



(11) **EP 4 091 819 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
23.11.2022 Bulletin 2022/47

(51) International Patent Classification (IPC):
B41J 2/015 ^(2006.01) **B41J 2/01** ^(2006.01)
B41J 2/045 ^(2006.01)

(21) Application number: **20914016.9**

(52) Cooperative Patent Classification (CPC):
B41J 2/01; B41J 2/015; B41J 2/045

(22) Date of filing: **15.01.2020**

(86) International application number:
PCT/JP2020/001024

(87) International publication number:
WO 2021/144877 (22.07.2021 Gazette 2021/29)

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(72) Inventor: **LI, Xinze**
Tokyo 100-7015 (JP)

(74) Representative: **Gille Hrabal**
Partnerschaftsgesellschaft mbB
Patentanwlte
Brucknerstrae 20
40593 Dsseldorf (DE)

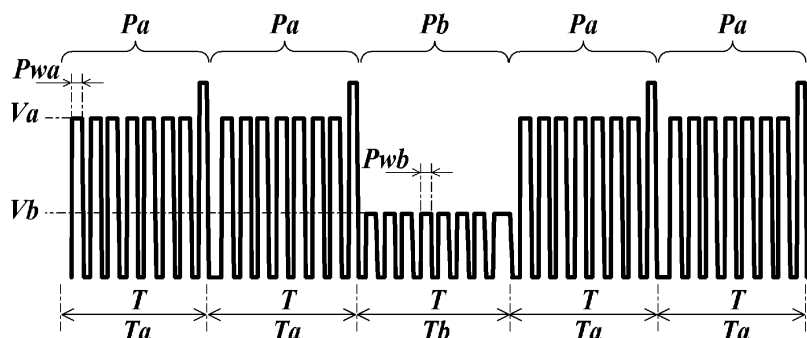
(71) Applicant: **KONICA MINOLTA, INC.**
Tokyo 100-7015 (JP)

(54) **INK-JET RECORDING DEVICE AND RECORDING OPERATION DRIVING METHOD**

(57) Provided is an ink-jet recording device in which a head driving unit for driving a recording operation of an ink-jet head is configured to be able to apply a discharge driving pulse P_a for causing an ink to be discharged from a nozzle, and a non-discharge driving pulse P_b for moving a meniscus formed in the nozzle without causing the ink to be discharged from the nozzle. Furthermore, the head driving unit carries out: during an ink discharge period for forming one dot during the recording operation, discharge driving in which the discharge driving pulse is

applied a number of times up to a number n of gradations with respect to one dot to be landed on a recording medium, wherein the dot diameter is changed according to the number of times; and, during an ink non-discharge period during the recording operation, non-discharge driving in which the non-discharge driving pulse is applied m times which is equal to or greater than the number n of gradations for a period equal to the ink discharge period for forming the one dot, to move the meniscus.

FIG. 4



EP 4 091 819 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to an ink-jet recording device and a recording operation driving method.

BACKGROUND ART

[0002] Conventional ink-jet devices are known that circulate ink through the ink-jet head and eject ink from the nozzle of the ink-jet head.

[0003] In general, the ink-jet recording device is equipped with the ink-jet head, which has a number of nozzles that eject tiny ink droplets.

[0004] Since these nozzles eject ink from a minute-diameter outlet, the state of the meniscus formed at the nozzle before ejection has a pronounced effect on the flying state of the droplets, i.e., on the image quality of the printed material. Improving the stability of droplets ejected from the ink-jet head nozzles is an important issue because it affects the image quality of printed materials.

[0005] On the other hand, it has been realized to generate multi-drive signals containing multiple drive pulses to eject relatively large droplets.

[0006] However, the state and position of the meniscus before ejection also changes during repeated ejection and non-ejection. Therefore, during ejection after the non-ejection period, ejection is more likely to be unstable due to non-ejection and flying bending of droplets.

[0007] The invention described in Patent Document 1 supplies, to the ink-jet head, a non-ejection drive voltage that moves the meniscus to the outside of the non-ejection nozzle in order to prevent ejection errors caused by foreign matter attached to the nozzle edges. The relationship between the diameter d_n of the non-ejection nozzle and the meniscus diameter d_m , which is moved to the outside of the non-ejection nozzle, is $1.1 \leq d_m/d_n \leq 1.4$.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0008] Patent Document 1: JP 2013-199021 A

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0009] However, the invention described in the Patent Document 1 to prevent ejection abnormalities caused by foreign matter adhesion, and the meniscus formed by the non-ejection drive voltage is static.

[0010] Even by forming a static meniscus during non-ejection as in the invention described in Patent Document 1, it is not possible to eliminate the instability that causes

non-ejection and flying bending of droplets during subsequent ejection.

[0011] The present invention has been made in consideration of the above problems in the conventional techniques, and an object of the present invention is to stably eject large droplets by the ink-jet recording device.

MEANS FOR SOLVING THE PROBLEM

[0012] According to an aspect of the present invention, an ink-jet recording device includes an ink-jet head that includes a pressure chamber connected to a nozzle and ejects ink in the pressure chamber from the nozzle; and a head driving unit that drives a recording operation by the ink-jet head, wherein the head driving unit is able to apply an ejection drive pulse that causes the ink to be ejected from the nozzle and a non-ejection drive pulse to an extent of causing meniscus formed in the nozzle to behave without causing the ink to be ejected from the nozzle, each of the ejection drive pulse and the non-ejection drive pulse being a drive pulse voltage that expands and contracts the pressure chamber, the head driving unit performs ejection driving of applying the ejection drive pulse a number of times with a gradation number n as an upper limit for one dot to be landed on a recording medium and changing a dot diameter according to the number of times during an ink ejection period for one-dot formation in the recording operation, and the head driving unit performs non-ejection driving of applying the non-ejection drive pulse m times and causing the meniscus to behave for a period equal to the ink ejection period for the one-dot formation, the m being a number equal to or more than the gradation number n , during an ink non-ejection period in the recording operation.

[0013] According to another aspect of the present invention, a recording operation driving method for driving a recording operation by an ink-jet head that includes a pressure chamber connected to a nozzle and ejects ink in the pressure chamber from the nozzle includes: using an ejection drive pulse that causes the ink to be ejected from the nozzle and a non-ejection drive pulse to an extent of causing meniscus formed in the nozzle to behave without causing the ink to be ejected from the nozzle, each of the ejection drive pulse and the non-ejection drive pulse being a drive pulse voltage that expands and contracts the pressure chamber, ejection driving that is applying the ejection drive pulse a number of times with a gradation number n as an upper limit for one dot to be landed on a recording medium and changing a dot diameter according to the number of times during an ink ejection period for one-dot formation in the recording operation, and non-ejection driving that is applying the non-ejection drive pulse m times and causing the meniscus to behave for a period equal to the ink ejection period for the one-dot formation, the m being a number equal to or more than the gradation number n , during an ink non-ejection period in the recording operation.

EFFECTS OF THE INVENTION

[0014] According to the present invention, it is possible to stably eject large droplets by the ink-jet recording device.

BRIEF DESCRIPTION OF DRAWINGS

[0015]

FIG. 1 is a block diagram showing the functional configuration of the ink-jet recording device according to an embodiment of the present invention.

FIG. 2 is a schematic diagram of the pressure chamber and nozzle viewed in the axial direction of the nozzle, showing changes in the pressure chamber in response to the drive pulse voltage.

FIG. 3 is a schematic diagram showing the operation of ink droplets ejected from nozzles.

FIG. 4 is a drive signal waveform diagram showing an example of drive pulse voltage for one embodiment of the invention.

FIG. 5 is a drive signal waveform diagram showing the drive pulse voltage for a comparative example.

FIG. 6 is a cross-sectional view of the nozzle and the meniscus in a statically stable state.

FIG. 7 is a cross-sectional view of the nozzle and the meniscus after continuous ejection.

EMBODIMENTS FOR CARRYING OUT THE INVENTION

[0016] Hereinafter, one embodiment of the invention is described below with reference to the drawings. The following is an embodiment of the invention and does not limit the invention.

[0017] The ink-jet recording device 1 includes the conveyance unit 10, the recording operation unit 20, the cleaning unit 30, the controller 40, the storage 50, the communication unit 70, the operation receiving unit 81, the display 82, the power supply unit 90, etc.

[0018] The conveyance unit 10 moves the recording media on which images are to be recorded to face the recording range by the recording operation unit 20. The conveyance unit 10 includes, for example, a conveyance motor 14 that draws out long recording media rolled up at a predetermined speed. The recording medium is, for example, woven fabric, but may be other materials such as paper.

[0019] The recording operation unit 20 records images by ejecting ink onto the recording media. The recording operation unit 20 includes: the ink-jet head 21 that includes multiple nozzles 27 which are arranged in a predetermined pattern to eject ink, and piezoelectric elements 26 which deform ink channels (pressure chambers) that supply ink to the nozzles 27 and provide pressure fluctuations to the ink; and the head driving unit 25 that outputs a drive pulse voltage that deforms each pi-

ezoelectric element 26.

[0020] Applying a drive pulse voltage P to the piezoelectric element 26 as shown in FIG. 2 deforms the side wall 29 of the pressure chamber 28 connected to the nozzle 27 and vibrates the meniscus 22 formed near the ejection opening of the nozzle 27 as shown in FIG. 3 to eject the ink droplet 23, separating it from the meniscus 22.

[0021] The cleaning unit 30 is equipped with a wiping member 32 that removes ink, its solidified matter, etc. adhering to the nozzle surface where nozzle 27 openings are arranged, and a driving unit 31 that operates said wiping member 32. The wiping member 32 is not limited to any particular material, but can be, for example, a non-woven fabric that absorbs ink or a resin member in a blade form that scrapes off solids.

[0022] The controller 40 is a processor that controls the overall operation of the ink-jet recording device 1. The controller 40 is equipped with, for example, a CPU 41 (Central Processing Unit) and RAM 42 (Random Access Memory), etc. The CPU 41 performs arithmetic operations and various control processes. The RAM 42 provides working memory space for CPU 41 and stores temporary data.

[0023] The storage 50 stores image data to be recorded and its processing data, as well as other setting data and programs. Image data may be stored, for example, in DRAM, which allows for temporary large-capacity storage and high-speed output. The setting data and programs are stored in non-volatile memory such as flash memory and/or HDD (Hard Disk Drive), which can be stored even when the power supply to the ink-jet recording device 1 is stopped.

[0024] The communication unit 70 controls data transmission and reception with external devices according to a predetermined communication standard (e.g., TCP/IP). The communication unit 70 may be connected to a LAN (Local Area Network) or the like and be able to connect to the external Internet via a router or the like, or it may connect directly to peripheral devices via a USB cable connected to the USB terminal.

[0025] The power supply unit 90 supplies power to the ink-jet recording device 1 from a power source.

[0026] Next, the driving of the recording operation is explained.

[0027] The head driving unit 25 applies, to the piezoelectric element 26, a drive pulse voltage P that expands and contracts the pressure chamber 28. Two types of drive pulse voltages P (Pa, Pb) shown in FIG. 4 are used. The head driving unit 25 can apply the ejection drive pulse Pa that causes ink to be ejected from the nozzle 27 and the non-ejection drive pulse Pb that causes the meniscus 22 formed at the nozzle 27 to behave without ejecting ink from the nozzle 27.

[0028] The voltage value of ejection drive pulse Pa is Va and the pulse width (time from the rise of the pulse to the start of its fall) is Pwa, and the voltage value of non-ejection drive pulse Pb is Vb and the pulse width is

Pwb.

[0029] The head driving unit 25 performs ejection driving of applying the ejection drive pulse the number of times with the gradation number n as the upper limit for one dot to be landed on the recording medium and changing the dot diameter according to the number of times, during the ink ejection period T_a (= cycle T) to form one dot in the recording operation.

[0030] In this embodiment, $n = 8$.

[0031] In the example shown in FIG. 4, eight pulses of ejection drive pulse P_a are applied in cycle T to form the largest dot diameter.

[0032] With the application of one ejection drive pulse P_a for each pulse, ink droplets are ejected and land on the recording medium as shown in FIG. 3.

[0033] By selecting the number of pulses of ejection drive pulses P_a , the number of droplets ejected is selected and the dot diameter is changed. The ink-jet recording device 1 uses the recording method of expressing gradation by this.

[0034] The head driving unit 25 performs non-ejection driving that is causing the meniscus 22 to behave by applying m times of non-ejection drive pulses P_b during the ink non-ejection period T_b (=cycle T) in the recording operation, m being equal to or more than the gradation number n . The non-ejection period T_b is equal to the ink ejection period T_a for one dot formation and corresponds to cycle T . In the embodiment, $n = m = 8$.

[0035] The voltage value V_b of the non-ejection drive pulse P_b is set lower than the voltage value V_a of the ejection drive pulse P_a . The pulse width P_{wb} of the non-ejection drive pulse P_b is set narrower than the pulse width P_{wa} of the ejection drive pulse P_a . This is to prevent ink ejection from occurring due to the application of the non-ejection drive pulse P_b . The meniscus 22 is set to behave to a degree large enough to be close to the time of ejection, with the condition that ink ejection does not occur when the non-ejection drive pulse P_b is applied. For this reason, the pulse width is preferably set to satisfy the condition of $0.6P_{wa} < P_{wb} \leq P_{wa}$. The voltage values preferably satisfy the condition of $0.3 < V_b/V_a < 0.5$.

[0036] The voltage value V_b or pulse width P_{wb} of the non-ejection drive pulse P_b may be equal to the ejection drive pulse P_a , and the other may be adjusted so that no ejection of ink occurs.

[0037] The ink ejection period T_a and ink non-ejection period T_b during the recording operation are for individual nozzles. The ink ejection period T_a or ink non-ejection period T_b is not fixed for the entire device, since when one nozzle is in ink ejection period T_a , another nozzle may be in ink non-ejection period T_b .

[0038] FIG. 5 shows the drive pulses of the comparative example.

[0039] This comparative example differs in that no pulse voltage is applied during the ink non-ejection period T_b , and, in the other respects, is the same as the drive pulses of the embodiment shown in FIG. 4.

[0040] In the static stable state before the drive pulse

is applied, the meniscus 22a is kept concave at approximately the ejection opening position of the nozzle 27, as shown in FIG. 6.

[0041] With continuous ejection, especially continuous ejection of large droplets ($n = 8$), the meniscus gradually recedes to the back of the nozzle 27. When the ink enters the ink non-ejection period T_b after continuous ejection, as shown in FIG. 7, the meniscus 22b is at the back of nozzle 27, and over time, the vibration dampens and the ink supply brings the position of the meniscus 22b closer to the ejection opening of the nozzle 27. However, if no pulse voltage is applied during the ink non-ejection period T_b , the position and vibration of the meniscus 22b is unstable and varies at the start of the ink ejection period T_a following the ink non-ejection period T_b . Furthermore, during continuous ejection, the meniscus becomes unstable due to the repetition of the FIG. 6 and FIG. 7 states. Thus, in the ink ejection period T_a after the ink non-ejection period T_b , ejection is more likely to be unstable due to non-ejection of droplets and flying bending of droplets, etc.

[0042] In the demonstration experiment of the comparative example in which driving was performed in a repetitive pattern of FIG. 5 with cycle $T = 175.4 \mu s$ and $P_{wa} = 1.2 AL$, when the droplet velocity reached 7.6 m/s, the occurrence of non-ejection of droplets was observed.

[0043] On the other hand, in the demonstration experiment of an example of the present invention in which driving was performed in a repetitive pattern of FIG. 4 with cycle $T = 175.4 \mu s$ and $P_{wa} = P_{wb} = 1.2 AL$, even when the droplet velocity reached 9.1 m/s, non-ejection of droplets did not occur, confirming stable ejection of ink.

[0044] In the example of the present invention, in the ink non-ejection period T_b , there is a constant vibration of the meniscus with a frequency and amplitude that approximates to the ink ejection period T_a and is dynamically stable with behavior similar to that of the ink ejection period T_a .

[0045] Therefore, the ink ejection period T_a following the ink non-ejection period T_b has a condition close to the ink ejection period T_a before the ink ejection period T_b , and the ink ejection is as stable as in the case of continuous ejection.

[0046] To achieve the above effect, $m \geq n$ is preferable. In particular, it is preferable to set $m = n$, as in the embodiment. The same number of meniscus vibration can occur in ink non-ejection period T_b as in ink ejection period T_a , and ink ejection is stable in the next ink ejection period T_a .

[0047] In order to effectively obtain the above effects, the following conditions are used.

[0048] The condition of $20 \mu m < d_n < 50 \mu m$ is satisfied when the ejection opening diameter of the nozzle 27 is d_n . More preferably, the condition of $30 \mu m < d_n < 50 \mu m$ is particularly satisfied.

[0049] Ink with a specific gravity greater than 1 is applied.

[0050] The condition of $1AL \leq P_{wa} \leq 1.4AL$ is satisfied.

More preferably, $1.2 AL \leq Pwa \leq 1.4 AL$ is satisfied. AL is one-half the natural vibration cycle of the pressure chamber 28.

[0051] As explained above, according to the embodiment, it is possible to stably eject large droplets by the ink-jet recording device.

INDUSTRIAL APPLICABILITY

[0052] The present invention is applicable to an ink-jet recording device.

EXPLANATION OF REFERENCE NUMERALS

[0053]

1 ink-jet recording device
20 recording operation unit
21 ink-jet head
22 meniscus
23 ink droplet
25 head driving unit
27 nozzle
28 pressure chamber
40 controller
P drive pulse voltage
T cycle

Claims

1. An ink-jet recording device comprising:

an ink-jet head that includes a pressure chamber connected to a nozzle and ejects ink in the pressure chamber from the nozzle; and
a head driving unit that drives a recording operation by the ink-jet head, wherein
the head driving unit is able to apply an ejection drive pulse that causes the ink to be ejected from the nozzle and a non-ejection drive pulse to an extent of causing meniscus formed in the nozzle to behave without causing the ink to be ejected from the nozzle, each of the ejection drive pulse and the non-ejection drive pulse being a drive pulse voltage that expands and contracts the pressure chamber,
the head driving unit performs ejection driving of applying the ejection drive pulse a number of times with a gradation number n as an upper limit for one dot to be landed on a recording medium and changing a dot diameter according to the number of times during an ink ejection period for one-dot formation in the recording operation, and
the head driving unit performs non-ejection driving of applying the non-ejection drive pulse m times and causing the meniscus to behave for

a period equal to the ink ejection period for the one-dot formation, the m being a number equal to or more than the gradation number n, during an ink non-ejection period in the recording operation.

2. The ink-jet recording device according to claim 1, wherein Pwa which is a pulse width of the ejection drive pulse and Pwb which is a pulse width of the non-ejection drive pulse satisfy $0.6Pwa < Pwb \leq Pwa$.

3. The ink-jet recording device according to claim 1 or 2, wherein Va which is a voltage value of the ejection drive pulse and Vb which is a voltage value of the non-ejection drive pulse satisfy $0.3 < Vb/Va < 0.5$.

4. The ink-jet recording device according to any one of claims 1 to 3, wherein $m = n$ is satisfied.

5. The ink-jet recording device according to any one of claims 1 to 4, wherein dn which is an ejection opening diameter of the nozzle satisfies $20 \mu m < dn < 50 \mu m$.

6. The ink-jet recording device according to any one of claims 1 to 4, wherein dn which is an ejection opening diameter of the nozzle satisfies $30 \mu m < dn < 50 \mu m$.

7. The ink-jet recording device according to any one of claims 1 to 6, wherein a specific gravity of the ink is larger than 1.

8. The ink-jet recording device according to any one of claims 1 to 7, wherein Pwa which is a pulse width of the ejection drive pulse and AL which is one-half a natural vibration cycle of the pressure chamber satisfy $1AL \leq Pwa \leq 1.4AL$.

9. The ink-jet recording device according to any one of claims 1 to 7, wherein Pwa which is a pulse width of the ejection drive pulse and AL which is one-half a natural vibration cycle of the pressure chamber satisfy $1.2 AL \leq Pwa \leq 1.4 AL$.

10. A recording operation driving method for driving a recording operation by an ink-jet head that includes a pressure chamber connected to a nozzle and ejects ink in the pressure chamber from the nozzle, the recording operation driving method comprising:

using an ejection drive pulse that causes the ink to be ejected from the nozzle and a non-ejection drive pulse to an extent of causing meniscus formed in the nozzle to behave without causing the ink to be ejected from the nozzle, each of the ejection drive pulse and the non-ejection drive pulse being a drive pulse voltage that expands and contracts the pressure chamber,

ejection driving that is applying the ejection drive pulse a number of times with a gradation number n as an upper limit for one dot to be landed on a recording medium and changing a dot diameter according to the number of times during an ink ejection period for one-dot formation in the recording operation, and
 non-ejection driving that is applying the non-ejection drive pulse m times and causing the meniscus to behave for a period equal to the ink ejection period for the one-dot formation, the m being a number equal to or more than the gradation number n , during an ink non-ejection period in the recording operation.

11. The recording operation driving method according to claim 10, wherein P_{wa} which is a pulse width of the ejection drive pulse and P_{wb} which is a pulse width of the non-ejection drive pulse satisfy $0.6P_{wa} < P_{wb} \leq P_{wa}$.
12. The recording operation driving method according to claim 10 or 11, wherein V_a which is a voltage value of the ejection drive pulse and V_b which is a voltage value of the non-ejection drive pulse satisfy $0.3 < V_b/V_a < 0.5$.
13. The recording operation driving method according to any one of claims 10 to 12, wherein $m = n$ is satisfied.
14. The recording operation driving method according to any one of claims 10 to 13, wherein d_n which is an ejection opening diameter of the nozzle satisfies $20 \mu\text{m} < d_n < 50 \mu\text{m}$.
15. The recording operation driving method according to any one of claims 10 to 13, wherein d_n which is an ejection opening diameter of the nozzle satisfies $30 \mu\text{m} < d_n < 50 \mu\text{m}$.
16. The recording operation driving method according to any one of claims 10 to 15, wherein a specific gravity of the ink is larger than 1.
17. The recording operation driving method according to any one of claims 10 to 16, wherein P_{wa} which is a pulse width of the ejection drive pulse and AL which is one-half a natural vibration cycle of the pressure chamber satisfy $1AL \leq P_{wa} \leq 1.4AL$.
18. The recording operation driving method according to any one of claims 10 to 16, wherein P_{wa} which is a pulse width of the ejection drive pulse and AL which is one-half a natural vibration cycle of the pressure chamber satisfy $1.2AL \leq P_{wa} \leq 1.4AL$.

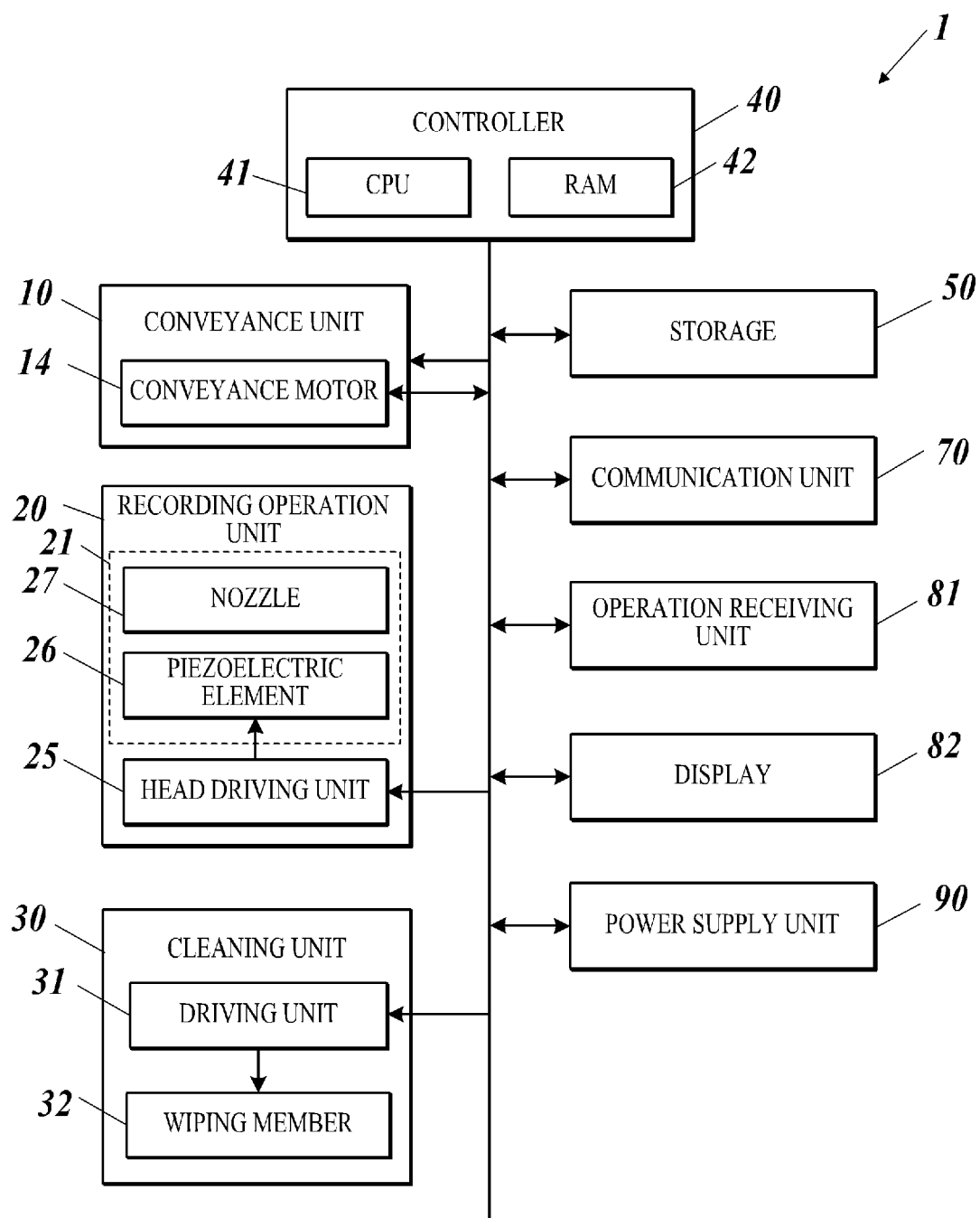
FIG. 1

FIG. 2

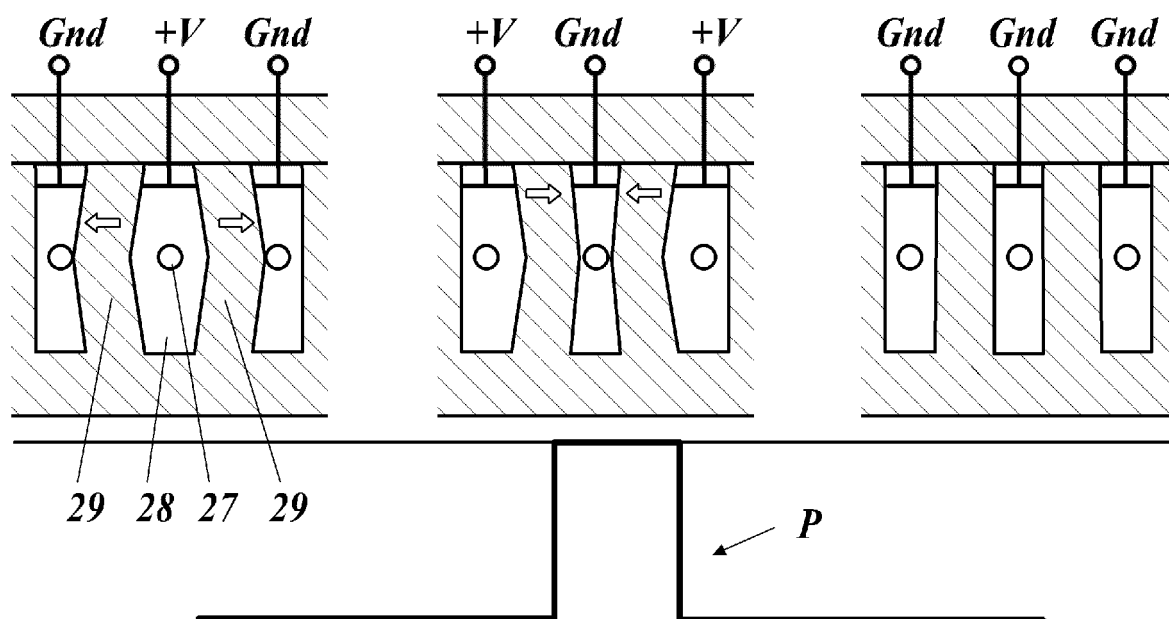


FIG. 3

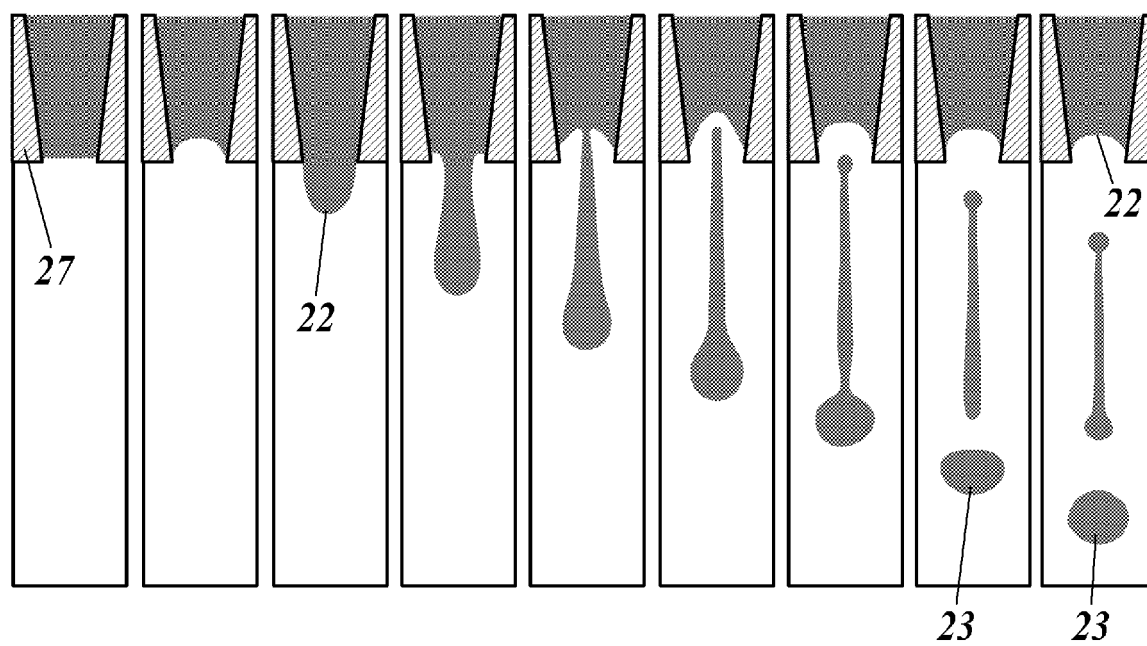


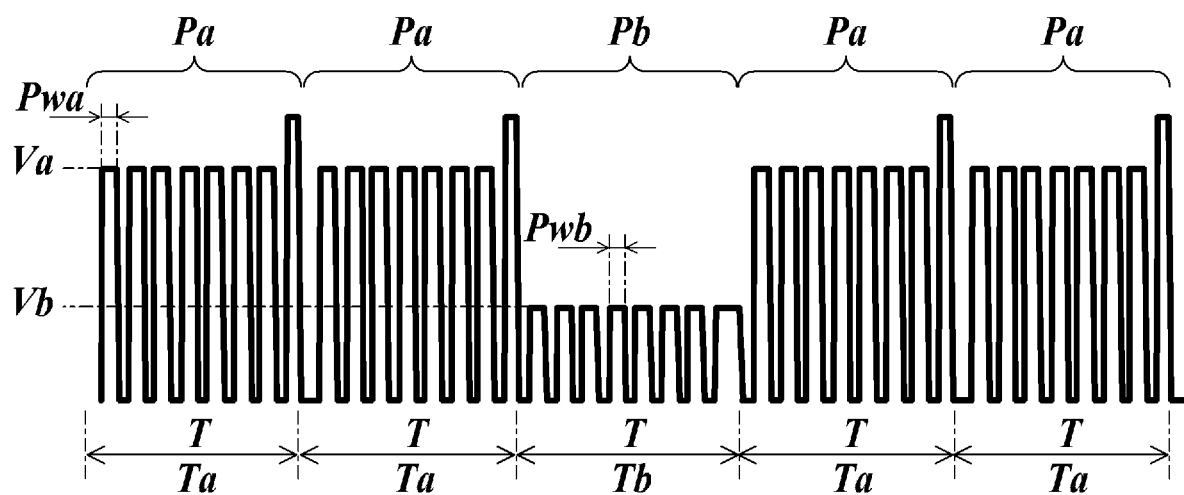
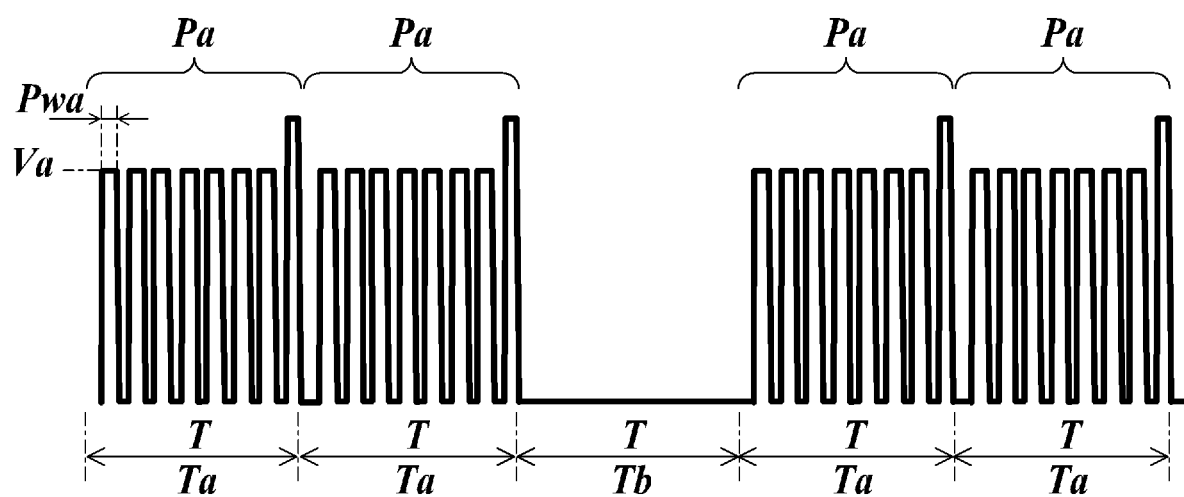
FIG. 4**FIG. 5**

FIG. 6

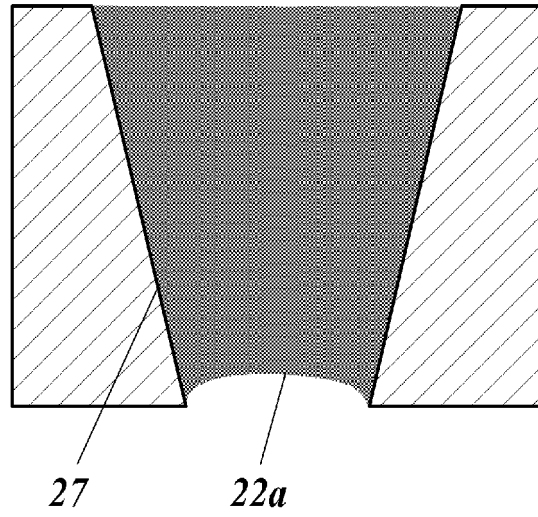
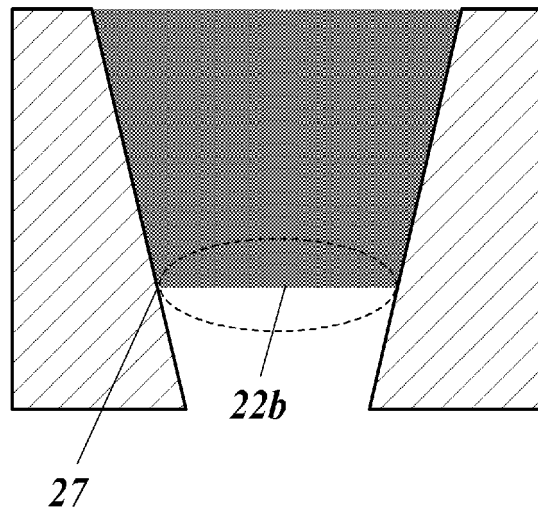


FIG. 7



5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2020/001024

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. B41J2/015(2006.01)i, B41J2/01(2006.01)i, B41J2/045(2006.01)i
 FI: B41J2/015 101, B41J2/01 401, B41J2/045, B41J2/01 403

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl. B41J2/015, B41J2/01, B41J2/045

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
 Published unexamined utility model applications of Japan 1971-2020
 Registered utility model specifications of Japan 1996-2020
 Published registered utility model applications of Japan 1994-2020

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2013-240947 A (KYOCERA DOCUMENT SOLUTIONS INC.) 05 December 2013, paragraphs [0048]-[0058], fig. 1-13	1-2, 7-11, 16-18 3, 5-6, 12, 14-15 4, 13
Y		
A		
X	JP 2015-085628 A (KYOCERA DOCUMENT SOLUTIONS INC.) 07 May 2015, paragraphs [0031]-[0043], fig. 1-12	1, 8-10, 17-18
X	JP 2014-144591 A (KYOCERA DOCUMENT SOLUTIONS INC.) 14 August 2014, paragraphs [0029]-[0038], fig. 1-11	1, 8-10, 17-18
Y	JP 2004-082718 A (CANON INC.) 18 March 2004, paragraphs [0027]-[0032], [0054]-[0057], fig. 1-6	3, 12

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
06.03.2020

Date of mailing of the international search report
24.03.2020

Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

5

10

15

20

25

30

35

40

45

50

55

INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2020/001024
--

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2000-117969 A (NEC CORP.) 25 April 2000, paragraphs [0038], [0058], fig. 1-14	5-6, 14-15
A	WO 2014/037929 A1 (HEWLETT-PACKARD INDUSTRIAL PRINTING LTD.) 13 March 2014, entire text, all drawings	1-18

5

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/001024

10

15

20

25

30

35

40

45

50

55

Patent Documents referred to in the Report	Publication Date	Patent Family	Publication Date
JP 2013-240947 A	05.12.2013	(Family: none)	
JP 2015-085628 A	07.05.2015	US 2015/0116401 A1	
		paragraphs [0042]-	
		[0054], fig. 1-12	
JP 2014-144591 A	14.08.2014	US 2014/0210885 A1	
		paragraphs [0052]-	
		[0072], fig. 1-11	
JP 2004-082718 A	18.03.2004	CN 10396341 A	
		US 2004/0001123 A1	
		paragraphs [0041]-	
		[0046], [0068]-	
		[0070], fig. 1-6	
JP 2000-117969 A	25.04.2000	US 6799821 B1	
		column 10, lines 54-	
		67, column 16, lines	
		58-64, fig. 1-14	
		WO 2000/023278 A1	
		EP 1123806 A1	
		CN 1323260 A	
WO 2014/037929 A1	13.03.2014	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2013199021 A [0008]