** has an opening **172**. When the heat sink **170** is attached to the rigid wiring member **730**, the opening **172** is provided at a position overlapping the abnormality notification circuits **55***a* and **55***b* provided on the surface **744** of the rigid wiring member **730**. That is, when the drive circuit substrate **700** is viewed along the direction from the rigid member **742** to the rigid member **741**, the abnormality notification circuits **55***a* and **55***b* are positioned overlapping with at least a part of the opening **172**. As a result, the user is visually notified whether or not an abnormality occurred in the drive circuit module **50** while reducing the concern that the heat release efficiency of the rigid wiring member **730** by the heat sink **170** and the heat conductive member **175** is reduced. The opening **172** may be a notch or the like as long as the heat sink **170** and the heat conductive member **175** are not arranged at the positions where the abnormality notification circuits **55***a* and **55***b* are arranged when the drive circuit substrate **700** is viewed along the direction from the rigid member **742** to the rigid member **741**.

Here, as described above, at least a part of the heat sink **170** and the heat conductive member **175** may be positioned overlapping with the driving signal output circuits **52***a*-**3**, **52***b*-**3**, **52***a*-**4**, and **52***b*-**4**. Therefore, when viewed along the direction from the rigid member **742** to the rigid member **741**, the abnormality notification circuits **55***a* and **55***b* are positioned not overlapping with the driving signal output circuits **52***a*-**3**, **52***b*-**3**, **52***a*-**4**, and **52***b*-**4**. As a result, the user is visually notified whether or not an abnormality occurred in the drive circuit module **50** while reducing the concern that the heat release efficiency of the rigid wiring member **730** by the heat sink **170** and the heat conductive member **175** is reduced.

Further, as illustrated in FIGS. **27**, **28**, and **30**, the relay substrate **150** is positioned on the +z**2** side of the drive circuit substrate **700** and is electrically coupled to the drive circuit substrate **700** via the connector CN**2**. At this time, the relay substrate **150** is provided on the +z**2** side of the drive circuit substrate **700** such that the side **153** is positioned along the side **711** of the rigid wiring member **710**, the side **154** is positioned along the side **731** of the rigid wiring member **730**, and the normal direction of the surface **152** of the relay substrate **150** intersects both the normal direction of the surface **723** of the rigid wiring member **710** and the normal direction of the surface **743** of the rigid wiring member **730**. That is, the relay substrate **150** is provided to configure one surface of a substantially box shape configured by the drive circuit substrate **700**. At this time, the surface **151** of the relay substrate **150** configures the outer surface of the substantially box shape, and the surface **152** of the relay substrate **150** configures the inner surface of the substantially box shape. At this time, the cooling fan **59** fixed to the relay substrate **150** blows the air on the surface **151** side of the relay substrate **150** to the surface **152** side of the relay substrate **150**, or blows the air on the surface **152** side of the relay substrate **150** to the surface **151** side of the relay substrate **150**. As a result, the cooling fan **59** generates an air flow toward the surface **783** of the rigid wiring member **770** on the inside of the drive circuit substrate **700** having a substantially box shape, and in a space between the surface **723** included in the rigid wiring member **710** of the drive circuit substrate **700** and the surface **743** included in the rigid wiring member **730** facing each other. In other words, the drive circuit substrate **700** having a substantially box shape includes the gas flow path having the surface **723** included in the rigid wiring member **710**, the surface **743** included in the rigid wiring member **730**, and the surface **783** included in the rigid wiring member **770**, and the cooling fan **59** provided on the relay substrate **150** generates an air flow in the gas flow path. Then, the cooling fan **59** cools the driving signal output circuits **52***a***-1** to **52***a***-4** and **52***b***-1** to **52***b***-4** by the air flow. In other words, the cooling fan **59** generates an air flow that cools the driving signal output circuits **52***a***-1** to **52***a***-4** and **52***b***-1** to **52***b***-4**. As a result, even when the drive circuit substrate **700** is assembled in the substantially box shape, the gas inside the substantially box shape circulates, and the cooling efficiencies of the driving signal output circuits **52***a***-1** to **52***a***-4** and **52***b***-1** to **52***b***-4** arranged inside the substantially box shape can be further improved.

In this case, the capacitor C**7***a* provided on the rigid wiring member **710** and the capacitor C**7***b* provided on the rigid wiring member **730** are preferably provided in the vicinity of the cooling fan **59**. The capacitors C**7***a* and C**7***b* configured as electrolytic capacitors have a larger component height and a smaller contact area with the drive circuit substrate **700** than the integrated circuit **500** and the transistors M**1** and M**2** configured as surface-mounted components. Therefore, the amount of heat generated by the capacitors C**7***a* and C**7***b* released to the drive circuit substrate **700** is small. By arranging the capacitors C**7***a* and C**7***b* in the vicinity of the cooling fan **59**, the capacitors C**7***a* and C**7***b* can be efficiently cooled by the air flow generated by the cooling fan **59**. As a result, the cooling efficiency of the capacitors C**7***a* and C**7***b* is improved, and the rising temperature of the drive circuit module **50** is reduced.

In other words, the shortest distance between the capacitor C**7***a* and the cooling fan **59** is shorter than the shortest distance between the transistors M**1** and M**2** and the cooling fan **59**, the shortest distance between the capacitor C**7***b* and the cooling fan **59** is shorter than the shortest distance between the transistors M**1** and M**2** and the cooling fan **59**. Accordingly, the cooling efficiency of the capacitors C**7***a* and C**7***b* is improved, and as a result, the temperature rise of the drive circuit module **50** is reduced.

Further, as illustrated in FIGS. **27**, **28**, and **29**, the opening plate **160** is positioned on the −y2 side of the drive circuit substrate **700** in the assembled state. The opening plate **160** is a plate-shaped member extending in the x**2***z***2** plane, and openings **161**, **162**, **163**, and **164** penetrating the plate-shaped member are formed on the opening plate **160**. Then, as illustrated in FIG. **29**, the opening plate **160** configures one surface having a substantially box shape of the drive circuit substrate **700** in the assembled state. Further, when the opening plate **160** is viewed along the normal direction of the opening plate **160** which is a plate-shaped member, the opening **161** is positioned overlapping with at least a part of the inductor L**1** of the driving signal output circuit **52***a***-1** and at least a part of the inductor L**1** of the driving signal output circuit **52***a***-2**, the opening **162** is positioned overlapping with at least a part of the inductor L**1** of the driving signal output circuit **52***b***-4** and at least a part of the inductor L**1** of the driving signal output circuit **52***b***-3**, the opening **163** is positioned overlapping with at least a part of the capacitor C**7***a*, and the opening **164** is positioned overlapping with at least a part of the capacitor C**7***b*.

The air flow generated inside the drive circuit substrate **700** in the assembled state by the cooling fan **59** passes through the openings **161**, **162**, **163**, and **164**. At this time, the flow speed of the air flow generated inside the drive circuit substrate **700** becomes the fastest in the vicinity of the openings **161**, **162**, **163**, and **164**. The inductor L**1** included in each of the driving signal output circuits **52***a***-1**, **52***a***-2**, **52***b***-4**, and **52***b***-3** having large component heights in the vicinity of the openings **161**, **162**, **163**, and **164** having such a large flow speed, and the capacitors C**7***a* and C**7***b* are positioned, and accordingly, the inductor L**1** and the capacitors C**7***a* and C**7***b* can be efficiently cooled by the air flow generated by the cooling fan **59**.

The electronic components having a large component height such as the inductor L**1** included in the driving signal output circuit **52** and the capacitors C**7***a* and C**7***b* have a smaller contact area with the drive circuit substrate **700**, and therefore, the amount of heat released to the drive circuit substrate **700** is small as compared with the surface-mounted component such as the integrated circuit **500** or the transistors M**1** and M**2**. Therefore, there is a possibility that the inductor L**1** and the capacitors C**7***a* and C**7***b* included in the driving signal output circuit **52** having a large component height cannot be sufficiently cooled only by the heat sinks **170** and **180** attached to the drive circuit substrate **700**.

By arranging the inductor L**1** and the capacitors C**7***a* and C**7***b* having such a large component height in the vicinity of the openings **161**, **162**, **163**, and **164** having a high flow speed of the air flow, the inductor L**1** having a large component height and the capacitors C**7***a* and C**7***b* can be efficiently cooled by the air flow generated by the cooling fan **59**, and as a result, the rising temperature of the drive circuit module **50** is reduced.

In this case, preferably, the opening plate **160** is arranged such that the inductor L**1** of the driving signal output circuit **52***a***-1** does not cover the entire opening **161**, the inductor L**1** of the driving signal output circuit **52***b***-4** does not cover the entire opening **162**, the capacitor C**7***a* does not cover the entire opening **163**, and the capacitor C**7***b* does not cover the entire opening **164**.

That is, when viewed along the normal direction of the opening plate **160** which is a plate-shaped member, preferably, the opening plate **160** is positioned such that at least a part of the opening **161** does not overlap with the inductor L**1** of the driving signal output circuit **52***a***-1**, at least a part of the opening **162** does not overlap with the inductor L**1** of the driving signal output circuit **52***b***-4**, at least a part of the opening **163** does not overlap with the capacitor C**7***a*, and at least a part of the opening **164** does not overlap with the capacitor C**7***b*.

As a result, the concern that the air flow passing through the openings **161**, **162**, **163**, and **164** is blocked by the inductor L**1** of the driving signal output circuit **52***a***-1**, the inductor L**1** of the driving signal output circuit **52***b***-4**, the capacitor C**7***a*, and the capacitor C**7***b* is reduced, and the concern that a local temperature rise occurs in the drive circuit module **50** is reduced.

As described above, the drive circuit module **50** includes the drive circuit substrate **700**, the relay substrate **150**, the opening plate **160**, and the heat sinks **170** and **180** attached to the drive circuit substrate **700**. The drive circuit module **50** operates based on various signals input via the relay substrate **150** to generate various control signals for controlling the operation of the print head **30**, and outputs the control signals to the print head **30** via the connector CN**1**.

The size of the drive circuit module **50** when viewed along the z**2** axis is smaller than the size when the print head **30** is viewed from the connector CN**1***b* to the discharge section **600**, and as illustrated in FIG. **30**, the drive circuit module **50** is arranged inside the print head **30** in a state where the connector CN**1***a* is attached to the print head **30**. That is, in the drive circuit substrate **700** included in the drive circuit module **50**, the sizes of the rigid member **781** and the rigid member **782** when the rigid wiring member **770** is viewed along the direction from the rigid member **781** to the rigid member **782** is smaller than the size of the print head **30** when viewed along the direction from the connector CN**1***b* to the discharge section **600**, the drive circuit substrate **700** included in the drive circuit module **50** is positioned inside the print head **30** in a state where the drive circuit substrate **700** is electrically coupled to the print head **30** by the connectors CN**1***a* and CN**1***b*.

As a result, when the liquid discharge module **20** having the drive circuit substrate **700** and the print head **30** electrically coupled to the drive circuit substrate **700** is attached to the liquid discharge apparatus **1**, the concern that the arrangement of the liquid discharge modules **20** will be restricted due to the size of the drive circuit substrate **700** on which many circuit components are provided is reduced. As a result, the liquid discharge modules **20** included in the liquid discharge apparatus **1** can be further densely arranged, and the concern that the liquid discharge apparatus **1** becomes large is reduced.

Further, as described above, in the drive circuit substrate **700** of the present embodiment, the size of the rigid wiring member **710** when the drive circuit substrate **700** is viewed along the z**1** axis and the size of the rigid wiring member **730** when the drive circuit substrate **700** is viewed along the z**1** axis is substantially equal. The size of the rigid wiring member **750** when the drive circuit substrate **700** is viewed along the z**1** axis is smaller than the size of the rigid wiring member **710** when the drive circuit substrate **700** is viewed along the z**1** axis and the size of the rigid wiring member **730** when the drive circuit substrate **700** is viewed along the z**1** axis. The size of the rigid wiring member **770** when the drive circuit substrate **700** is viewed along the z**1** axis is smaller than the size of the rigid wiring member **710** when the drive circuit substrate **700** is viewed along the z**1** axis and the size of the rigid wiring member **730** when the drive circuit substrate **700** is viewed along the z**1** axis. In other words, the size of the rigid member **781** when the drive circuit substrate **700** is viewed along the direction from the rigid member **781** to the rigid member **782** is smaller than the size of the rigid member **721** when viewed along the direction from the rigid member **721** to the rigid member **722**, and smaller than the size of the rigid member **741** when viewed along the direction from the rigid member **741** to the rigid member **742**.

As a result, it is possible to increase the mounting area of the electronic component on the drive circuit substrate **700** included in the liquid discharge module **20**. As a result, even when the number of components mounted on the drive circuit substrate **700** increases due to the increase in the number of discharge sections **600** included in the print head **30**, the liquid discharge modules **20** included in the liquid discharge apparatus **1** can be densely arranged, and the concern that the liquid discharge apparatus **1** becomes large is reduced.

Here, the drive circuit module **50** is an example of a substrate unit. Further, the piezoelectric element **60** included in the discharge module **32-1** is an example of a first piezoelectric element, the discharge section **600** included in the discharge module **32-1** is an example of a first discharge section, the piezoelectric element **60** included in the discharge module **32-3** is an example of a second piezoelectric element, and the discharge section **600** included in the discharge module **32-3** is an example of a second discharge section. Further, the driving signal output circuit **52***a***-1** is an example of a first drive circuit, the driving signal COMA**1** output by the driving signal output circuit **52***a***-1** is an example of a first driving signal, the driving signal output circuit **52***a***-3** is an example of a first drive circuit, and the driving signal COMA**3** output by the driving signal output circuit **52***a***-3** is an example of a second driving signal. In addition, the connector CN**1***b* is an example of a first connector, and the connector CN**1***a* is an example of a second connector. Further, the drive circuit substrate **700** is an example of a wiring substrate, the rigid members **721**, **722**, **741**, **742**, **761**, **762**, **781**, and **782** included in the drive circuit substrate **700** are examples of a plurality of rigid members, and the flexible wiring member **790** is an example of a flexible member. In addition, the rigid member **721** is an example of a first rigid member, the rigid member **741** is an example of a second rigid member, the rigid member **722** is an example of a third rigid member, the rigid member **742** is an example of a fourth rigid member, the surface **723** of the rigid member **721** is an example of a first front surface, the surface **743** of the rigid member **741** is an example of a second front surface, the surface **724** of the rigid member **722** is an example of a third front surface, the surface **744** of the rigid member **742** is an example of a fourth front surface, the surface **791** of the flexible wiring member **790** is an example of a first surface, the surface **792** of the flexible wiring member **790** is an example of a second surface, the region **701** of the flexible wiring member **790** is an example of a first region, the region **705** of the flexible wiring member **790** is an example of a second region, and at least one of the regions **702** and **704** of the flexible wiring member **790** is an example of a third region.

3. Operational Effect

As described above, the liquid discharge apparatus **1** of the present embodiment includes the print head **30** that discharges an ink, and the drive circuit substrate **700** that is electrically coupled to the print head **30**. In addition, the drive circuit substrate **700** includes the rigid wiring member **710** including the rigid members **721** and **722** provided with a plurality of circuit components, the rigid wiring member **730** including rigid members **741** and **742**, the rigid wiring member **750** including the rigid members **761** and **762**, the rigid wiring member **770** including the rigid members **781** and **782**, and the flexible wiring member **790** more flexible than the rigid wiring members **710**, **730**, **750**, and **770**. The rigid members **721**, **722**, **741**, **742**, **761**, **762**, **781**, and **782** are laminated on the flexible wiring member **790**, and accordingly, the rigid wiring members **710**, **730**, **750**, and **770** are electrically coupled to each other by the flexible wiring member **790**.

At this time, in the rigid wiring member **710** and the rigid wiring member **730**, the rigid member **721** included in the rigid wiring member **710** and the rigid member **741** included in the rigid wiring member **730** are arranged such that the surface **723** and the surface **743** face each other when the flexible wiring member **790** is bent in the regions **702** and **704**. As a result, in the liquid discharge module **20**, the region occupied by the drive circuit substrate **700** electrically coupled to the print head **30** can be reduced, the liquid discharge modules **20** can be densely arranged, and the size reduction of the liquid discharge apparatus **1** including the plurality of liquid discharge modules **20** can be realized.

Further, the rigid wiring member **770** of the drive circuit substrate **700** is positioned such that the normal direction of the surface **783** of the rigid member **781** included in the rigid wiring member **770** intersects both the normal direction of the surface **723** of the rigid member **721** included in the rigid wiring member **710**, and the normal direction of the surface **743** of the rigid member **741** included in the rigid wiring member **730**. That is, the rigid wiring member **770** is positioned to cover at least a part of a region between the rigid wiring member **710** and the rigid wiring member **730** positioned facing each other.

Accordingly, the concern about ink mist entering the region between the rigid wiring member **710** and the rigid wiring member **730** is reduced. As a result, the concern that ink mist adheres to various circuits provided on the drive circuit substrate **700** is reduced, the operational stability of various circuits provided on the drive circuit substrate **700** is improved, and the operational stability of the print head **30** that operates based on the output signals of the various circuits provided on the drive circuit substrate **700** is also improved. Therefore, the discharge accuracy of the ink discharged from the print head **30** is improved.

Further, the rigid wiring member **770** is provided with the connector CN**1***a* that is electrically coupled to the print head **30**. The connector CN**1***a* is fitted to the connector CN**1***b* provided on the print head **30** to electrically couple the drive circuit substrate **700** and the print head **30**. That is, the drive circuit substrate **700** and the print head **30** are electrically coupled by the connector CN**1** which is a BtoB connector. As a result, the impedance of the propagation path through which the signal output by the drive circuit substrate **700** and input to the print head **30** propagates is reduced. As a result, the accuracy of the signal input to the print head **30** is improved, and the discharge accuracy of the ink discharged from the print head **30** is improved.

In the drive circuit substrate **700** configured as described above, the circuit configured with various circuit components provided on the rigid members **721**, **722**, **741**, **742**, **761**, **762**, **781**, and **782**, and the wiring wh**2** through which the voltage signal VHV as the power supply voltage of the driving signal selection circuit **200** included in the print head **30** propagates, are continuously provided over the region **701** in which the rigid members **721** and **722** are laminated, the region **703** in which the rigid members **761** and **762** are laminated, the region **705** in which the rigid members **741** and **742** are laminated, the region **702** positioned between the region **701** and the region **703**, and the region **704** positioned between the region **703** and the region **705**, in the flexible wiring member **790**. That is, the voltage signal VHV propagates through the wiring wh**2** without passing through the via wiring and is supplied to the rigid wiring member **710**, the rigid wiring member **730**, and the rigid wiring member **750**. As a result, the concern that signals of different wiring layers are superimposed as noise on the voltage signals VHV supplied to the rigid wiring member **710**, the rigid wiring member **730**, and the rigid wiring member **750** is reduced. That is, the accuracy of the voltage signal VHV supplied to the various circuits provided on the rigid wiring member **710**, various circuits provided on the rigid wiring member **730**, and the various circuits provided on the rigid wiring member **750** is improved, and the operational stability of various circuits provided in the rigid wiring member **710**, various circuits provided on the rigid wiring member **730**, and various circuits provided on the rigid wiring member **750** is improved. As a result, the accuracy of the output signal output by various circuits provided on the rigid wiring member **710**, various circuits provided on the rigid wiring member **730**, and various circuits provided on the rigid wiring member **750** is improved, the operation of the print head **30** that operates based on the output signal is stabilized, and the discharge accuracy of the ink discharged from the print head **30** is improved.

Further, in the liquid discharge apparatus **1** of the present embodiment, the wiring wh**2** through which the voltage signal VHV propagates is provided continuously and linearly over the region **701**, the region **703**, and the region **705** in the direction from the region **701** to the region **705** of the flexible wiring member **790**. The voltage signal VHV functions as a power supply voltage of the driving signal selection circuit **200** included in the print head **30** and the circuit composed of various circuit components provided on the rigid member **721**, **722**, **741**, **742**, **761**, **762**, **781**, and **782**. Therefore, a large amount of current flows through the wiring wh**2** through which the voltage signal VHV propagates. By making the wiring wh**2** linear, the concern that the current density based on the voltage signal VHV propagating through the wiring wh**2** is biased is reduced, and the concern that the voltage value of the voltage signal VHV fluctuates is reduced. As a result, the accuracy of the voltage signal VHV supplied to the various circuits provided on the rigid wiring members **710**, **730**, and **750** is improved, and the operational stability of the various circuits provided on the rigid wiring members **710**, **730**, and **750** is improved. As a result, the accuracy of the output signal output by various circuits provided on the rigid wiring members **710**, **730**, and **750** is improved, the operation of the print head **30** that operates based on the output signal is further stabilized, and the discharge accuracy of the ink discharged from the print head **30** is further improved. Here, the linear shape includes the case where the wiring wh**2** is provided along the virtual straight line from the region **701** to the region **705** in the drive circuit substrate **700** in the expanded state.

Further, the rigid member **721** of the rigid wiring member **710** and the rigid member **741** of the rigid wiring member **730** are provided with the driving signal output circuits **52***a*-**1** to **52***a*-**4** and **52***b*-**1** to **52***b*-**4**. The driving signal output circuits **52***a*-**1** to **52***a*-**4** and **52***b*-**1** to **52***b*-**4** generate driving signals COMA**1** to COMA**4** and COMB**1** to COMB**4** by performing class D amplification based on the voltage signal VHV. The accuracy of the voltage signal VHV input to the rigid members **721** and **741** provided with the driving signal output circuits **52***a*-**1** to **52***a*-**4** and **52***b*-**1** to **52***b*-**4** is improved, and accordingly, the accuracy of the driving signals COMA**1** to COMA**4** and COMB**1** to COMB**4** output by the driving signal output circuits **52***a*-**1** to **52***a*-**4** and **52***b*-**1** to **52***b*-**4** is also improved. As a result, the discharge accuracy of the ink discharged from the print head **30** is further improved.

Further, the size of the rigid wiring member **770** having the connector CN**1***a* electrically coupled to the connector CN**1***b* of the print head **30** when viewed along the direction from the rigid member **781** to the rigid member **782** is smaller than the size of the print head **30** when viewed along the direction from the connector CN**1***b* to the discharge section **600**, and accordingly, the liquid discharge modules **20** including the drive circuit substrate **700** and the print head **30** can be densely arranged, and as a result, the size of the liquid discharge apparatus **1** provided with the plurality of liquid discharge modules **20** can be further reduced.

At this time, the drive circuit substrate **700** has the connectors CN**3***a* and CN**3***b*, the connector CN**3***a* is provided on the rigid wiring member **710**, and the connector

CN3*b* is provided on the rigid wiring member **770**. Then, in the drive circuit substrate **700** in the assembled state, the substantially box shape is held by fitting the connector CN3*a* and the connector CN3*b*. As a result, a holding member for holding the shape of the drive circuit substrate **700** in the assembled state is not required, and the size of the drive circuit module **50** including the drive circuit substrate **700** can be further reduced. As a result, the liquid discharge modules **20** including the drive circuit module **50** can be further densely arranged, and as a result, the size of the liquid discharge apparatus **1** provided with the plurality of liquid discharge modules **20** can be further reduced.

Further, the connectors CN3*a* and CN3*b* of the drive circuit substrate **700** are fitted to electrically couple the rigid wiring member **710** and the rigid wiring member **770**. As a result, the signal generated by the rigid wiring member **710** can propagate to the rigid wiring member **770** without passing through the rigid wiring members **730** and **750**. As a result, the number of wiring patterns provided on the drive circuit substrate **700** can be reduced, and the size of the drive circuit substrate **700** can be further reduced. As a result, the liquid discharge modules **20** including the drive circuit module **50** can be further densely arranged, and as a result, the size of the liquid discharge apparatus **1** provided with the plurality of liquid discharge modules **20** can be further reduced.

At this time, the clock signal SCK and the differential print data signal Dpt output by the discharge control circuit **51** included in the FPGA provided on the drive circuit substrate **700** are input to the print head **30** via the connectors CN**1***a* and CN**1***b* and the rigid wiring member **770**. The clock signal SCK and the differential print data signal Dpt are signals having a small voltage value, the clock signal SCK and the differential print data signal Dpt can propagate to the rigid wiring member **770** via the connectors CN3*a* and CN3*b* without passing through the rigid wiring members **730** and **750**, and accordingly, the signal accuracy of the clock signal SCK and the differential print data signal Dpt input to the print head **30** is improved. As a result, the discharge accuracy of the ink from the print head **30** is further improved.

Further, in the drive circuit module **50**, the rigid wiring member **710** and the rigid wiring member **730** included in the drive circuit substrate **700** are positioned such that the surface **723** and the surface **743** face each other, the heat sink **180** is positioned on the surface **724** of the rigid wiring member **710**, the heat sink **170** is positioned on the surface **744** of the rigid wiring member **730**, and the cooling fan **59** generates an air flow in the region between the rigid wiring member **710** and the rigid wiring member **730** positioned facing each other. As a result, the drive circuit substrate **700** is cooled from both surfaces of the drive circuit substrate **700** by both the heat dissipation effect due to the air flow generated by the cooling fan **59** and the heat release effect due to the heat sinks **170** and **180**, the cooling efficiency, which is the heat release efficiency of the drive circuit substrate **700**, is improved, and the operational stability of various circuits provided on the drive circuit substrate **700** is further improved. As a result, the signal accuracy of the output signal output by the drive circuit substrate **700** is improved, and the discharge accuracy of ink from the print head **30** that discharges an ink based on the output signals of various circuits provided on the drive circuit substrate **700** is also improved.

At this time, the heat conductive member **185** having insulation performance is positioned between the heat sink **180** and the surface **724** of the rigid wiring member **710**, and the heat conductive member **175** having insulation performance is positioned between the heat sink **170** and the surface **744** of the rigid wiring member **730**. The heat conductive member **185** is in contact with both the surface **724** and the heat sink **180**, and the heat conductive member **175** is in contact with both the surface **744** and the heat sink **170**. As a result, the adhesion and insulation performance between the heat sink **170** and the rigid wiring member **730** are improved, and the adhesion and insulation performance between the heat sink **180** and the rigid wiring member **710** are improved. As a result, the heat release performance by the heat sinks **170** and **180** is further improved, the heat release efficiency of the drive circuit substrate **700**, which is the cooling efficiency, is further improved, the insulation performance between the heat sinks **170** and **180** and the drive circuit substrate **700** is improved, and the operational stability of various circuits provided on the drive circuit substrate **700** is further improved.

Further, in the drive circuit substrate **700** in the present embodiment, the rigid wiring member **770** of the drive circuit substrate **700** is positioned such that the normal direction of the surface **783** of the rigid member **781** included in the rigid wiring member **770** intersects both the normal direction of the surface **723** of the rigid member **721** included in the rigid wiring member **710**, and the normal direction of the surface **743** of the rigid member **741** included in the rigid wiring member **730**, to configure a part of the gas flow path of the gas generated by the cooling fan **59**. At this time, the cooling fan **59** generates an air flow toward the rigid wiring member **770**. As a result, the cooling fan **59** can also cool the electronic components that configure the circuit provided on the rigid wiring member **770**. Thereby, the operational stability of various circuits provided on the drive circuit substrate **700** is further improved.

Further, in the drive circuit module **50** configured as described above, the driving signal output circuits **52***a*-**1**, **52***a*-**2**, **52***b*-**1**, and **52***b*-**2** that output the driving signals COMA**1**, COMA**2**, COMB**1**, and COMB**2** are provided on the surface **723** of the rigid wiring member **710**, and the driving signal output circuits **52***a*-**3**, **52***a*-**4**, **52***b*-**3**, and **52***b*-**4** that output the driving signals COMA**3**, COMA**4**, COMB**3**, and COMB**4** are provided on the surface **743** of the rigid wiring member **730**. The driving signal output circuits **52***a*-**1** to **52***a*-**4** and **52***b*-**1** to **52***b*-**4** supply the driving signals COMA**1** to COMA**4** and COMB**1** to COMB**4** based on the voltage signal VHV to each of the plurality of discharge sections **600**, and thus a large amount of heat is generated. Even when the drive circuit substrate **700** is provided with the driving signal output circuits **52***a*-**1** to **52***a*-**4** and **52***b*-**1** to **52***b*-**4** having such a large amount of heat generation, the drive circuit substrate **700** of the present embodiment is cooled by both the heat dissipation effect by an air flow generated by the cooling fan **59** and the heat release effect by the heat sinks **170** and **180**, and accordingly, the operational stability of the driving signal output circuits **52***a*-**1** to **52***a*-**4** and **52***b*-**1** to **52***b*-**4** is further improved.

Further, the drive circuit substrate **700** is provided with the capacitors C7*a* and C7*b* which are electrolytic capacitors. In the capacitors C7*a* and C7*b*, the drive circuit substrate **700** is provided such that the shortest distance between the capacitors C7*a* and C7*b* and the cooling fan **59** is shorter than the shortest distance between the transistors M**1** and M**2** included in the driving signal output circuit **52** and the cooling fan **59**. The component heights of the capacitors C7*a* and C7*b*, which are electrolytic capacitors, are larger than those of the surface mount-type transistors M**1** and M**2**. Therefore, the cooling is performed via the drive circuit substrate **700**, and the cooling effect is small due to the heat release by the heat sinks **170** and **180**. By arranging the capacitors C7*a* and C7*b* close to the cooling fan **59**, the capacitors C7*a* and C7*b* can be cooled. As a result, the operational stability of various circuits provided on the drive circuit substrate **700** is further improved.

Further, the drive circuit module **50** has a plate-shaped opening plate **160** having the opening **161** and the opening **162** through which the air flow generated by the cooling fan **59** passes. When viewed along the normal direction of the opening plate **160**, the opening plate **160** is positioned such that the opening **161** overlaps with at least a part of the inductor L**1** of the driving signal output circuit **52***a*-**1**, and the opening **162** overlaps with at least a part of the inductor L**1** of the driving signal output circuit **52***a*-**1**. When the air flow generated by the cooling fan **59** passes through the openings **161** and **162**, the flow speed of the air flow increases. By providing the inductor L**1** included in the driving signal output circuit **52** having a large component height in a region where the flow speed of the air flow generated by the cooling fan **59** increases, the cooling efficiency of the inductor L**1** can be improved, and the operational stability of various circuits provided on the drive circuit substrate **700** is improved. As a result, the signal accuracy of the output signal output by the drive circuit substrate **700** is improved, and the discharge accuracy of ink from the print head **30** that discharges an ink based on the output signals of various circuits provided on the drive circuit substrate **700** is also improved.

Further, since the flow speed of the air flow generated by the cooling fan **59** when passing through the openings **161** and **162** can be increased, a sufficient cooling capacity can be obtained even with the small cooling fan **59**. As a result, the concern that the discharge accuracy of the ink discharged from the print head **30** is lowered due to the vibration that may occur when the cooling fan **59** is driven is reduced.

Further, the drive circuit module **50** includes the relay substrate **150** in which the FFC cable **21** through which the voltage signals VHV and VMV propagate and the FFC cable **22** through which the clock signal SCK, the differential print data signal Dp, and the differential drive data signal Dd propagate are electrically coupled on the surface **151**, and the connector CN**2***a* electrically coupled to the drive circuit substrate **700** is provided on the surface **152** opposite to the surface **151**. That is, a signal propagated through the FFC cables **21** and **22** is input to the relay substrate **150** and output to the drive circuit substrate **700** via the connector CN**2***a*. As a result, the drive circuit substrate **700** can be attached to and detached from the liquid discharge apparatus **1** only by attaching and detaching the connectors CN**2***a* and CN**2***b*, and the work efficiency of the maintenance work, the replacement work, and the assembly work of the drive circuit substrate **700** can be improved.

Further, since the drive circuit substrate **700** can be attached to and detached from the liquid discharge apparatus **1** only by attaching and detaching the connectors CN**2***a* and CN**2***b*, the space to be secured for the attachment and detachment can be reduced. As a result, the liquid discharge modules **20** can be further densely arranged, and as a result, the size of the liquid discharge apparatus **1** can be further reduced.

Further, a cooling fan **59** is fixed to the relay substrate **150**. As a result, the drive circuit substrate **700** can be attached to and detached from the liquid discharge apparatus **1**, and the cooling fan **59** can be attached and detached. As a result, it is not necessary to provide the drive circuit substrate **700** with wiring that propagates the fan driving signal Fp for driving the cooling fan **59**, and the size of the drive circuit substrate **700** can be reduced.

Further, the drive circuit module **50** includes the temperature detection circuit **56** that detects the environmental temperature of the drive circuit module **50** and the internal space temperature of the drive circuit module **50**, and the control unit **2** and the head control circuit **12** control the operations of the drive circuit module **50** and the print head **30** based on the environmental temperature detected by the temperature detection circuit **56**. That is, in the liquid discharge apparatus **1** of the present embodiment, the temperatures of various circuits included in the drive circuit module **50** are not detected individually, but the internal space temperature of the drive circuit module **50** that changes according to the operating state of the drive circuit module **50** is detected by the temperature detection circuit **56** as the environmental temperature. The control unit **2** and the head control circuit **12** control the operations of the drive circuit module **50** and the print head **30** based on the environmental temperature detected by the temperature detection circuit **56**. As a result, it is not necessary to individually provide a temperature detector such as a sensor element for each electronic component or the like included in the drive circuit module **50**, and the size of the drive circuit module **50** can be reduced. As a result, the liquid discharge modules **20** can be further densely arranged, and the size of the liquid discharge apparatus **1** can be further reduced.

The temperature detection circuit **56** is provided on the rigid wiring member **750** positioned between the rigid wiring member **710** provided with the driving signal output circuits **52***a*-**1**, **52***a*-**2**, **52***b*-**1**, and **52***b*-**2**, and the rigid wiring member **730** provided in the driving signal output circuit **52***a*-**3**, **52***a*-**4**, **52***b*-**3**, and **52***b*-**4** in the drive circuit substrate **700**. As a result, the concern that the contribution of the temperature change that can occur in the driving signal output circuits **52***a*-**1** to **52***a*-**4** and **52***b*-**1** to **52***b*-**4**, which generate a large amount of heat, with respect to the environmental temperature detected by the temperature detection circuit **56** becomes extremely high is reduced. That is, the detection accuracy of the environmental temperature detected by the temperature detection circuit **56** is improved. Therefore, the accuracy of operation control of the control unit **2**, the drive circuit module **50** by the head control circuit **12**, and the print head **30**, based on the environmental temperature detected by the temperature detection circuit **56**, is improved, and the discharge accuracy of the ink discharged from the print head **30** is improved.

Further, in the drive circuit substrate **700**, the driving signal output circuit **52***a*-**1** and the driving signal output circuit **52***b*-**1** provided on the rigid wiring member **710** each have the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1**, and the driving signal output circuit **52***a*-**1** and the driving signal output circuit **52***b*-**1** are positioned overlapping with each other at least partially along the direction from the side **713** to the side **714**. At this time, the integrated circuit **500** included in the driving signal output circuit **52***a*-**1** and the integrated circuit **500** included in the driving signal output circuit **52***b*-**1** are arranged not overlapping with each other along the direction from the side **713** to the side **714**. As a result, the concern that a local high temperature part is generated in the drive circuit substrate **700** due to the concentration of the heat generated in the driving signal output circuit **52***a*-**1** and the heat generated in the driving signal output circuit **52***b*-**1** is reduced.

Further, in the drive circuit substrate **700** according to the present embodiment, the driving signal output circuit **52***b***-4** provided on the rigid wiring member **730** includes the integrated circuit **500**, the transistors M**1** and M**2**, and the inductor L**1**. The driving signal output circuit **52***a***-1** and the driving signal output circuit **52***b***-4** are positioned overlapping with each other at least partially along the x**2** axis. The integrated circuit **500** included in the driving signal output circuit **52***a***-1** and the integrated circuit **500** included in the driving signal output circuit **52***b***-4** are arranged not overlapping with each other along the x**2** axis. As a result, even in the drive circuit substrate **700** in the assembled state, the concern that a local high temperature part is generated in the drive circuit substrate **700** due to the concentration of the heat generated in the driving signal output circuit **52***a***-1** and the heat generated in the driving signal output circuit **52***b***-4** is reduced.

That is, in the liquid discharge apparatus **1** of the present embodiment, the driving signal output circuits **52***a***-1** to **52***a***-4** and **52***b***-1** to **52***b***-4** having a large heat generation amount are arranged in a staggered manner. As a result, in the drive circuit substrate **700**, the concern that local heat concentration occurs is reduced, and as a result, the waveform accuracy of the driving signals COMA**1** to COMA**4** and COMB**1** to COMB**4** output by the drive circuit substrate **700** to the print head **30** is improved, and the discharge accuracy of the ink discharged from the print head **30** is improved. In this case, the transistors M**1** and M**2** included in the driving signal output circuit **52***a***-1** and the transistors M**1** and M**2** included in the driving signal output circuit **52***b***-1** are arranged not overlapping with each other along the direction from the side **713** to the side **714**, the transistors M**1** and M**2** included in the driving signal output circuit **52***a***-1** and the transistors M**1** and M**2** included in the driving signal output circuit **52***b***-4** are arranged not overlapping with each other along the x**2** axis, and accordingly, the heat concentration in the drive circuit substrate **700** can be further reduced. In addition, the inductor L**1** included in the driving signal output circuit **52***a***-1** and the inductor L**1** included in the driving signal output circuit **52***b***-1** are arranged not overlapping with each other along the direction from the side **713** to the side **714**, the inductor L**1** included in the driving signal output circuit **52***a***-1** and the inductor L**1** included in the driving signal output circuit **52***b***-4** are arranged not overlapping with each other along the x**2** axis, and accordingly, the heat concentration in the drive circuit substrate **700** can be further reduced.

Further, a capacitor C**53**, which is an electrolytic capacitor for stabilizing the voltage value of the reference voltage signal VBS, is provided on the surface **783** of the rigid wiring member **770** of the drive circuit substrate **700**, and the connector CN**1***a* electrically coupled to the print head **30** is provided on the surface **784** of the rigid wiring member **770** of the drive circuit substrate **700**. That is, the voltage value of the reference voltage signal VBS is stabilized in the rigid wiring member **770** provided with the connector CN**1***a* electrically coupled to the print head **30**. As a result, the stability of the voltage value of the reference voltage signal VBS supplied to the print head **30** is improved, the displacement accuracy of the piezoelectric element **60** included in the print head **30** is improved, and the discharge accuracy of the ink discharged by the displacement of the piezoelectric element **60** is improved.

Further, the reference voltage signal VBS supplied to the electrode **612** of the piezoelectric element **60** is commonly supplied to the piezoelectric element **60** to which the driving signal VOUT based on the driving signals COMA**1** and COMB**1** is supplied, the piezoelectric element **60** to which the driving signal VOUT based on the driving signals COMA**2** and COMB**2** is supplied, the piezoelectric element **60** to which the driving signal VOUT based on the driving signals COMA**3** and COMB**3** is supplied, and the piezoelectric element **60** to which the driving signal VOUT based on the driving signals COMA**4** and COMB**4** is supplied. The reference voltage signal VBS is supplied from one reference voltage signal output circuit **530**. As a result, even the piezoelectric element **60** to which the driving signal VOUT based on the different driving signal COM is supplied can be driven based on the common reference potential, the displacement accuracy of the piezoelectric element **60** included in the print head **30** can be improved, and the discharge accuracy of the ink discharged by the displacement of the piezoelectric element **60** is improved.

Further, the drive circuit module **50** includes the abnormality notification circuits **55***a* and **55***b*. The abnormality notification circuits **55***a* and **55***b* are provided on the surfaces **744** of the rigid wiring member **730** of the drive circuit substrate **700**, which is the surface **744** of the rigid member **742** included in the rigid wiring member **730**. That is, the abnormality notification circuit **55** is provided on the outer surface of the drive circuit substrate **700** in the assembled state, which is configured in a substantially box shape. As a result, the user can visually confirm the abnormality of the liquid discharge module **20**, and the reliability of the liquid discharge module **20** and the liquid discharge apparatus **1** is improved.

At this time, as described above, the heat sink **170** is positioned on the surface **744** of the rigid wiring member **730** of the drive circuit substrate **700**, which is the surface **744** of the rigid member **742** included in the rigid wiring member **730**. On the surface **744** of the rigid wiring member **730** of the drive circuit substrate **700**, which is the surface **744** of the rigid member **742** included in the rigid wiring member **730**, along the direction from the rigid member **742** to the rigid member **741**, the abnormality notification circuits **55***a* and **55***b* are positioned not overlapping with the driving signal output circuit **52**, and the heat sink **170** is positioned overlapping with the driving signal output circuit **52**. Accordingly, the visibility of the abnormality notification circuits **55***a* and **55***b* is not impaired, and the heat generated in the driving signal output circuit **52** can be released. As a result, the accuracy of the signal output by the drive circuit substrate **700** can be improved, and the reliability of the liquid discharge module **20** and the liquid discharge apparatus **1** can be improved.

Further, the heat sink **170** has the opening **172**, and the abnormality notification circuits **55***a* and **55***b* are positioned overlapping with the opening **172** along the direction from the rigid member **742** to the rigid member **741**. Accordingly, the visibility of the abnormality notification circuits **55***a* and **55***b* is not impaired, and the heat generated in the driving signal output circuit **52** can be efficiently released. As a result, the accuracy of the signal output by the drive circuit substrate **700** can be improved, and the reliability of the liquid discharge module **20** and the liquid discharge apparatus **1** can be improved.

4. Modification Example

Next, the liquid discharge apparatus **1** of the modification example will be described. FIG. **31** is a diagram illustrating a schematic configuration of the liquid discharge apparatus **1** of a modification example. In the liquid discharge apparatus **1** described above, it is described that the drive circuit module **50** included in the liquid discharge module **20** has the cooling fan **59**, and the cooling fan **59** generates an air flow in the gas flow path configured with the rigid wiring members **710**, **730**, **750**, and **770** of the drive circuit substrate **700** to cool the drive circuit substrate **700**. However, in the liquid discharge apparatus **1** of the modification example, a compressor CP is provided in place of or in addition to the cooling fan **59**, the air flow generated by driving the compressor CP is supplied to the gas flow path configured with the rigid wiring members **710**, **730**, **750**, and **770** of the drive circuit substrate **700** to cool the drive circuit substrate **700**.

That is, the liquid discharge apparatus **1** of the modification example includes the print head **30** that discharges an ink as an example of a liquid, the drive circuit module **50** that is electrically coupled to the print head **30**, the compressor CP that sends out the compressed air AR, and a tube TB that couples the drive circuit module **50** and the compressor CP, and the compressor CP supplies the compressed air AR via the tube TB to a region where the surface **723** of the rigid member **721**, which is the surface **723** of the rigid wiring member **710** included in the drive circuit substrate **700**, and the surface **743** of the rigid member **741**, which is the surface **743** of the rigid wiring member **730**, face each other.

As illustrated in FIG. **31**, the compressor CP is provided separately from the head unit **3**. At this time, the compressor CP is provided in a space outside the printing region where the head unit **3** discharges the ink to the medium P to form an image, and preferably in a space isolated from the printing region. When the compressor CP is driven, the air in the space is suctioned, compressed, and then output as the compressed air AR. The compressed air AR output by the compressor CP is supplied to the liquid discharge module **20** via the tube TB.

FIG. **32** is an exploded perspective view illustrating an example of a structure of the liquid discharge module **20** of a modification example. As illustrated in FIG. **32**, the tube TB is coupled to the through-hole **159** penetrating the surface **151** and the surface **152** formed on the relay substrate **150**. As a result, the compressed air AR is supplied to the liquid discharge module **20**. The compressed air AR is supplied via the through-hole **159** of the relay substrate **150** to the region where the surface **723** of the rigid member **721**, which is the surface **723** of the rigid wiring member **710** of the drive circuit substrate **700** included in the drive circuit module **50**, and the surface **743** of the rigid member **741**, which is the surface **743** of the rigid wiring member **730**, face each other. Even in the liquid discharge apparatus **1** of the modification example configured as described above, the same operational effects as those of the above-described embodiment can be obtained.

Further, in the liquid discharge apparatus **1** of the modification example, as described above, the compressor CP is provided in a space isolated from the printing region. As a result, the compressed air AR output by the compressor CP is not mixed with ink mist which is a part of the ink discharged to the medium P by the print head **30**, and dust such as paper dust and feathers which may be generated by transporting the medium P. Therefore, the concern that the ink mist and the dust adhere to various electronic components provided on the drive circuit substrate **700** cooled by the compressed air AR is reduced. As a result, the operational stability of the drive circuit substrate **700** is further improved, and the discharge accuracy of the ink from the print head **30** that operates based on the output signal output by the drive circuit substrate **700** is further improved.

That is, in the liquid discharge apparatus **1** of the modification example, since the cloth is used as the medium P, in a case of the so-called textile printing ink jet printer having a high risk of dust floating in the printing region, from the viewpoint of further improving the operational stability of the drive circuit substrate **700** and further improving the discharge accuracy of the ink from the print head **30**, which operates based on the output signal output by the drive circuit substrate **700**, particularly large effect is achieved.

Further, in the above-described embodiment, it is described that the temperature detection circuit **56** that detects the environmental temperature of the drive circuit module **50**, generates the temperature information signal Tt including temperature information corresponding to the environmental temperature, and outputs the temperature information signal Tt to the head control circuit **12** is provided on the rigid wiring member **750**. However, the temperature detection circuit **56** may be provided in the region separated from the driving signal output circuits **52*a*-3**, **52*a*-4**, **52*b*-3**, and **52*b*-4** in the rigid wiring member **730**.

FIG. **33** is a diagram illustrating an example of component arrangement in the drive circuit substrate **700** in an expanded state of a modification example. As illustrated in FIG. **33**, in the drive circuit substrate **700** of the modification example, the temperature detection circuit **56** is a region separated from the driving signal output circuits **52*a*-3**, **52*a*-4**, **52*b*-3**, and **52*b*-4**. Specifically, the temperature detection circuit **56** is provided along the side **731** of the rigid wiring member **730**, and the driving signal output circuits **52*a*-3**, **52*a*-4**, **52*b*-3**, and **52*b*-4** are provided in the region along the side **732** positioned facing the side **731** in the rigid wiring member **730**. That is, in the rigid wiring member **730**, the temperature detection circuit **56** and each of the driving signal output circuits **52*a*-3**, **52*a*-4**, **52*b*-3**, and **52*b*-4** are respectively arranged such that the shortest distance between the temperature detection circuit **56** and the side **731** is shorter than the shortest distance between the temperature detection circuit **56** and the side **732**, and the shortest distance between the transistors M**1** and M**2** included in each of the driving signal output circuits **52*a*-3**, **52*a*-4**, **52*b*-3**, and **52*b*-4**, and the side **732** is shorter than the shortest distance between the transistors M**1** and M**2** included in each of the driving signal output circuits **52*a*-3**, **52*a*-4**, **52*b*-3**, and **52*b*-4**, and the side **731**.

Even when the temperature detection circuit **56** is arranged in such an arrangement, the temperature detection circuit **56** and the driving signal output circuits **52*a*-3**, **52*a*-4**, **52*b*-3**, and **52*b*-4** are positioned apart from each other. Therefore, the contribution of heat generated in the driving signal output circuits **52*a*-3**, **52*a*-4**, **52*b*-3**, and **52*b*-4** to the temperature detection circuit **56** is reduced, and the same operational effects as those of the above-described embodiments can be obtained.

The embodiments and the modification examples were described above, but the present disclosure is not limited to the embodiments, and can be implemented in various aspects without departing from the gist thereof. For example, the above-described embodiments can also be appropriately combined with each other.

The present disclosure includes substantially the same configurations (for example, configurations having the same functions, methods, and results, or configurations having the same objects and effects) as the configurations described in the embodiments. Further, the present disclosure includes configurations in which non-essential parts of the configuration described in the embodiments are replaced. In addition, the present disclosure includes configurations that achieve the same operational effects or configurations that can achieve the same objects as those of the configurations described in the embodiment. Further, the present disclosure includes configurations in which a known technology is added to the configurations described in the embodiments.

The following contents are derived from the above-described embodiments.

According to an aspect, there is provided a liquid discharge apparatus including: a print head that discharges a liquid; a substrate unit electrically coupled to the print head; a compressor that sends out compressed air; and a tube that couples the substrate unit and the compressor, in which the print head includes a first discharge section that has a first piezoelectric element that is displaced by receiving a first driving signal and discharges a liquid by displacement of the first piezoelectric element, a second discharge section that has a second piezoelectric element that is displaced by receiving a second driving signal and discharges a liquid by displacement of the second piezoelectric element, and a first connector electrically coupled to the substrate unit, the substrate unit includes a second connector that is electrically coupled to the print head by being fitted to the first connector, a first drive circuit that outputs the first driving signal, a second drive circuit that outputs the second driving signal, and a wiring substrate provided with the second connector, the first drive circuit, and the second drive circuit, the wiring substrate is a rigid flexible substrate including a plurality of rigid members provided with the second connector, the first drive circuit, and the second drive circuit, and a flexible member more flexible than the plurality of rigid members, the flexible member includes a first surface, a second surface opposite to the first surface, a first region, a second region, and a third region, the third region is positioned between the first region and the second region, the plurality of rigid members include a first rigid member and a second rigid member, the first rigid member includes a first front surface, and is laminated on the first surface of the first region such that the first front surface extends along the first surface, the second rigid member includes a second front surface, and is laminated on the first surface of the second region such that the second front surface extends along the first surface, the first drive circuit is provided on the first rigid member, the second drive circuit is provided on the second rigid member, the first rigid member and the second rigid member are positioned such that the first front surface and the second front surface face each other when the flexible member is bent in the third region, and the compressor supplies the compressed air via the tube to a region where the first front surface and the second front surface face each other.

According to this liquid discharge apparatus, the first drive circuit provided in the first rigid member including the first front surface and the second drive circuit provided in the second rigid member including the second front surface are efficiently cooled by the compressed air supplied by the compressor to the region where the first front surface and the second front surface face each other. Thereby, the operational stability of the first drive circuit and the second drive circuit is improved. At this time, the compressed air is supplied from the compressor via the tube. Therefore, the degree of freedom in arranging the compressor is increased, and by providing the compressor outside the region where the ink mist can float, the concern that the ink mist is mixed in the compressed air supplied to the region where the first front surface and the second front surface face each other is reduced. As a result, the concern that ink mist adheres to the first drive circuit and the second drive circuit is reduced, and the operational stability of the first drive circuit and the second drive circuit is improved. As a result, the waveform accuracy of the first driving signal and the second driving signal is improved, and the discharge accuracy of ink from the first discharge section and the second discharge section is also improved.

In the aspect of the liquid discharge apparatus, the plurality of rigid members may include a third rigid member and a fourth rigid member, the third rigid member may include a third front surface, and may be laminated on the second surface of the first region such that the third front surface extends along the second surface, the fourth rigid member may include a fourth front surface, and may be laminated on the second surface of the second region such that the fourth front surface extends along the second surface, and electronic components that configure the first drive circuit and the second drive circuit may not be provided on the third rigid member and the fourth rigid member.

According to this liquid discharge apparatus, the electronic components that configure the first drive circuit and the second drive circuit are not arranged on the third front surface opposite to the first front surface and the second front surface, and the fourth front surface of the wiring substrate forming the region through which the compressed air passes. Accordingly, the operational stability of the first drive circuit and the second drive circuit is further improved. As a result, the waveform accuracy of the first driving signal and the second driving signal is further improved, and the discharge accuracy of ink from the first discharge section and the second discharge section is further improved.

In the aspect of the liquid discharge apparatus, the liquid discharge apparatus may be a textile printing ink jet printer that discharges a liquid to a cloth.

According to this liquid discharge apparatus, even in a textile printing ink jet printer that uses a cloth as a medium, the compressor is provided outside the region where feathers from the cloth may float. Accordingly, the concern that the feathers are mixed in the compressed air supplied to the region where the first front surface and the second front surface face each other is reduced. As a result, the concern that feathers adhere to the first drive circuit and the second drive circuit is reduced, and the operational stability of the first drive circuit and the second drive circuit is improved. As a result, the waveform accuracy of the first driving signal and the second driving signal is improved, and the discharge accuracy of ink from the first discharge section and the second discharge section is also improved.

What is claimed is:

1. A liquid discharge apparatus comprising:

a print head that discharges a liquid;

a substrate unit electrically coupled to the print head;

a compressor that sends out compressed air; and

a tube that couples the substrate unit and the compressor, wherein

the print head includes

a first discharge section that has a first piezoelectric element that is displaced by receiving a first driving signal and discharges a liquid by displacement of the first piezoelectric element,

a second discharge section that has a second piezoelectric element that is displaced by receiving a second driving signal and discharges a liquid by displacement of the second piezoelectric element, and

a first connector electrically coupled to the substrate unit,

the substrate unit includes
a second connector that is electrically coupled to the print head by being fitted to the first connector,
a first drive circuit that outputs the first driving signal,
a second drive circuit that outputs the second driving signal, and
a wiring substrate provided with the second connector, the first drive circuit, and the second drive circuit,
the wiring substrate is a rigid flexible substrate including a plurality of rigid members provided with the second connector, the first drive circuit, and the second drive circuit, and a flexible member more flexible than the plurality of rigid members,
the flexible member includes a first surface, a second surface opposite to the first surface, a first region, a second region, and a third region,
the third region is positioned between the first region and the second region,
the plurality of rigid members include a first rigid member and a second rigid member,
the first rigid member includes a first front surface, and is laminated on the first surface of the first region such that the first front surface extends along the first surface,
the second rigid member includes a second front surface, and is laminated on the first surface of the second region such that the second front surface extends along the first surface,
the first drive circuit is provided on the first rigid member,
the second drive circuit is provided on the second rigid member,
the first rigid member and the second rigid member are positioned such that the first front surface and the second front surface face each other when the flexible member is bent in the third region, and
the compressor supplies the compressed air via the tube to a region where the first front surface and the second front surface face each other.

2. The liquid discharge apparatus according to claim **1**, wherein
the plurality of rigid members include a third rigid member and a fourth rigid member,
the third rigid member includes a third front surface, and is laminated on the second surface of the first region such that the third front surface extends along the second surface,
the fourth rigid member includes a fourth front surface, and is laminated on the second surface of the second region such that the fourth front surface extends along the second surface, and
electronic components that configure the first drive circuit and the second drive circuit are not provided on the third rigid member and the fourth rigid member.

3. The liquid discharge apparatus according to claim **1**, which is a textile printing ink jet printer that discharges a liquid to a cloth.

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