(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 351 392 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
25.07.2018 Bulletin 2018/30

(51) Int Cl.:
B41J 2/175 *(2006.01)*

(21) Application number: **17206960.1**

(22) Date of filing: **13.12.2017**

(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:
MA MD TN

(30) Priority: **23.01.2017 JP 2017009191**

(71) Applicant: **SCREEN Holdings Co., Ltd.**
Kyoto 602-8585 (JP)

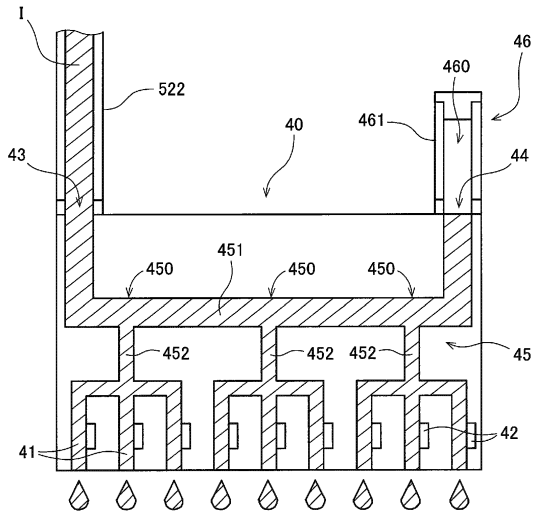
(72) Inventors:
- **FUKUI, Tamio**
  Kyoto-shi, Kyoto 602-8585 (JP)
- **AOIKE, Masaaki**
  Kyoto-shi, Kyoto 602-8585 (JP)
- **NAGASE, Yuichi**
  Kyoto-shi, 602-8585 (JP)

(74) Representative: **Goddar, Heinz J.**
Boehmert & Boehmert
Anwaltspartnerschaft mbB
Pettenkoferstrasse 22
80336 München (DE)

(54) INKJET PRINTER

(57) An inkjet printer includes at least one head for ejecting ink in the form of droplets, the ink being supplied from an ink tank. The head includes: a plurality of nozzles; an interior flow passage for supplying the ink to the nozzles; and a pressure adjustment part. The pressure adjustment part is connected to the interior flow passage. The pressure adjustment part has a damper space filled with a fixed amount of gas. The gas in the damper space is in contact with the ink filling the interior flow passage. When a negative pressure is developed in the nozzles by the ejection of the ink, the gas in the pressure adjustment part expands, so that the negative pressure in the nozzles is rapidly relieved. This prevents outside air from entering the nozzles.

Fig. 5



EP 3 351 392 A1

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an inkjet printer including a head for ejecting ink in the form of droplets.

Description of the Background Art

[0002] An inkjet printer which ejects ink from a plurality of heads toward elongated strip-shaped printing paper while transporting the printing paper has heretofore been known. In the inkjet printer of this type, the ink stored in an ink tank is supplied through pipes to the heads. The ink supplied to the heads is ejected in the form of ink droplets from a multiplicity of nozzles provided in the lower surface of each of the heads. A conventional inkjet printer is disclosed, for example, in Japanese Patent Application Laid-Open No. 2015-174378.

[0003] In the conventional inkjet printer, the pressure in the ink tank is maintained constant. Thus, an ink surface in each of the nozzles is controlled to form a meniscus. However, once ink droplets are ejected from the nozzles, the amounts of ink in the nozzles are decreased momentarily. For this reason, a slightly negative pressure is developed in the nozzles immediately after the ink droplets are ejected from the nozzles. This negative pressure is gradually returned to normal by the ink supplied from the ink tank.

[0004] However, there is a distance between the ink tank and the nozzles in accordance with the length of the pipes. Accordingly, it takes a certain amount of time between the instant at which the negative pressure is developed in the nozzles and the instant at which the negative pressure is returned to normal by supplying the ink from the ink tank.

[0005] In particular, there has been a need for high-speed and high-quality printing on printing paper in recent years. It is hence necessary to eject a multiplicity of ink droplets in succession from the nozzles of the heads in a short time. If ink droplets are ejected before the negative pressure developed in the nozzles by the ejection of previous ink droplets is returned to normal, the negative pressure in the nozzles increases gradually. This causes outside air to enter the nozzles in some cases after the completion of the ejection of a series of ink droplets. The air entering the nozzles can cause ejection failures during the ejection of next ink droplets.

SUMMARY OF THE INVENTION

[0006] It is therefore an object of the present invention to provide a technique capable of rapidly relieving a negative pressure in nozzles when the negative pressure is developed in the nozzles by the ejection of ink.

[0007] The present invention is intended for an inkjet printer comprising at least one head for ejecting ink in the form of droplets, the ink being supplied from an ink tank. The head comprises: a plurality of nozzles for ejecting ink droplets; an interior flow passage for supplying the ink to the nozzles; and a pressure adjustment part connected to the interior flow passage, the pressure adjustment part having a damper space filled with a fixed amount of gas, the gas in the damper space being in contact with the ink filling the interior flow passage.

[0008] According to the present invention, when a negative pressure is developed in the nozzles by the ejection of the ink, the gas in the pressure adjustment part expands, so that the negative pressure in the nozzles is rapidly relieved. This prevents outside air from entering the nozzles.

[0009] These and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a diagram conceptually showing a configuration of an inkjet printer;
Fig. 2 is a bottom plan view of one head unit;
Fig. 3 is a block diagram showing connections between a controller and components;
Fig. 4 shows one head unit and a configuration of an ink supply mechanism for supplying ink to the head unit;
Fig. 5 is a sectional view of one head;
Fig. 6 shows the process of filling the head with ink;
Fig. 7 is a sectional view of the head according to a modification; and
Fig. 8 shows one head unit according to another modification and a configuration of the ink supply mechanism for supplying ink to the head unit.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] A preferred embodiment according to the present invention will now be described with reference to the drawings. A direction in which printing paper 9 is transported is referred to as a "transport direction" hereinafter.

<1. Configuration of Inkjet Printer>

[0012] Fig. 1 is a diagram conceptually showing a configuration of an inkjet printer 1 according to one preferred embodiment of the present invention. This inkjet printer 1 is an apparatus which records a multi-color image on the printing paper 9 that is an elongated strip-shaped recording medium by ejecting inks from a plurality of head units 20 toward the printing paper 9 while transporting

the printing paper 9. As shown in Fig. 1, the inkjet printer 1 includes a transport mechanism 10, four head units 20, and a controller 30.

[0013] The transport mechanism 10 is a mechanism for transporting the printing paper 9 in the transport direction along the length of the printing paper 9. The transport mechanism 10 according to the present preferred embodiment includes an unwinding roller 11, a plurality of transport rollers 12, and a winding roller 13. The printing paper 9 is unwound from the unwinding roller 11, and is transported along a transport path formed by the transport rollers 12. Each of the transport rollers 12 rotates about a horizontal axis to guide the printing paper 9 downstream along the transport path. The transported printing paper 9 is wound and collected on the winding roller 13.

[0014] At least one of the unwinding roller 11, the transport rollers 12 and the winding roller 13 is driven by the driving force of a motor to rotate actively. The remainder of the unwinding roller 11, the transport rollers 12 and the winding roller 13 are driven to rotate as the printing paper 9 is transported. Tension in the transport direction is applied to the printing paper 9 on the transport path by a difference in rotation speed between the rollers. This suppresses slack and wrinkles in the printing paper 9 during the transport of the printing paper 9.

[0015] Part of the transport mechanism 10 may be a separate device independent of the remaining parts. For example, only part of the transport mechanism 10 which includes the winding roller 13 may be a separate device independent of the remaining parts of the transport mechanism 10.

[0016] The four head units 20 are mechanisms for ejecting inks toward the printing paper 9 transported by the transport mechanism 10. This inkjet printer 1 is what is called a one-pass type printer which records an image on the printing paper 9 by ejecting ink droplets from the head units 20 while the printing paper 9 passes under the four head units 20 only once. As shown in Fig. 1, the printing paper 9 is moved substantially horizontally under the four head units 20 in a direction in which the head units 20 are arranged. During this movement, a recording surface of the printing paper 9 faces upwardly (toward the head units 20). The four head units 20 eject ink droplets of respective colors, i.e. black (K), cyan (C), magenta (M) and yellow (Y), which are color components of a multi-color image toward the recording surface of the printing paper 9.

[0017] The four head units 20 are different from each other in color of ink for ejection, but are similar to each other in structure. Fig. 2 is a bottom plan view of one of the head units 20. As shown in Fig. 2, the one head unit 20 according to the present preferred embodiment includes a housing 21, and three heads 40 fixed to the housing 21. Each of the three heads 40 has an exposed ejection surface at the lower surface of the housing 21. As shown in Fig. 2, the three heads 40 are arranged in a width direction (a horizontal direction perpendicular to the transport direction) of the printing paper 9. The middle one of the heads 40 as seen in the width direction is positioned downstream as seen in the transport direction from the remaining two heads 40 disposed on the opposite ends as seen in the width direction.

[0018] As shown on an enlarged scale in Fig. 2, the lower surface of each of the heads 40 has a plurality of nozzles 41 arranged in a regular alignment. The nozzles 41 are displaced in relation to each other in the width direction, and each of the nozzles 41 is assigned to a region having a width of one pixel on the printing paper 9. At the time of printing, ink droplets are ejected from the nozzles 41 of the heads 40 toward the recording surface of the printing paper 9. As a result, the four head units 20 record respective single-color images on the recording surface of the printing paper 9. A multi-color image is formed on the recording surface of the printing paper 9 by superimposing the four single-color images.

[0019] The number of heads 40 in each of the head units 20 may be one, two or not less than four. The number of head units 20 included in the inkjet printer 1 may be in the range of one to three or not less than five. For example, the inkjet printer 1 may further includes a head unit for ejecting ink of a spot color in addition to the four head units 20 for ejecting inks of black, cyan, magenta and yellow.

[0020] The controller 30 is a means for controlling the operations of the components in the inkjet printer 1. As conceptually shown in Fig. 1, the controller 30 is formed by a computer including a processor 31 such as a CPU, a memory 32 such as a RAM, and a storage part 33 such as a hard disk drive. A computer program P for executing a printing process is installed in the storage part 33.

[0021] Fig. 3 is a block diagram showing connections between the controller 30 and the components in the inkjet printer 1. As shown in Fig. 3, the controller 30 is connected to the transport mechanism 10 and the four head units 20 described above for communication therewith. The controller 30 temporarily reads the computer program P stored in the storage part 33 onto the memory 32. The processor 31 performs arithmetic processing based on the computer program P, so that the controller 30 controls the operations of the aforementioned components. Specifically, the controller 30 controls pressurizing mechanisms 42 to be described later in each of the heads 40 while controlling a motor connected to at least one of the rollers in the transport mechanism 10. Thus, the printing process in the inkjet printer 1 proceeds.

[0022] The inkjet printer 1 according to the present preferred embodiment is selectable between a low-speed printing mode and a high-speed printing mode. In the low-speed printing mode, the controller 30 executes the printing process while transporting the printing paper 9 at a low speed. In the high-speed printing mode, the controller 30 executes the printing process while transporting the printing paper 9 at a speed higher than that in the low-speed printing mode.

<2. Ink Supply Mechanism>

[0023] The inkjet printer 1 includes an ink supply mechanism 50 for each of the head units 20. Fig. 4 shows one of the head units 20 and a configuration of the ink supply mechanism 50 for supplying ink I to the one head unit 20.

[0024] As shown in Fig. 4, the ink supply mechanism 50 includes an ink tank 51, a supply pipe 52, and a meniscus adjustment part 53.

[0025] The ink tank 51 is a container for storing therein the ink I to be supplied to the head unit 20. The ink I is stored near the bottom of the interior space in the ink tank 51. The ink tank 51 is connected to an ink source not shown through an addition pipe 54. When the ink I in the ink tank 51 is reduced to a small amount, the ink I is added from the ink source through the addition pipe 54 into the ink tank 51. Gas (for example, air) is present in the space lying over the stored ink I in the interior space of the ink tank 51.

[0026] The supply pipe 52 is a pipe that connects the ink tank 51 and the three heads 40 mounted in the head unit 20. As shown in Fig. 4, the supply pipe 52 includes a main pipe 521 and three branch pipes 522. The main pipe 521 has an upstream end connected to the bottom of the ink tank 51. The three branch pipes 522 extend from three branch positions 520 provided on the main pipe 521 toward the heads 40, respectively. Each of the branch pipes 522 has a downstream end connected to a supply port 43 to be described later of a corresponding one of the heads 40.

[0027] The meniscus adjustment part 53 is a mechanism for adjusting a gas pressure in the ink tank 51. The meniscus adjustment part 53 may be formed by a gas pressure sensor and a suction pump, for example. The gas pressure in the space lying over the ink I in the ink tank 51 is adjusted to a pressure slightly lower than its surrounding ambient pressure by the meniscus adjustment part 53. This prevents the ink I from dripping down from the nozzles 41 of the heads 40. The surface of the ink I in each of the nozzles 41 forms a meniscus.

<3. Structure of Head>

[0028] Fig. 5 is a sectional view of one of the heads 40. As mentioned above, the multiplicity of nozzles 41 are provided in the lower surface of each of the heads 40. For purposes of avoiding complexity of illustration, only nine nozzles 41 are schematically shown in Fig. 5. The one head 40 as shown in Fig. 5 includes the pressurizing mechanisms 42 for the respective nozzles 41. For example, a piezoelectric element is used as each of the pressurizing mechanisms 42. The piezoelectric element is deformed in accordance with voltage supplied from the controller 30. This applies pressure to the ink I in a corresponding one of the nozzles 41, so that ink droplets are ejected from the corresponding one of the nozzles 41. The pressurizing mechanisms 42 may be mechanisms which thermally expand the ink by means of a heater.

[0029] The head 40 as shown in Fig. 5 includes the supply port 43, a drainage port 44, an interior flow passage 45, and a pressure adjustment part 46. The supply port 43 and the drainage port 44 are provided in spaced-apart positional relation in the upper surface of the head 40. The supply port 43 is provided, for example, near one widthwise edge of the upper surface of the head 40. The drainage port 44 is provided, for example, near the other widthwise edge of the upper surface of the head 40. The branch pipe 522 of the supply pipe 52 has a downstream end connected to the supply port 43.

[0030] The interior flow passage 45 is a flow passage of the ink I provided inside the head 40. As shown in Fig. 5, the interior flow passage 45 includes a main flow passage 451 and a plurality of branch flow passages 452. The main flow passage 451 extends from the supply port 43 to the drainage port 44. The branch flow passages 452 extend from respective branch positions 450 provided on the main flow passage 451 toward the nozzles 41. The ink I introduced from the supply port 43 passes through the main flow passage 451 and the branch flow passages 452, and is then supplied to the nozzles 41.

[0031] Fig. 6 shows the process of filling the head 40 with the ink I. For filling the unfilled head 40 with the ink I, a drainage pipe 441 is connected to the drainage port 44, as shown in Fig. 6. Then, the ink I stored in the ink tank 51 is introduced through the supply pipe 52 and the supply port 43 to the interior flow passage 45 by the pressure of a pump not shown. Gas and excess ink I present in the interior flow passage 45 are discharged through the drainage port 44 to the drainage pipe 441.

[0032] Referring again to Fig. 5, the pressure adjustment part 46 is a mechanism for adjusting the pressure in the nozzles 41 immediately after the ink ejection. As shown in Fig. 5, the pressure adjustment part 46 includes a damper pipe 461. After the aforementioned process of filling the heads 40 with the ink I is completed, the drainage pipe 441 is removed from the drainage port 44 of the head 40, and the damper pipe 461 is connected to the drainage port 44. Thus, the pressure adjustment part 46 is connected to the downstream end of the main flow passage 451. The damper pipe 461 is a cylindrical container with a lid. When the damper pipe 461 is connected to the drainage port 44, a damper space 460 that is an isolated enclosed space is formed in the damper pipe 461. The damper space 460 is filled with a fixed amount of gas.

[0033] The gas in the damper space 460 is in contact with the ink I that fills the main flow passage 451. For example, air is used as the gas in the damper space 460. Alternatively, an inert gas such as nitrogen gas may be used in place of air to fill the damper space 460. The use of the inert gas suppresses the deterioration of the ink I due to the gas in the damper space 460.

[0034] The ejection of ink droplets from the nozzles 41 decreases the amount of ink I filling the nozzles 41. Accordingly, the pressure in the nozzles 41 immediately

after the ejection of the ink I is a negative pressure lower than outside atmospheric pressure. In the structure according to the present preferred embodiment, the gas in the damper space 460 expands immediately after the negative pressure is developed. Thus, the negative pressure in the nozzles 41 is rapidly relieved. This prevents outside air from entering the nozzles 41 because of the negative pressure in the nozzles 41. As a result, ejection failures of ink droplets resulting from the entry of air is suppressed.

[0035] In particular, the negative pressure is prone to develop in the nozzles 41 when ink droplets are ejected in succession from the nozzles 41 in the high-speed printing mode. In such a structure that the heads 40 are connected to the single ink tank 51 through the supply pipe 52 as in the present preferred embodiment, it is time-consuming to add the ink I from the ink tank 51 after the ejection of the ink droplets from the nozzles 41. In the structure according to the present preferred embodiment, however, the negative pressure in the nozzles 41 is rapidly relieved by the expansion of the gas in the pressure adjustment part 46.

[0036] In the structure according to the present preferred embodiment, the pressure adjustment part 46 is implemented only by attaching the damper pipe 461 to the drainage port 44. Thus, the negative pressure in the nozzles 41 is relieved without the use of any complicated mechanism such as a regulator and without the use of power inherent in the pressure adjustment part 46. The drainage port 44 serves both as an opening for connecting the drainage pipe 441 during the filling of the head 40 with the ink I and as an opening for connecting the damper pipe 461 after the filling of the head 40 with the ink I. In this manner, the drainage port 44 has such two functions. This reduces the number of openings provided in the head 40.

[0037] When the volume of the damper space 460 is too small, it is difficult to effectively produce the effect of expanding the gas in the damper space 460 in accordance with the negative pressure in the nozzles 41. For this reason, the volume of the damper space 460 is preferably not less than 2 cm^3, for example, and more preferably not less than 3 cm^3. The damper pipe 461 according to the present preferred embodiment extends upwardly from the drainage port 44. Thus, if part of the ink I in the main flow passage 451 temporarily enters the damper pipe 461, the ink I is not accumulated in the damper pipe 461. Therefore, the volume of the damper space 460 is not reduced by the accumulation of the ink I.

<4. Modifications>

[0038] While the one preferred embodiment according to the present invention has been described hereinabove, the present invention is not limited to the aforementioned preferred embodiment.

[0039] Fig. 7 is a sectional view of the head 40 according to a modification. In the modification shown in Fig. 7, the pressure adjustment part 46 is connected to an opening provided near the supply port 43, rather than the drainage port 44. In such a configuration, the negative pressure in the nozzles 41 is rapidly relieved by the pressure adjustment part 46 when the length of the flow passage extending from the nozzles 41 to the pressure adjustment part 46 is shorter than the length of the flow passage extending from the nozzles 41 to the ink tank 51.

[0040] It is, however, more preferable that the pressure adjustment part 46 is connected to a location downstream from the most downstream one of the branch positions 450 of the main flow passage 451 as in the aforementioned preferred embodiment. This is because such a structure poses a lower risk that part of the gas in the damper space 460 becomes bubbles which in turn enter the interior flow passage 45 to reach the nozzles 41.

[0041] Fig. 8 shows one of the head units 20 according to another modification and a configuration of the ink supply mechanism 50 for supplying the ink I to the one head unit 20. In the modification shown in Fig. 8, the pressure adjustment part 46 is connected to the ink tank 51 through a relay pipe 47 and a regulator 60. The regulator 60 maintains the gas pressure in the damper space 460 constant. This allows the regulator 60 to positively adjust the amount of gas in the damper space 460 at a constant amount. This avoids the problem that the amount of gas in the damper space 460 changes gradually with prolonged use.

[0042] The aforementioned inkjet printer 1 records an image on the printing paper 9. However, the inkjet printer according to the present invention may be configured to record an image on a recording medium other than general paper (for example, a film made of resin).

[0043] The components described in the aforementioned preferred embodiment and in the modifications may be combined together, as appropriate, without inconsistencies.

[0044] While the invention has been described in detail, the foregoing description is in all aspects illustrative and not restrictive. It is understood that numerous other modifications and variations can be devised without departing from the scope of the invention.

Claims

1. An inkjet printer comprising
at least one head for ejecting ink in the form of droplets, the ink being supplied from an ink tank,
said head comprising:

a plurality of nozzles for ejecting ink droplets;
an interior flow passage for supplying the ink to said nozzles; and
a pressure adjustment part connected to said interior flow passage,
said pressure adjustment part having a damper space filled with a fixed amount of gas,

the gas in said damper space being in contact with the ink filling said interior flow passage.

2. The inkjet printer according to claim 1, wherein said damper space is an isolated enclosed space.

3. The inkjet printer according to claim 1, further including:

a regulator for maintaining a gas pressure in said damper space constant.

4. The inkjet printer according to any one of claims 1 to 3, wherein:

said interior flow passage includes
a main flow passage, and
a plurality of branch flow passages extending from respective branch positions provided on said main flow passage toward said nozzles; and
said pressure adjustment part is connected to said main flow passage in a location downstream from the most downstream one of said branch positions of said main flow passage.

5. The inkjet printer according to claim 4, wherein:

said head further includes
a supply port for introducing the ink into said interior flow passage, and
a drainage port for discharging the ink from said interior flow passage; and
said pressure adjustment part is connected to said drainage port.

6. The inkjet printer according to claim 5, wherein said pressure adjustment part includes a damper pipe connected to said drainage port, and
said damper space is formed in said damper pipe.

7. The inkjet printer according to claim 6, wherein said damper pipe extends upwardly from said drainage port.

8. The inkjet printer according to any one of claims 1 to 7, wherein
said damper space has a volume of not less than 2 cm^3.

9. The inkjet printer according to any one of claims 1 to 8, wherein
the gas filling said damper space is an inert gas.

10. The inkjet printer according to any one of claims 1 to 9, wherein:

said at least one head includes a plurality of heads; and
a pipe connecting said ink tank and said plurality of heads includes
a main pipe connected to said ink tank, and
a plurality of branch pipes extending from said main pipe toward said plurality of heads.

Fig. 1

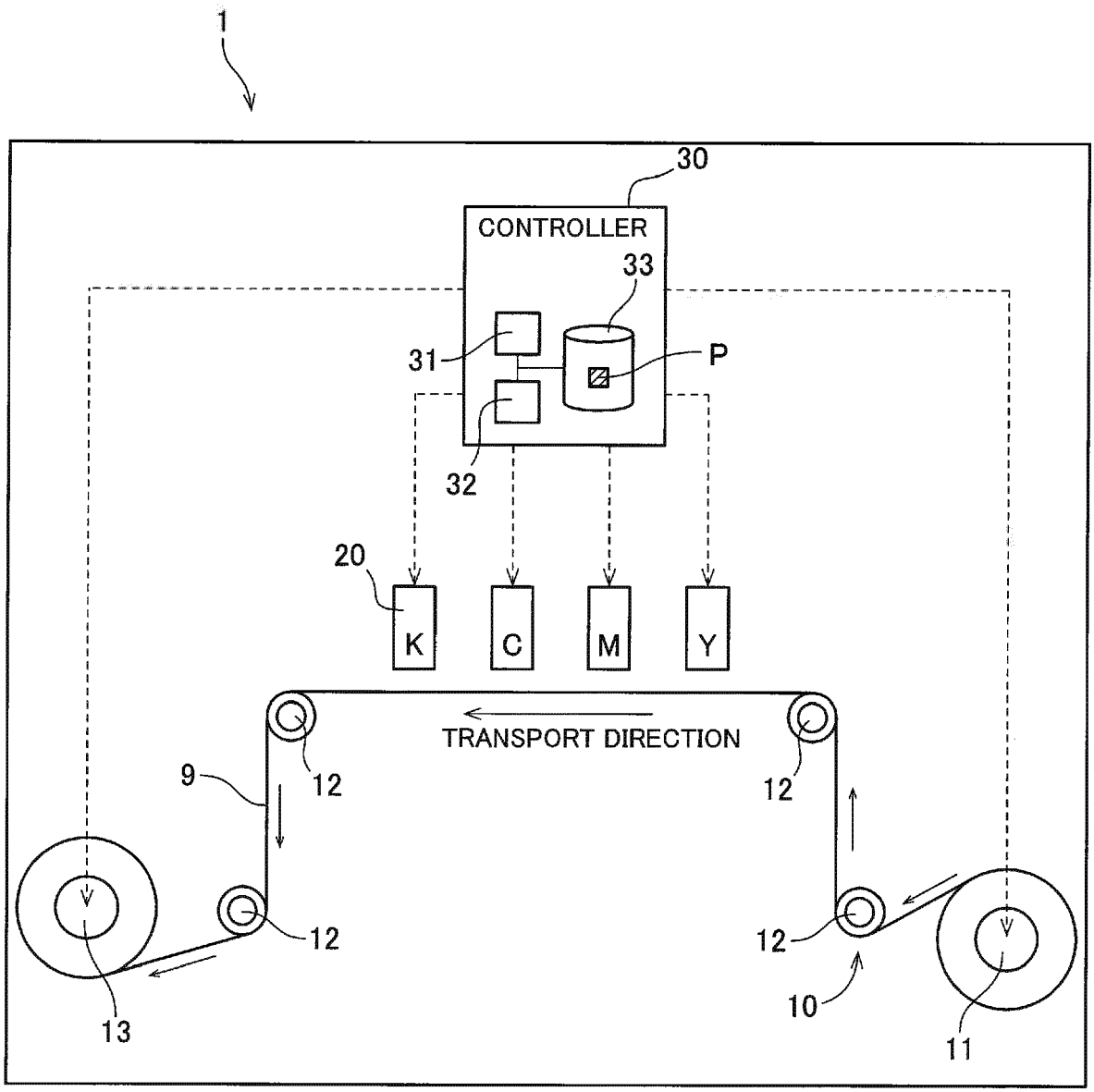

1
30
CONTROLLER
33
31
P
32
20
K
C
M
Y
TRANSPORT DIRECTION
9
12
12
12
12
10
13
11

Fig. 2

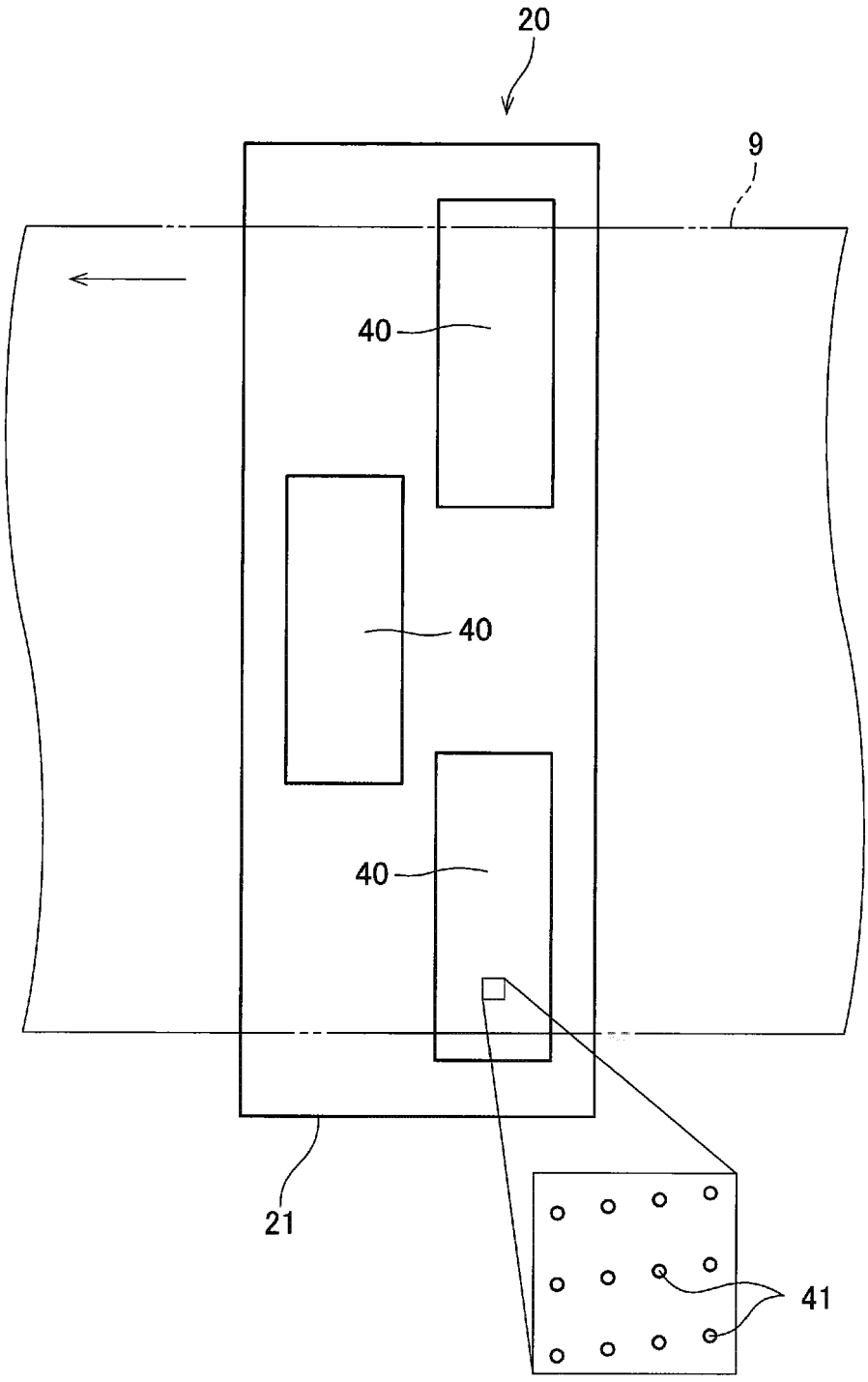


Fig. 3

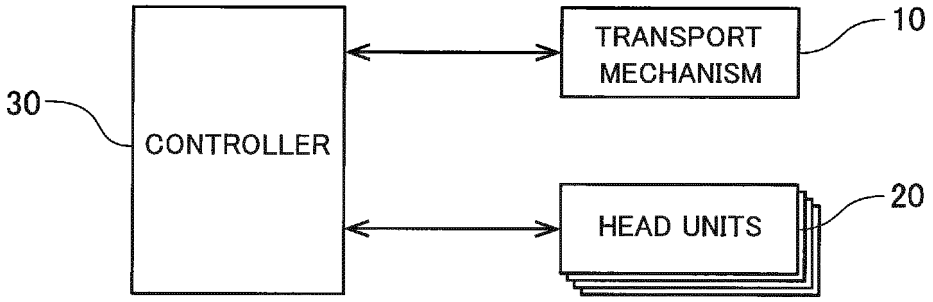


Fig. 4

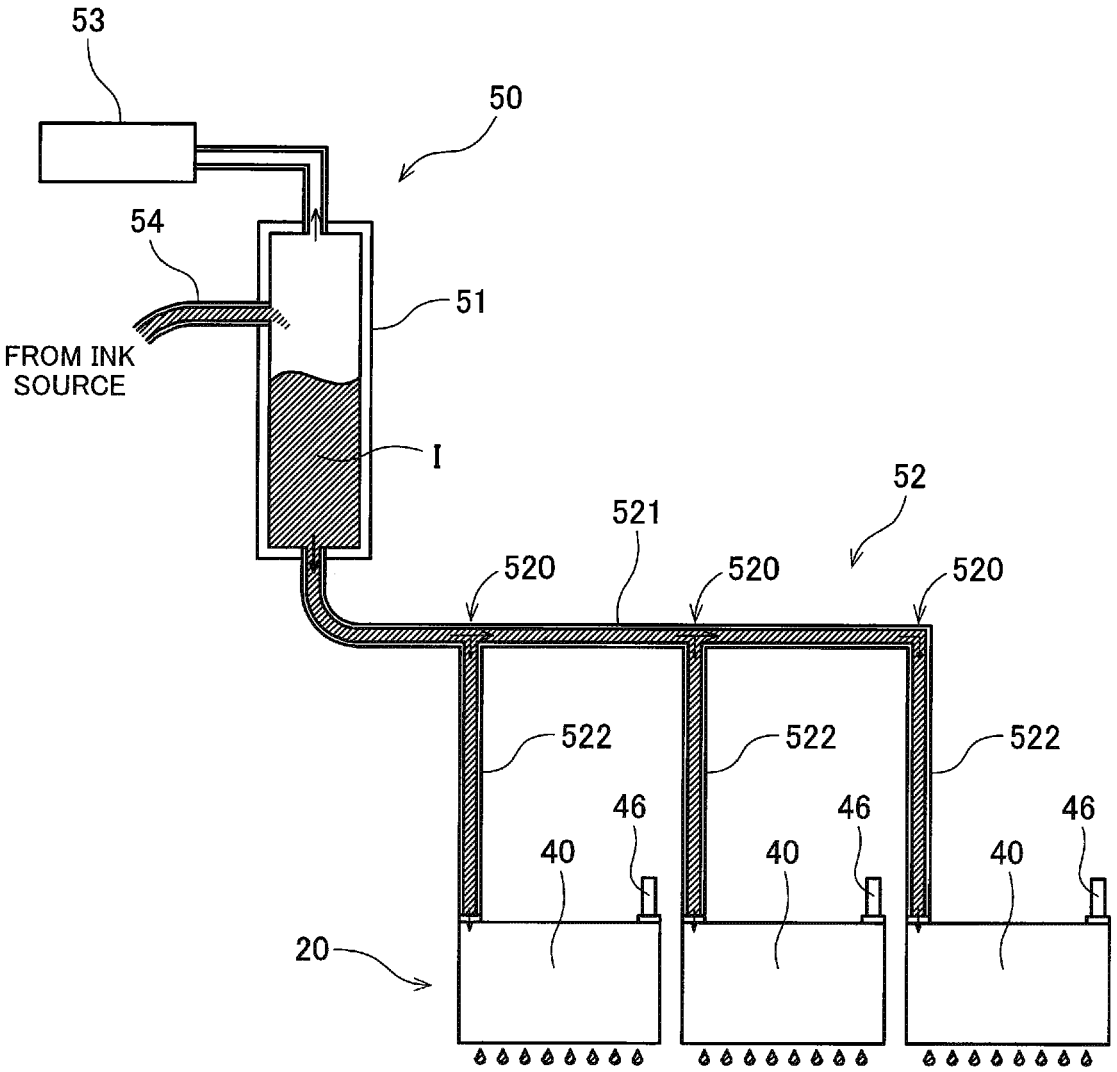

53
50
54
51
FROM INK SOURCE
I
52
521
520
520
520
522
522
522
46
46
46
40
40
40
20

Fig. 5

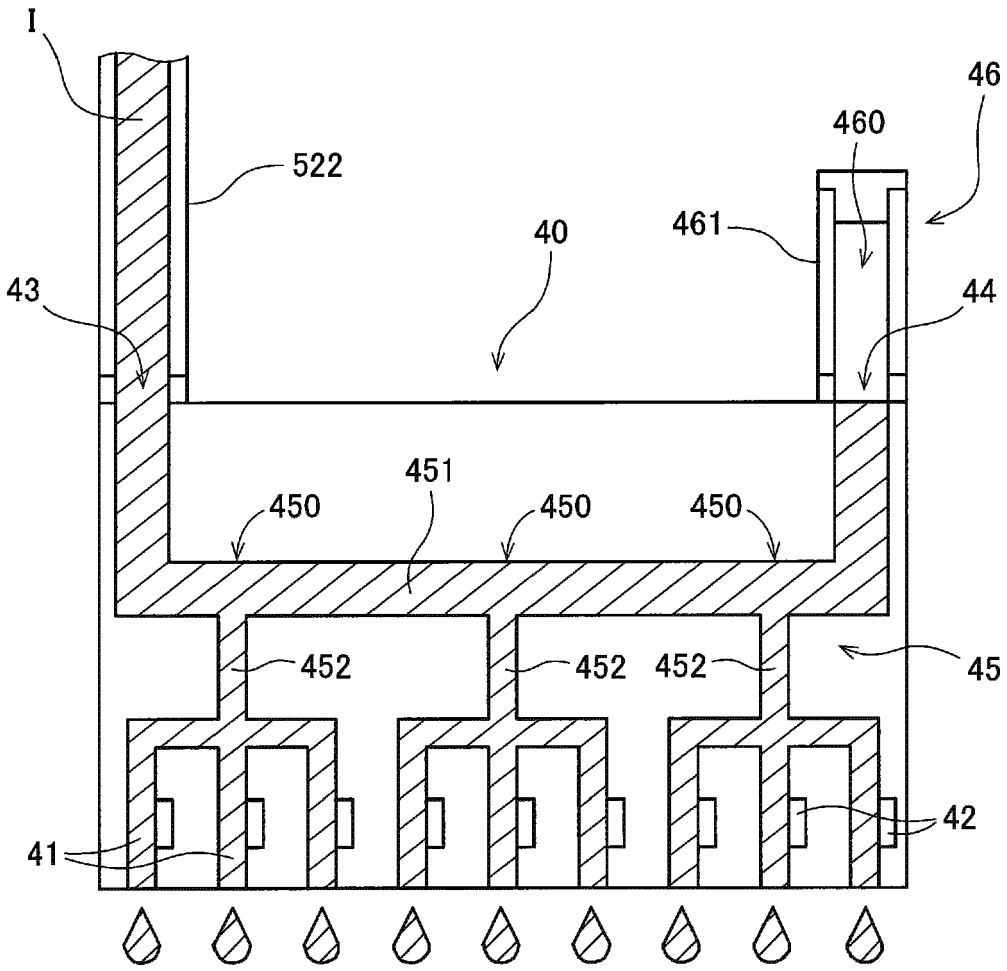


Fig. 6

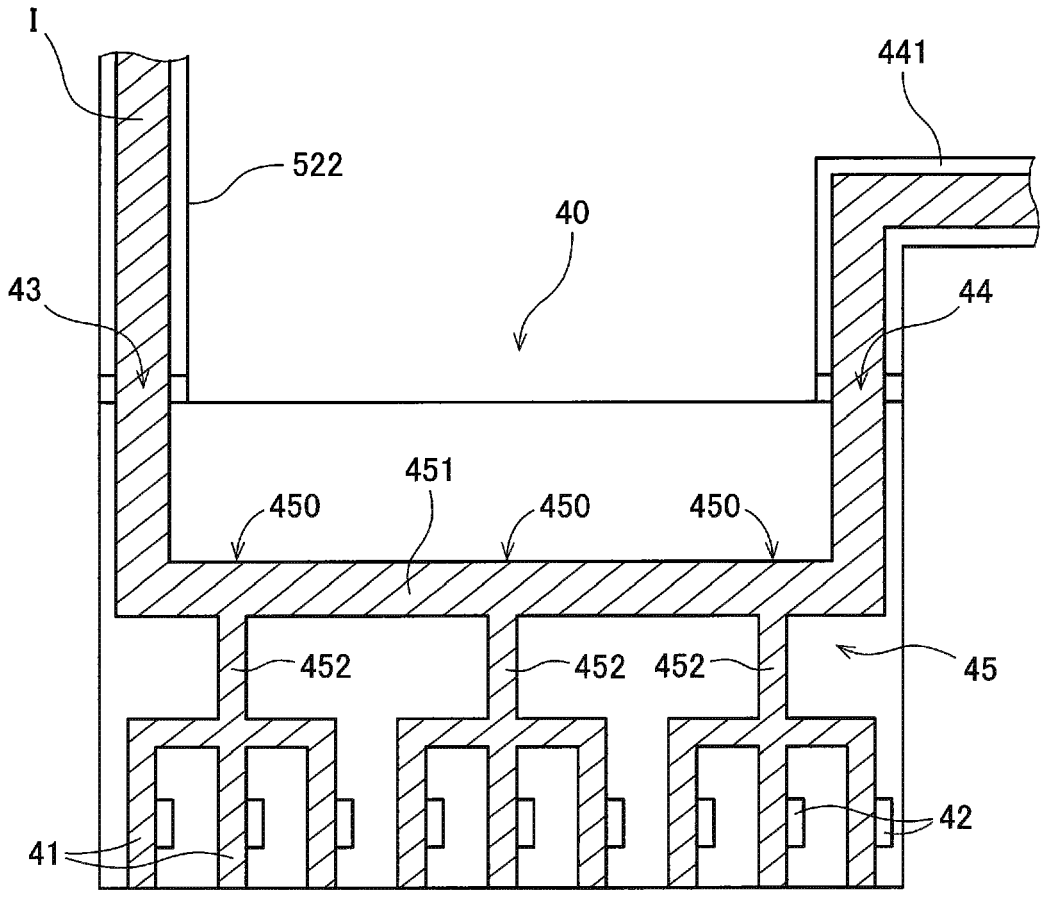


Fig. 7

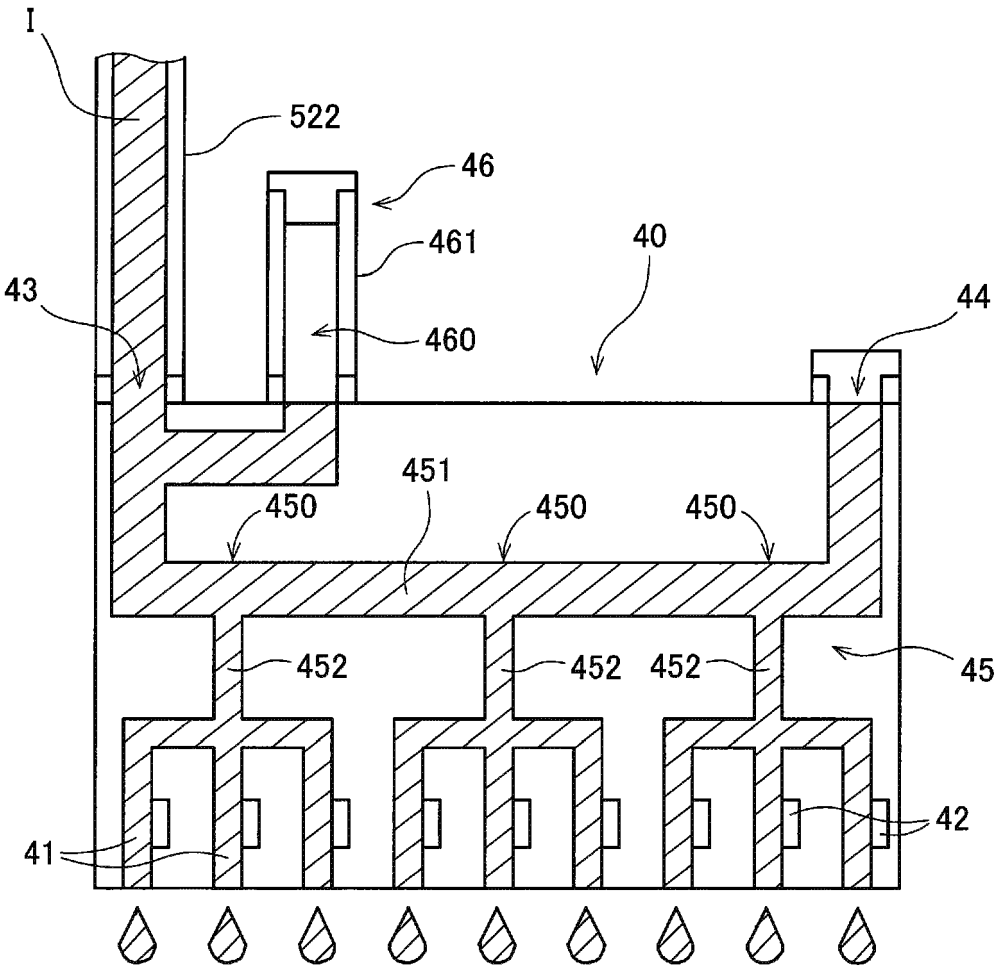
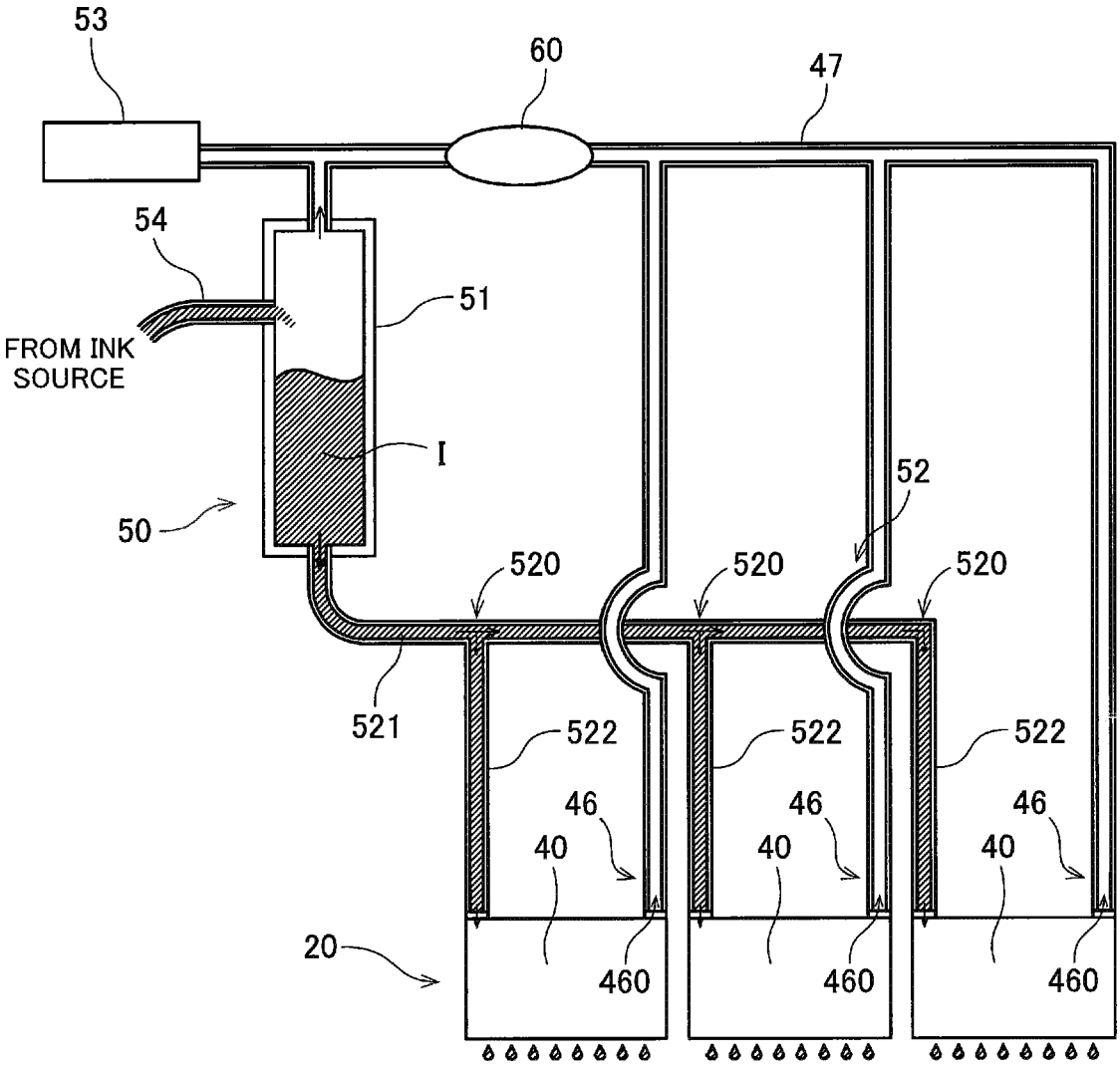


Fig. 8


53
60
47
54
51
FROM INK SOURCE
I
50
52
520
520
520
521
522
522
522
46
46
46
40
40
40
20
460
460
460

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 17 20 6960

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2016/042993 A1 (FUJIFILM CORP [JP]) 24 March 2016 (2016-03-24) * the whole document *	1-10	INV. B41J2/175
X	US 2016/257126 A1 (ISHIDA YUKIMASA [JP]) 8 September 2016 (2016-09-08)	1-4,8-10	
A	* paragraph [0031] - paragraph [0092]; figures 1-14 *	5-7	
X	US 2007/206079 A1 (BROWN BRIAN ROBERT [AU] ET AL) 6 September 2007 (2007-09-06)	1-4,8,9	
A	* paragraph [0139] - paragraph [0209]; figures 1-33 *	5-7,10	
A	US 2010/214384 A1 (TAKATA MASAYUKI [JP]) 26 August 2010 (2010-08-26) * paragraph [0042] - paragraph [0090]; figures 1-11B *	1-10	
A	US 2007/153071 A1 (CHUNG JIN-KOO [KR] ET AL) 5 July 2007 (2007-07-05) * the whole document *	1-10	
			TECHNICAL FIELDS SEARCHED (IPC)
			B41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	1 June 2018	Dewaele, Karl

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 20 6960

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-06-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2016042993 A1	24-03-2016	DE 112015004254 T5	14-06-2017
		JP 6072380 B2	01-02-2017
		JP WO2016042993 A1	27-04-2017
		WO 2016042993 A1	24-03-2016
US 2016257126 A1	08-09-2016	CN 105936182 A	14-09-2016
		JP 2016163965 A	08-09-2016
		US 2016257126 A1	08-09-2016
US 2007206079 A1	06-09-2007	NONE	
US 2010214384 A1	26-08-2010	JP 4941483 B2	30-05-2012
		JP 2010194861 A	09-09-2010
		US 2010214384 A1	26-08-2010
US 2007153071 A1	05-07-2007	CN 1990122 A	04-07-2007
		US 2007153071 A1	05-07-2007

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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 2015174378 A **[0002]**