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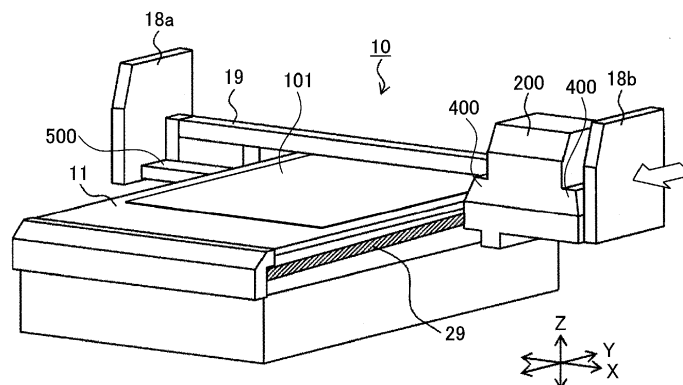
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(54) **LIQUID DISCHARGE APPARATUS, LIGHT EMISSION CONTROL METHOD FOR LIQUID DISCHARGE APPARATUS, AND LIGHT EMISSION CONTROL PROGRAM**

(57) A liquid discharge apparatus (10) includes a head unit having a plurality of nozzles aligned in a sub scan direction, a light emitting module (400) coupled to the head unit and having a plurality of light emitting elements configured to emit light to the liquid, a scan unit (19) configured to perform a main scan movement and a sub scan movement, a light-emission control unit configured to control on-and-off states of at least one of the

light emitting elements independently, wherein a time interval between a discharge and a start of irradiation of the liquid discharged by the nozzle located relatively close to a rear end of the head unit is longer than a time interval between a discharge and a start of irradiation of the liquid discharged by the nozzle located relatively close to a front end of the head unit.

FIG.1



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a liquid discharge apparatus, a light emission control method for a liquid discharge apparatus, and a light emission control program.

2. Description of the Related Art

[0002] In an active energy ray-curing type inkjet printer forming an image by discharging ink curable by an active energy ray and emitting active energy ray to the ink, there is an active energy ray coating printing technique for overcoating printed images with clear ink for the purpose of giving gloss to printed images.

[0003] In such an active energy ray coating technique, when an overcoat layer is formed on an image, the overcoat layer (gloss layer) wetly spreads in a different manner between the areas where the transparent ink is applied and the areas where the transparent ink is not applied, and this makes the gloss of the overcoat layer non-uniform.

[0004] Patent Document 1 suggests a technique for uniformizing the wetly spread overcoat layer by applying a matte layer of clear coating to specific areas on the basis of inverted data of color ink in order to uniformize the luster of the overcoat layer.

[0005] However, in the technique of Patent Document 1, data obtained by inverting the color ink is required, and it takes much time to process the data, and steps of two or more jobs, i.e., forming of the matte layer and thereafter the overcoat layer, are required, which increases the number of processing steps, and reduces the productivity.

[0006] In view of the above circumstances, it is an object of the present invention to provide a liquid discharge apparatus that can form an overcoat layer having a uniform luster without reducing productivity.

[0007] Patent Document 1: Japanese Unexamined Patent Application Publication No. 2015-214133

SUMMARY OF THE INVENTION

[0008] In order to achieve the above object, according to an aspect of the present invention, a liquid discharge apparatus includes:

a head unit having a plurality of nozzles aligned in a sub scan direction, the nozzles configured to discharge liquid curable by light onto a recording medium;
a light emitting module coupled to the head unit and having a plurality of light emitting elements aligned in the sub scan direction, the light emitting elements

configured to emit light to irradiate the liquid on the recording medium to cure the liquid;

a scan unit configured to perform a main scan movement and a sub scan movement, the main scan movement causing the head unit and the light emitting module to move in a main scan direction perpendicular to the sub scan direction, and the sub scan movement causing the head unit and the light emitting module to move in the sub scan direction; and

a light-emission control unit configured to control on-and-off states of at least one of the light emitting elements independently,

wherein the nozzles discharge the liquid and the light emitting module emits light during at least a part of the scan movements, and

wherein a time interval between a discharge and a start of irradiation of the liquid discharged by the nozzle located relatively close to a rear end of the head unit in the sub scan direction is longer than a time interval between a discharge and a start of irradiation of the liquid discharged by the nozzle located relatively close to a front end of the head unit in the sub scan direction.

[0009] With a liquid discharge apparatus according to an aspect, an overcoat layer having a uniform luster can be formed without reducing productivity.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 is an overall perspective view illustrating an inkjet recording apparatus according to a first embodiment of the present invention;

FIG. 2 is a cross-sectional view illustrating a carriage of FIG. 1;

FIG. 3 is a rear view illustrating an arrangement of a head unit and a light emitting module in the carriage of FIG. 2;

FIG. 4 is an overall view illustrating an inkjet recording apparatus according to a second embodiment of the present invention;

FIG. 5 is a block diagram illustrating a hardware configuration according to an example of an image forming apparatus according to the present invention;

FIG. 6 is a functional block diagram illustrating a control unit for image processing performed by the image forming apparatus according to the present invention;

FIG. 7 is a drawing for explaining the positions of the heads and the light emission states of the light emitting modules in the carriage of FIG. 3;

FIG. 8 is a schematic drawing for explaining positions of scan areas by the head unit on a recording medium according to the first embodiment;

FIG. 9 is a schematic drawing illustrating states of

dots in respective layers for each scan on a recording medium corresponding to the positions of the scan areas on the recording medium in FIG. 8 according to the first embodiment;

FIG. 10 is an explanatory diagram illustrating multiple types of discharge patterns;

FIG. 11 is an enlarged view illustrating a light emission state of the light emitting module in the carriage of FIG. 3; and

FIG. 12 is a control flow of discharge and light emission adjustment according to the first embodiment.

DESCRIPTION OF THE EMBODIMENTS

[0011] Hereinafter, embodiments for carrying out the present invention will be described with reference to the drawings. In the following drawings, similar constituent elements are denoted by the same reference numerals, and redundant description thereabout may be omitted.

<First embodiment>

[0012] First, overall configuration of a plurality of embodiments of an image forming apparatus according to the present invention will be explained.

[0013] FIG. 1 is an overall perspective view illustrating an inkjet recording apparatus, which is an example of an image forming apparatus, according to a first embodiment of the present invention.

[0014] An inkjet recording apparatus 10 includes a carriage 200 and a stage 11 on which a recording medium 101 is placed. The carriage 200 is provided with a head unit 300 which is an inkjet type image forming unit having a plurality of liquid discharge heads provided with a plurality of nozzles, and forms an image by discharging liquid from the nozzles of the recording head. The nozzles are provided on the surface facing the stage 11. In the present embodiment, the liquid is, for example, an ultraviolet curable ink.

[0015] A light emitting module 400 serving as a light source for emitting ultraviolet rays is provided on the surface of the carriage 200 facing the stage 11. The light emitting module 400 emits light having a wavelength that cures the liquid discharged from the nozzles.

[0016] A guide rod 19 is supported between left and right side plates 18a, 18b, and the guide rod 19 holds the carriage 200 so as to allow the carriage 200 to be movable in the X direction (main scan direction).

[0017] The carriage 200, the guide rod 19, and the side plates 18a and 18b are configured to be movable together along a guide rail 29 provided at the lower part of the stage 11 in the Y direction (sub scan direction). Furthermore, the carriage 200 is held so as to be movable in the Z direction (vertical direction).

[0018] In FIG. 1, the stage 11 on which the recording medium 101 is placed is fixed. In an inkjet recording apparatus such as the one illustrated in Fig. 1, an image is formed by alternately repeating a main scan operation

to discharge ink from the nozzles onto the recording medium 101 while moving the recording head in the main scan direction and a sub scan operation to move the recording head in the sub scan direction.

[0019] Therefore, in the present embodiment, the carriage 200 and the guide rod 19 function as a scan unit in the main scan direction (X direction, second direction), and the carriage 200 and the guide rail 29 function as a scan unit in the sub scan direction (Y direction, first direction).

[0020] Next, the details of the carriage (main scanning unit) 100 will be described with reference to FIG. 2 and FIG. 3. A detailed sectional view of the carriage 200 is illustrated in FIG. 2, and a rear view is illustrated in FIG. 3. The head unit 300 in the center provided in the carriage 200 discharges ink. The head unit 300 includes heads (color heads) 301CM and 301YK that discharge CMYK color inks.

[0021] Each head 301 is formed with four nozzle row groups each having a plurality of nozzle holes for discharging ink disposed in the sub scan direction, and the CM head 301 is filled with C and M inks each in two rows, and the YK head 301 is filled with Y and K inks each in two rows. In addition, the head unit 300 also includes a head 301S discharging S ink, which is a special color ink (spot color) such as a specific color that is frequently used or a special color that cannot be generated by mixing YMCK inks.

[0022] The head unit 300 is also provided with a front clear head 301CL1 and a rear clear head 301CL2 for discharging clear ink (transparent ink) that forms matte and gloss coat layers. In this configuration, the upper right head in the head unit 300 does not discharge the clear ink, but, for example, discharges a primer (Pr) serving as a foundation or a second special color. Each color head has three rows of heads in the sub scan direction, and the heads that discharge clear ink are arranged in two rows.

[0023] Each head 301 is an example of a liquid discharge head which, when a drive signal is applied to a piezoelectric material, the piezoelectric material causes contraction which results in a pressure change, thereby discharging ink.

[0024] In order to maintain and recover the performance of the head 301, the carriage 200 moves to a maintenance unit 500 illustrated in FIG. 1 to have the head maintained. Although not illustrated, the carriage 200 has a pressurizing mechanism. Any given amount of ink is discharged from the head by the pressure mechanism. When the ink is discharged, the ink may remain attached to the surface of the nozzle surface of the head 301. Therefore, a wiper 501 moves up and moves in the sub scan direction to wipe off the ink attached to the surface of the head 301. The carriage 200 is equipped with a height sensor 41. The height of the recording medium 101 is measured by the height sensor 41. Based on the measured value, the carriage 200 descends until the head gap between the head 301 and the recording me-

dium 101 becomes 1 mm or a configured value.

[0025] In the image formation, when the carriage 200 reciprocates (passes) in the main scan direction (X direction) on the recording medium 101, ink is discharged from the heads 301 of the head unit 300 to form an image. When the carriage 200 reciprocates, the ink discharged from the heads 301 onto the recording medium 101 is cured by UV light (ultraviolet) which is an active energy ray emitted from the light emitting module 400.

[0026] Each time the scanning is completed, the carriage 200 moves to a predetermined position in the sub scan direction, and an image is formed on the surface of the recording medium 101.

[0027] In order to obtain a clear gloss coating, rather than irradiating the ink immediately after the discharging, the ink is cured at a predetermined timing to form a gloss coating layer after a predetermined period of time elapses since the clear ink was applied to desired portions. A time for smoothing clear ink (hereinafter referred to as a leveling time) after the application of the clear ink is adjusted and set. The setting of the leveling time from when the clear ink is discharged to when the UV light is emitted will be described in detail with FIG. 7 to FIG. 12. The coating referred to herein is not limited to the gloss coating. Color coating or clear ink may be directly applied to the entire surface of the base material, or the clear ink may be applied after printing with the color ink.

[0028] As illustrated in FIG. 3, the light emitting module 400 is composed of an assembly of multiple LED-UV lamps that use LEDs as the light source, and includes a light emitting module 400L at a left-hand side and a light emitting module 400R at a right-hand side. Lamp groups 401L and 401R are divided into light emitting blocks 401L1 to 401L9 and 401R1 to 401R9, respectively, each composed of an independent lamp, and are configured to be able to control the outputs of the LEDs independently for each of the light emitting blocks. Hereinafter, the light emitting blocks 401L1 to 401L9 and 401R1 to 401R9 may also be referred to as lamps 401L1 to 401L9 and 401R1 to 401R9, respectively. Also, since the light emitting module 400L and the light emitting module 400R are configured in a similar manner, the light emitting module 400R will be hereinafter explained as an example, and in such a case, the light emitting module 400R may be simply referred to as the light emitting module 400. Likewise, since the lamp groups 401L and 401R are configured in a similar manner, the lamp group 401R will be hereinafter explained as an example, and in such a case, the lamp group 401R may be simply referred to as the lamp group 401.

[0029] The lamp groups 401L and 401R are connected to a lamp moving mechanism 42. The lamp moving mechanism 42 is connected to a lamp fixing mechanism 43 fixed to the head unit 300 of the carriage 200 and a guide rail 444. A lamp fixing pin 45 is connected to the lamp fixing mechanism 43 through the lamp moving mechanism 42. The lamp group 401 can be moved in the sub scan direction along the guide rail 44 by turning the lamp

fixing pin 45 to release the fixing of the lamp group 401 and pushing or pulling the lamp group 401. When the lamp group 401 is moved to a desired position, the lamp group 401 can be fixed with the lamp fixing pin 45 and printing can be performed at the desired lamp position.

<Second embodiment>

[0030] FIG. 4 is an overall view (rear view) illustrating an inkjet recording apparatus according to the second embodiment of the present invention.

[0031] In the present embodiment, a conveying belt 71, i.e., conveying means on which a recording medium 101 is placed, is movable. In an inkjet recording apparatus 1 according to the present embodiment, in the sub scan operation, the recording medium 101 is moved in the sub scan direction relative to a carriage 20 including a head unit 300 and light emitting modules 40L and 40R.

[0032] In the present embodiment, the conveying belt 71 and conveying rollers 72a and 72b for conveying the recording medium 101 are provided, and an attraction support plate 72 for maintaining the conveying state is provided. Maintenance units 50a and 50b are provided at both sides of the conveying belt 71 in the main scan direction.

[0033] Therefore, in the present embodiment, an image is formed by alternately repeating a main scan movement to discharge ink from the nozzles of multiple heads 301 onto the recording medium 101 while moving the carriage 20 in the main scan direction and a sub scan operation to move the recording medium 101 in the sub scan direction.

[0034] Therefore, in the present embodiment, the carriage 20 and the guide rod 19 function as a scan unit in the main scan direction (X direction, second direction), and the conveying belt 71, the attraction support plate 72, and the conveying rollers 72a and 72b function as a scan unit in the sub scan direction (Y direction, first direction).

<Hardware configuration example>

[0035] FIG. 5 is a block diagram illustrating an example of an entire configuration of a hardware configuration of an image forming system including the inkjet recording apparatuses 10 and 1 according to the first and second embodiments, respectively. In the system as illustrated in FIG. 5, for example, in an image forming system, a PC 2 which is an external apparatus is connected to the image forming apparatus (inkjet recording apparatuses 10 and 1) forming an image with a mechanical structure as illustrated in FIG. 1 to FIG. 3, FIG. 4, and the like, and the PC 2 executes image processing. The functions of the image processing executed by the PC 2 may be provided in the inkjet recording apparatuses 10 and 1.

[0036] The PC 2 (computer) has a printer driver. The printer driver converts image data to recording data. The recording data converted by the printer driver is trans-

mitted to the inkjet recording apparatus 10. The recording data includes command data for operating a conveying unit 600 and the like, and pixel data of an image. The pixel data is composed of 2-bit data for each pixel and is expressed with four levels of grayscale.

[0037] As illustrated in FIG. 7, the image forming apparatus 30 (inkjet recording apparatuses 10 and 1) according to the present embodiment includes a controller unit 3, a detection group 4, a conveying unit 600, a carriage 200, a head unit 300, a light emitting module 400, and a maintenance unit 500.

[0038] The controller unit 3 includes a unit control circuit 31, a memory 32, a CPU (Central Processing Unit) 33, and an interface (I/F) 34. The controller unit 3 controls each unit based on the data received from the PC 2, i.e., a computer, and forms an image. The controller unit 3 is also a computer that controls each unit based on detection data from the detection group 4 and the like.

[0039] The interface 34 is an interface for connecting the image forming apparatus 30 (10, 1) to the external PC (Personal Computer) 2. The connection between the image forming apparatus 30 and the PC 2 can be any connection, including, for example, a connection via a network or a connection via a communication cable directly connecting the image forming apparatus 30 and the PC 2.

[0040] The detection group 4 includes, for example, various sensors provided in the inkjet recording apparatus 10 (1) such as the height sensor 41 illustrated in FIG. 2 and FIG. 3.

[0041] The CPU 33 controls the operation of each unit of the inkjet recording apparatus 10 via the unit control circuit 31 using the memory 32 as a work area. More specifically, the CPU 33 controls the operation of each unit based on the recording data received from the PC 2 and the data detected by the detection group 4, and forms an image which is a liquid application surface 102 on the recording medium 101 (base material).

(Functional blocks)

[0042] Next, functional blocks of the present invention will be described. FIG. 6 is a functional block diagram illustrating image processing in an image forming system according to the present invention.

[0043] The image processing apparatus 12 includes a main control unit 13. The main control unit 13 is a computer that includes a CPU and the like, and controls the entire image processing apparatus 12. The main control unit 13 may be constituted by units other than a general-purpose CPU. For example, the main control unit 13 may be constituted by a circuit or the like.

[0044] Further, as illustrated in FIG. 6, the image processing apparatus 12 may be implemented by a PC 2 connected to the image forming apparatus 30, or may be provided in the image forming apparatus 30.

[0045] The main control unit 13 includes a data reception unit 12A, a data generation unit 12B, and a data

output unit 12C. A part or all of the data reception unit 12A, the data generation unit 12B, and the data output unit 12C may be implemented by causing a processing apparatus such as a CPU to execute a program, i.e., implemented by software, or may be implemented by hardware such as an IC (Integrated Circuit), or may be implemented using a combination of software and hardware.

[0046] The data reception unit 12A receives image data. The image data is information such as the shape and color of the image to be formed. The data reception unit 12A may acquire image data from an external apparatus via a communication unit, or may acquire image data from storage means provided in the image processing apparatus 12.

[0047] The data generation unit 12B performs predetermined data processing such as mask processing on the image data received by the data reception unit 12A. In the present embodiment, color ink image data and clear ink image data are generated based on image data (for example, JPEG image data) and a desired glossiness.

[0048] The data output unit 12C outputs the image data generated by the data generation unit 12B to the image forming apparatus 30.

[0049] The image forming apparatus 30 (10, 1) includes a recording drive unit 26, a printing mode reception unit 21, a light emitting unit 22, first and second drive units 23, 24, a recording control unit 27, and a light-emission control unit 28.

[0050] The recording drive unit 26 is a head drive unit that drives the head units 300K to 300W to discharge droplets of ink based on the image data controlled by the recording control unit 27.

[0051] The light emitting unit 22 corresponds to the lamp groups 401R and 401L serving as light sources in the light emitting modules 400R and 400L provided in the carriage 200, and is a light emission drive unit that turns ON and OFF each light emitting block including one or more lamps obtained by dividing the lamp groups 401R and 401L in the sub scan direction.

[0052] The first and second drive units 23 and 24 drive the scan unit. The first drive unit 23 drives the carriage 200 in the X direction during main scan (i.e., main scan movement, main scan operation). The second drive unit 24 drives the carriage 200 (in the first embodiment) or the recording medium 101 (in the second embodiment) in the sub scan direction during sub scanning (i.e., sub scan movement, sub scan operation).

[0053] The recording control unit 27 receives print data from the image processing apparatus 12. The recording control unit 27 controls the recording drive unit 26 so as to discharge droplets corresponding to each pixel from the head unit 300 in accordance with the received print data.

[0054] For example, the recording control unit 27 calculates an interval between discharge of ink and emission of light, calculates glossiness of the image formed

on the recording medium 101 from the amount of the discharged ink and the interval between discharge of ink and emission of light, and performs an operation to determine the amounts of color ink and clear ink to be discharged in order to uniformize the glossiness.

[0055] The light-emission control unit 28 controls the light emitting unit 22 so as to set the light emission timing and the light emission duration of each light emitting block of the light emitting module 400 according to instructions of a matte area (matte portion) and a gloss area (gloss portion).

[0056] Specifically, the recording control unit 27 includes a color ink gradation setting unit 27A, a transparent ink discharge pattern selecting unit 27B, a transparent ink gradation setting unit 27C, a print rate adjusting unit 27D, and a droplet size adjusting unit 27E.

[0057] The color ink gradation setting unit 27A is set to apply a gradation mask, for each head, to the image data to be formed in color, so that both ends of the color head in the sub scan direction become gradually thinner.

[0058] The transparent ink discharge pattern selecting unit 27B selects any one of the transparent ink gradation setting unit 27C, the print rate adjusting unit 27D, and the droplet size adjusting unit 27E for each of the matte area and gloss area, so that the matte area and gloss area are painted in a different manner with transparent ink. Details for painting the matte area and gloss area in a different manner will be described later with FIG. 10.

[0059] The transparent ink discharge pattern selecting unit 27B, the transparent ink gradation setting unit 27C, the print rate adjusting unit 27D, and the droplet size adjusting unit 27E function as a liquid discharge amount adjusting unit for adjusting the discharge amount of the transparent ink.

[0060] The light-emission control unit 28 includes a light emission area setting unit 28A and a light emission time setting unit 28B.

[0061] The light emission area setting unit 28A sets the area to be irradiated by the light emitting unit 22. The light emission time setting unit 28B sets an emission start timing and a light emission duration of a lamp for the light emitting unit 22. The detailed control of the lamp groups (light emitting modules) 401L and 401R will be described in detail with FIG. 7.

[0062] In this block diagram, for example, the function of adjusting discharge of the transparent ink and adjusting the light emitting module 400 is provided in the image forming apparatus. Alternatively, the function of adjusting discharge of the transparent ink and adjusting the light emitting module 400 may be provided in the data generation unit 12B in the PC 2.

[0063] Furthermore, in another information processing apparatus (for example, a host apparatus) connected to the PC 2, a program may be prepared, and an operation file in, for example, a CSV (Comma Separated Value) file format or an Excel file format is stored in advance, and by loading the program to the PC 2, a discharge adjustment program for the clear ink may be executed.

<Adjustment example of light emission and discharge pattern>

[0064] Subsequently, adjustment of ink discharge and light emission according to the first embodiment will be explained with reference to FIG. 7 to FIG. 12. FIG. 7 is a drawing for explaining the positions of the heads and the light emission states of the lamp group 401R in the carriage 200 of FIG. 3. Since the lamp groups 401R and 401L (light emitting modules 400R and 400L) are configured in similar manners, only the lamp group 401R (light emitting module 400R) will be hereinafter explained as an example. As illustrated in FIG. 7, the head unit 300 is provided with, in the sub scan direction, two clear heads 301CL1 and 301CL2 for discharging UV curing-type clear ink.

[0065] As illustrated in FIG. 7, color printing is performed with the four color heads 301C1, 301M1, 301Y1, and 301K1 disposed relatively close to a front end of the head unit 300 in the travelling direction, and then clear coating is applied by the clear heads 301CL1 and 301CL2.

[0066] When the clear ink is discharged immediately after the color ink is discharged in the same scan movement operation, a desired image cannot be formed because the color ink and the clear ink mix with each other. For this reason, in the same scan operation, color ink and clear ink are not discharged from heads at the same position in the sub scan direction.

[0067] The front clear head 301CL1 and the rear clear head 301CL2 described below mean heads discharging the clear ink at positions relatively close to a front end and a rear end, respectively, of the head unit 300 in the travelling direction (moving direction) of the carriage 200 in the sub scan direction.

[0068] The light emitting module 400 is composed of multiple lamps, arranged side by side, each having a light emission region arranged in the sub scan direction, and the multiple lamps can be independently controlled to be turned on and off. The lamps emit light of active energy ray that cures ink (liquid).

[0069] In FIG. 7, the light emitting module 400 is in a state of discharge operation. The lamps 401R5 to 401R8 are turned off, and lamps 401R1 to 401R4 and 401R9 are turned on. That is, a portion corresponding to the rear clear head 301CL2 is turned off, and at least a portion corresponding to the front clear head 301CL1 is turned on.

[0070] In this way, a part of the front clear head 301CL1 is irradiated by the lamps 401R3, 401R4 in the "ON" state, so that at least a part of the ink discharged from the front clear head 301CL1 is cured immediately after the discharge to become matte (becomes a matte area).

[0071] Therefore, the rear clear head 301CL2 and a part of the front clear head 301CL1 are located at the positions corresponding to the lamps 401R5, 401R6, 401R7, 401R8 in the "OFF" state, and the ink discharged from the rear clear head 301CL2 is not irradiated imme-

diately after the discharge, but is leveled and is then irradiated by the lamp 401R9 in the "ON" state to become gloss (to become a gloss area).

[0072] In this example, there are two clear heads discharge clear ink, and an area to which the clear ink is discharged from some of the nozzles of the front clear head 301CL1 relatively close to the front end of the head unit 300 in the travelling direction is configured to be the matte area, and an area to which the clear ink is discharged from the nozzles of the rear clear head 301CL2 and the remaining nozzles of the front clear head 301CL1 relatively close to the rear end of the head unit 300 in the travelling direction is configured to be the gloss area, but the allocation of the areas may be configured in other ways.

[0073] Here, where the entire sub scanning area of one or more clear heads that discharge the clear ink is defined as "multiple nozzles", nozzles that discharge the clear ink that becomes the matte area can be considered to be "front nozzles" in the travelling direction, and nozzles that discharge the clear ink that becomes the gloss area can be considered to be "rear nozzles" in the travelling direction.

[0074] In the example of FIG. 7, the "front nozzles" correspond to some of the nozzles of the front clear head 301CL1 relatively close to the front end of the head unit 300. The "rear nozzles" correspond to the nozzles of the rear clear head 301CL2 and the remaining nozzles of the front clear head 301CL1 relatively close to the rear end of the head unit 300 in the travelling direction.

[0075] In a case where the length of a head and the length of a lamp can be substantially the same in the sub scan direction, the "front nozzles" correspond to the nozzles of the entire area of the front clear head, and the "rear nozzles" correspond to the nozzles of the entire area of the rear clear head.

[0076] Alternatively, there may be three or more clear heads discharging the clear ink, or there may be only one clear head. For example, in a case where matte area and gloss area are made using only one clear head, the "front nozzles" correspond to some of the nozzles of the clear head relatively close to the front end of the head unit 300 in the travelling direction, and the "rear nozzles" correspond to the remaining nozzles of the clear head relatively close to the rear end of the head unit 300 in the travelling direction.

<State of ink droplets>

[0077] Here, ink landing areas and states of landed droplets as a result of scanning performed multiple times in a case where the lamps as illustrated in FIG. 7 are controlled to be turned on and off will be explained with reference to FIG. 8 and FIG. 9.

[0078] FIG. 8 is a schematic drawing for explaining positions of scan areas by the head unit 300 on the recording medium 101 according to the first embodiment. FIG. 9 is a schematic drawing illustrating states of landed droplets

in respective layers for each scan on a recording medium 101 corresponding to the positions of the scan areas on the recording medium 101 illustrated in FIG. 8 according to the first embodiment.

[0079] In FIG. 8, the drawings (a), (b), (c), and (d) illustrate the positions of the scan areas in the first, second, third, and fourth scans, respectively, in a state where the position of the recording medium 101 is fixed and the carriage 200 moves in the sub scan direction by a linefeed width.

[0080] In FIG. 8, a bidirectional printing sequence will be explained. In the bidirectional printing sequence, an image is formed on a recording medium 101 by alternately repeating an operation in which the carriage scans in the main scan direction and an operation in which the carriage moves in the sub scan direction. The operation in which the carriage moves in the sub scan direction during the reciprocal operation of the carriage in the main scan direction is also referred to as a moving operation for a linefeed width.

[0081] In this example, the linefeed width in the sub scan direction is the same as the width of the gloss area.

[0082] In FIG. 9, the drawings (a), (b), (c), and (d) are schematic drawings illustrating the states of the dots (ink droplets) landed as a result of the first, second, third, and fourth scans as illustrated in the drawings (a), (b), (c), and (d), respectively, of FIG. 8. FIG. 9 corresponds to drawings as seen from the right-hand side of FIG. 8.

[0083] Here, as illustrated in the drawings (a) to (d) of FIG. 9, during printing, the light emitting module 400 is configured such that, as illustrated in FIG. 7, the lamps 401R1, 401R2, 401R3, 401R4, 401R5, and 401R9 are turned on at all times, and the lamps 401R6, 401R7, 401R8 are turned off at all times.

[0084] As illustrated in the drawing (a) of FIG. 8 and the drawing (a) of FIG. 9, only the color ink droplets are discharged in the first scan. Then, the color ink droplets are irradiated by the lamps 401R1 and 401R2, whereby the color ink droplets are cured.

[0085] As illustrated in the drawing (b) of FIG. 8 and the drawing (b) of FIG. 9, in the second scan, color ink droplets are discharged, and clear ink droplets are discharged from the front clear heads. Then, the color ink droplets and clear ink are irradiated by the front lamps 401R1 and 401R2, whereby the color ink droplets are cured, and the clear ink droplets become matte.

[0086] Here, in the discharge area of the clear ink by the front clear head 301CL1, light is emitted in the same scan as the discharge of the ink. Therefore, in this discharge area, an interval from when the ink droplets land on the recording medium 101 (base material) to when UV light is emitted thereon is relatively short. Therefore, the landed droplets are cured in an upright position without being appreciably leveled (i.e., unified or smoothed). As a result, unevenness can be formed on the surface to make a matte texture as the image quality, so that the discharge area can become a matte area.

[0087] As illustrated in the drawing (c) of FIG. 8 and

the drawing (c) of FIG. 9, in the third scan, color ink droplets are discharged, and clear ink droplets are discharged from the front clear head 301CL1 and the rear clear head 301CL2. Then, the area of the color ink droplets and the front side area of the clear ink droplets are irradiated by the front lamps 401R1 to 401R4, so that the color ink droplets are cured and the clear ink droplets become matte. In the area of the clear ink droplets discharged by the rear clear head 301CL2, the light is not emitted in the same scan, and the clear ink droplets are not cured.

[0088] As illustrated in the drawing (d) of FIG. 8 and the drawing (d) of FIG. 9, in the fourth scan, color ink droplets are discharged, and clear ink droplets are discharged from the front clear head 301CL1 and the rear clear head 301CL2. Then, the lamps 301R1 and 301R2 emit light to the color ink droplets and a part of the clear ink droplets at the front side discharged from the front clear head 301CL1, so that the color ink droplets and the part of the clear ink droplets are cured to become matte. In the same scan, the clear ink droplets applied from the rear clear head 301CL2 are not irradiated with light and are therefore not cured. Furthermore, the lamp 401R9 disposed close to the rear end of the head unit 300 emits light to the previously discharged clear ink droplets. It should be noted that the third scan illustrated in the drawing (c) of FIG. 8 is an example of a first main scan movement, and the fourth scan illustrated in the drawing (d) of FIG. 8 is an example of a second main scan movement.

[0089] As illustrated in the drawings (c) and (d) of FIG. 9, the clear ink droplets applied to the recording medium 101 by the rear clear head 301CL2 are not immediately irradiated with light by the lamp groups 401R, and are irradiated with light by a corresponding light emitting block after a time corresponding to a single scan has elapsed.

[0090] In the area to which the clear ink is applied by the rear clear head, an interval from when the ink droplets land on the recording medium 101 (base material) to when UV light is emitted thereon is longer, so that the dots wetly spread to level the clear ink layer, which lowers the dot height. When UV light is emitted with the clear ink layer having been appreciably leveled, luster is given to the image surface, and the area becomes a gloss area that causes glossiness.

[0091] In the drawing (d) of FIG. 9, the clear ink droplets in the third layer flow into the gap between the ink droplets in the uneven matte area in the second layer.

[0092] The clear ink droplets, which are discharged from the rear clear head 301CL2 and which are not irradiated with light in the third scan in the drawing (c) of FIG. 9, are irradiated with UV light in the fourth scan in the drawing (d) of FIG. 9. Therefore, since the ink droplets in the area are left for at least a time corresponding to a single scan as a time prior to lamp emission, the landed droplets in the second layer flow into the recessed portions in the uneven first layer in which the color ink is cured in an upright position, so that the surface is further smoothed (leveled).

[0093] In the example of FIG. 9, during print operation, the clear ink is not discharged by the rear clear head 301CL2 in the first scan, which starts the print operation. Therefore, the formation of the matte layer by the clear ink is achieved in the second scan and subsequent scans. With respect to the start of the print operation, the liquid is discharged from the rear clear head 301CL2 for the first time in the third scan, and the area to which the liquid is discharged by the rear clear head 301CL2 becomes the gloss area in a subsequent scan (i.e., the fourth scan).

[0094] The head unit 300 has y heads in the sub scan direction, at least two of which are clear heads. Accordingly, the (y-1)-th head from the front end of the head unit 300 is a front clear head and the y-th head is a rear clear head. Therefore, the formation of the matte layer by the clear ink discharged from the front clear head is achieved in the (y-1)-th scan and subsequent scans, and the formation of the gloss layer by the clear ink discharged from the rear clear head is achieved in the (y+1)-th scan and subsequent scans.

[0095] As illustrated in the drawings (a) to (d) of FIG. 9, as the carriage moves in the travelling direction due to a linefeed, the ink droplets are discharged to the front side (i.e., a right-hand side area in each drawing of FIG. 9) in the travelling direction. As illustrated in the drawing (d) of FIG. 9, the gloss area is formed closer to the rear end of the head unit 300 than a rear end of an area where the ink droplets are discharged. In other words, the gloss area is formed closest to the rear end of the head unit 300 (i.e., a left-hand side area in the drawing (d) of FIG. 9) in the area where the ink droplets are landed on the recording medium 101. Therefore, the ink droplets are not overlaid on the gloss layer.

[0096] As described above, multiple heads 301R1 and 301R2 discharging the clear ink are provided in the sub scan direction, and the light emission start timing is differentiated between the front and rear clear head 301R1 and 301R2 in the travelling direction of the carriage in the sub scan direction, so that in at least the fourth and subsequent scans, the gloss layer is formed on the matte layer for every linefeed width, and as a result, the produced uppermost layer at the rear side is the gloss layer at all times. Since the matte layer is formed at all times, the matte layer can reduce unevenness even in a significantly uneven portion such as a thin portion and the like of the color layer, thus allowing the gloss layer to easily wetly spread in a beautiful manner. Therefore, an overcoat layer having uniform luster can be formed without generating special discharging data.

[0097] In FIG. 9, an example has been explained in which the discharge area (scan area) to which the clear ink was discharged by the rear clear head 301CL2 in the previous scan is irradiated with light in a scan subsequent to the scan in which the clear ink was discharged, so that the gloss layer is formed. Alternatively, the gloss layer may be formed by irradiating the discharge area with light in a scan still after the scan subsequent to the scan in

which the clear ink was discharged.

[0098] In that case, the light emission area protruding to the rear end from the area to which the liquid is discharged by the discharge heads is further moved to the rear end, or the number of scans is increased by reducing the linefeed amount, so that in a scan at least two scans after the scan in which the clear ink was discharged, the clear ink discharge area to which the clear ink was discharged by the rear clear head 301CL2 is irradiated with light. Therefore, the clear ink discharge area is left for a longer period of time before it is irradiated with light, resulting in a gloss in which the leveling has further more progressed.

[0099] By making use of the mechanism of FIG. 9, the clear ink discharge area to which the clear ink was discharged by the rear clear head 301CL2 disposed closer to the rear end of the head unit 300 in the sub scan direction is irradiated with light after one or more scans since the clear ink was discharged, and as a result, the surface thereof becomes glossy. Back to FIG. 7, the ink discharged from the nozzles in the non-lighting portion corresponding to the lamps 401R6 to 401R8 is not immediately cured, and as a result, the ink is leveled (smoothed), and thereafter, the ink is irradiated by the lamp 401R9 to become a coating film.

[0100] As described above, in the present invention, by adjusting the light emission start timing (leveling time), the front side is made as a matte area, and the rear side is made as a gloss area (overcoat layer). Therefore, an additional operation for discharging the clear ink with a time difference is not necessary, and the matte and the gloss overcoat layers can be formed in a series of operations.

[0101] Furthermore, together with the adjustment of the light emission start timing, it is preferable to adjust the attachment amount of the clear ink in each of the matte area and the gloss area.

[0102] As a premise, in a color image formed by a color head before the clear ink is discharged, a banding is likely to be seen due to a linefeed error and the like. Accordingly, the banding is concealed by reducing a print rate at ends of the discharged ink.

[0103] When the clear ink is discharged, different masks are used for the matte area and the gloss area. More specifically, a gradation mask is used for the matte area, and a uniform mask is used for the gloss area.

[0104] In the front clear head 301CL1, it is preferable to set an adjusted discharge pattern so that the application amount of the liquid at both end portions in the sub scan direction is less than that in the central portion. In the matte area formed by the clear head, a banding is likely to be seen due to a linefeed error in a manner similar to color areas. Accordingly, a print rate at ends is lowered in a manner similar to the color areas.

[0105] The rear clear head 301CL2 adjusts the discharge amount of the clear ink so as to uniformly discharge the liquid. Even in the gloss area, when the clear ink is discharged with a large dot interval in a manner of

gradation, ink droplets are less likely to be unified, and do not easily wetly spread. Therefore, the gradation is not used. Moreover, in the gloss area, it is not necessary to use the gradation since a banding due to a line feed does not occur because the ink droplets wetly spread to become smooth.

[0106] More specifically, in FIG. 7, the color heads 301C1, 301M1, 301Y1, and 301K1 and the front clear head 301CL1 have an application amount in a form of gradation in which an application amount (print rate) is lower at both ends. Conversely, in the rear clear head 301CL2, the print rate is substantially uniform.

[0107] In the lamps 401R3 to 401R5 corresponding to the discharge area to which the clear ink is discharged by the nozzles of the front clear head 301CL1, the lamps 401R3 and 401R4 are turned on, and the lamp 401R5 is turned off. The ink discharged from the nozzles in the portion of the lamps 401R3 and 401R4 is irradiated immediately after the application, and therefore becomes a matte texture. In the matte area formed by the front clear head 301CL1, a banding is likely to be seen due to a linefeed error and the like in a manner similar to color areas. Accordingly, the banding is concealed by reducing a print rate at both ends in a manner similar to the color areas.

[0108] The lamps 401R5, 401R6, 401R7, and 401R8, which correspond to the discharge area to which the clear ink is discharged by the nozzles of the rear clear head 301CL2, i.e., the rear clear head, are turned off. Therefore, the ink discharged from the rear clear head 301CL2 is not cured immediately after the ink attaches to the color coating. Droplets in uncured ink attach to each other, and wetly spread to become smooth. If the matte layer were not formed, in a portion where the attachment amount of the color ink is little, the unevenness would become noticeable because of the base material and the color ink, and the ink of the ink coating by the rear clear head 301CL2 would not easily wetly spread in a beautiful manner.

[0109] In the embodiments of the present invention, the mater layer is formed on the color layer. The matte layer formed by the front clear head 301CL1 flows into the uneven portion to reduce the unevenness. As a result, the ink coating by the rear clear head 301CL2 in the layer on or above the matte layer spreads in a beautiful manner. Therefore, when the ink coating by the rear clear head 301CL2 is cured by the lamp 401R9, a beautiful coating film is completed. At that occasion, in a case where, e.g., the print rate of the rear clear head 301CL2 were low, droplets would not easily unify with adjacent droplets and would not easily wetly spread in a beautiful manner. Therefore, the rear clear head 301CL2 preferably has a uniform print rate to enable droplets to easily unify with adjacent droplets.

[0110] It should be noted that the adjusted discharge pattern applied to the front clear head 301CL1 is not limited to the gradation. Other examples (e.g., interleaving and reduction in the sizes of droplets) that reduce the

application amount at both ends will be hereinafter explained with FIG. 10.

[0111] When the total ink amount of the rear clear head 301CL2 is larger than the ink amount of the front clear head 301CL1, the clear ink will be smoothed in a more beautiful manner. For example, the print rate of the clear ink by the front clear head 301CL1 is set to 30% for the entire head, and the print rate of the rear clear head 301CL2 is set to 90% for the entire head.

[0112] Therefore, in order to adjust the ink amount, an adjusted pattern for at least both end portions such as the gradation pattern as described above is applied to the front clear head 301CL1 that discharges less ink amount.

<Jetting pattern>

[0113] Next, an adjusted discharge pattern of clear ink will be explained with reference to FIG. 10.

[0114] In FIG. 10, a drawing (a) is a bottom view illustrating an example of a discharge head, and drawings (b) to (e) are drawings for explaining various types of discharge patterns. FIG. 10 illustrates an example in which the length in the sub scan direction of any of discharge patterns illustrated in the drawings (b) to (e) in FIG. 10 corresponds to the length of a nozzle row N of the head illustrated in the drawing (a) in FIG. 10.

[0115] As illustrated in FIG. 8, in order to paint the matte area and the gloss area in a different manner by adjusting discharge, the matte area is painted using, as illustrated in the drawings (b) to (d) in FIG. 10, an adjusted discharge mask (i.e., a mask having an adjusted discharge pattern) in which the discharge state changes in the sub scan direction, and the gloss area is painted using, as illustrated in the drawing (e) in FIG. 10, a uniform mask (i.e., a mask having a uniform pattern).

[0116] The drawing (b) in FIG. 10 illustrates a gradation mask as an example of an adjusted discharge mask. The gradation is a process to, for image data printed by a single head, darken around the center and reduce the number of dots discharged from the nozzles (i.e., reduce the print rate) toward the ends.

[0117] Here, the print rate is a value indicating a ratio of a number of pixels in which ink is output through discharge operation according to the values of the pixel data, with respect to a total number of pixels in the pixel data corresponding to the nozzles in a head of the head unit 300.

[0118] For example, when the carriage 200 scans at a predetermined speed, the print rate becomes 100% in a case where all of any given nozzles execute discharge operation at respective positions to discharge X droplets of ink where the nozzles are capable of discharging X droplets of ink (X is an integer). However, not all the nozzles may perform discharge operation at respective positions. In such a case, the print rate (%) is a ratio of a number of times output data (drive data) for actually performing discharge operation is applied to the nozzles,

with respect to a denominator of X droplets.

[0119] The drawing (c) of FIG. 10 illustrates an end portion interleaved mask as an example of an adjusted discharge mask. In this example, the print rate gradually decreases in areas having a predetermined width E at both ends of a head in the sub scan direction. More specifically, the number of dots decreases while the sizes of the dots stay the same, so that the amount of ink attached per area is reduced.

[0120] Here, the gradation mask and the end portion interleaved mask are the same in that the dots are interleaved in a stepwise manner toward the end portion in the areas at both end portions. However, the gradation mask and the end portion interleaved mask are different in that, in the gradation mask, a central portion is darkened in a stepwise manner to compensate for the interleaving at both end portions, whereas, in the end portion interleaved mask, the adjustment processing of dots is not performed in the central portion which is not interleaved.

[0121] The drawing (d) of FIG. 10 illustrates a droplet size adjusted mask as an example of an adjusted discharge mask. In this example, the droplet size gradually decreases in areas having the predetermined width E at both ends of a head in the sub scan direction. More specifically, the sizes of dots to which the discharged droplets are attached are reduced (i.e. the sizes of the droplets are reduced), so that the amount of ink attached per area decreases.

[0122] Here, in order to adjust a droplet size, i.e., a discharge amount per droplet that is discharged from a nozzle, a droplet amount may be selected from stepwise discharge amounts including a discharge amount for a large droplet, a discharge amount for a medium droplet, and a discharge amount for a small droplet that are set in advance. Alternatively, a droplet size may be adjusted and set by finely adjusting a regulation size to a predetermined size.

<Position movement of light emitting module>

[0123] FIG. 11 is an enlarged view for explaining positions of lamps 401R1 to 401R9 in the light emitting module 400.

[0124] As a premise, when each of the light emitting blocks 401R1 to 401R9 of the lamp group 401 is smaller, control can be performed more precisely as desired, but when the element R is too small, the cost increases. Therefore, when a commercially available lamp with a predetermined width is used, the light emission range is less likely to be exactly the same as the length of the head.

[0125] For this reason, when the entire area of the rear clear head 301CL2 is attempted to be set as a gloss area, a portion of the front clear head 301CL1 that is to be a matte area would have an uncertain length.

[0126] However, since a single matte area is formed by a single head image, a matte would be incomplete

when the matte area has an inadequate length, which results in a banding.

[0127] Therefore, a range in which the front clear head 301CL1 makes a matte area is preferably extremely short, i.e., 1/4 or less, or extremely long, i.e., 3/4 or more. This is because when the matte area is extremely short, the thin matte area is unnoticeable, and when the matte area is extremely long, the print rate in a portion that does not become the matte area is extremely low, and the matte area is almost completed, which makes the banding be less likely to be noticed.

[0128] When a printing amount is high at a border between an area corresponding to the lamp 401R4 in the "ON" state and an area corresponding to the lamp 401R5 in the "OFF" state, the matte area may spread more than expected due to the effect of leakage light, which may result in banding. Therefore, in order to avoid such light effects, the border is preferably configured to be located at a position of a low print rate.

[0129] More specifically, the border between a lamp in the "ON" state and a lamp in the "OFF" state among the plurality of lamps is set in areas, at both end portions of the front clear head 301CL1 in the sub scan direction, having the predetermined width E (see FIG. 10) at both ends where the print rate is lower than other portions.

[0130] In FIG. 7 and FIG. 11, the single rear clear head 301CL2 is set for gloss, and the single front clear head 301CL1 is set for matte, but the ranges of the gloss area and the matte area can be set such that, as long as the gloss area has at least a linefeed width, the gloss area may be set as a portion of the single rear clear head 301CL2, a range slightly longer than the single rear clear head 301CL2, a plurality of rear clear heads, or the like. In this case, in a single head, the nozzles may be divided and set for a block of the gloss area and a block for the matte area.

[0131] For example, in a case where a setting of a border in a head between the range of the gloss area and the range of the matte area changes due to a change in a linefeed width, a position at a border between a lamp in the "ON" state and a lamp in the "OFF" state is also to be changed, but the position at the border between these lamps may not coincide with the position of the border in the head between the gloss area and the matte area at which the range of the matte area becomes 1/4 or less or the range of the matte area becomes 3/4 or more.

[0132] In such a case, in addition to the ON and OFF switching control of the lamps, the switching position (the border between a lamp in the "ON" state and a lamp in the "OFF" state) may be adjusted to a desired position by adjusting the position of an area L of the light emitting module 400 with respect to an area H of the nozzle row in the head unit 300 of the carriage 200.

[0133] For example, to move the light emitting module 400R, the lamp fixing pin 45 is turned to release the fixing of the lamp group 401, and the lamp group 401 is pushed or pulled, so that the lamp group 401 can be moved in the sub scan direction along the guide rail 44. When the

lamp group 401 moves to a desired position, the lamp group 401 is fixed with the lamp fixing pin 45 to complete the movement.

[0134] Such a movement of the lamp groups 401L and 401R of the light emitting module 400 is manually performed after the linefeed width is determined but before printing is executed. Note that the light emitting module 400 may be moved automatically according to a control in the apparatus.

[0135] In order to form a gloss area with a time difference from a matte area as illustrated in the drawing (d) of FIG. 9 in a single scan movement, an area that can be irradiated by the lamp groups 401L and 401R is preferably set so as to extend longer by at least a linefeed width toward the rear end of the head unit 300 in the sub scan direction than an area in which the clear ink is discharged to the recording medium 101 from the plurality of clear heads 301CL1 and 301CL2.

[0136] For example, in a case where the gloss area is formed with only the lamp 401R9 closest to the rear end of the head unit 300 in the sub scan direction, the linefeed width is set to B or less. In a case where the linefeed width is longer (i.e., wider) than B, the two rear lamps 401R8 and 401R9 may be set as the lamps for forming the gloss area.

[0137] FIG. 8 and FIG. 9 explain an example in which the head width is equal to the linefeed width, and an image for the head width is formed with a single scan, so that the ink is applied to the area of the head unit 300 in the sub scan direction with three scans, but the setting for allocating the matte and the gloss according to the present invention can also be applied to a multi-pass printing sequence.

[0138] In a case of the multi-pass printing sequence, a linefeed occurs with a linefeed width shorter than the length of the head in the sub scan direction. For example, in a case where an image is formed in the sub scan direction with 24 scans (scan movements) with the head unit 300 in the sub scan direction, the area to which the color ink is discharged is 1/3 of the head unit 300. Therefore, the number of scans per each head area is eight (the number of linefeeds is seven). Hereinafter explained is an example of multi-pass printing of "4 passes" with "1/2 interlace", which means that the number of divisional printing in the main scan direction X (i.e., pass) is four times and the number of divisional printing in the sub scan direction Y (i.e. interlace) is two times, and accordingly, the number of scans is eight times ($n=8$).

[0139] In this case, as illustrated in the drawing (b) of FIG. 9, the front clear head 301CL1 starts to discharge clear ink from the ninth (i.e., $(n+1)$ -th) scan, and as illustrated in the drawing (c) of FIG. 9, the rear clear head 301CL2 starts to discharge clear ink from the seventeenth (i.e., $(2n+1)$ -th) scan.

[0140] Further, as illustrated in the drawing (d) of FIG. 9, the area in which the rear clear head 301CL2 discharged the clear ink starts to be irradiated from the twenty-fifth (i.e., $(3n+1)$ -th) scan.

<Flow of discharge adjustment and light emission adjustment>

[0141] Next, discharge adjustment and light emission adjustment according to the first embodiment will be explained with reference to FIG. 12. FIG. 12 is a control flow of discharge and light emission adjustment according to the first embodiment.

[0142] In step S1, a print sequence and a linefeed width are set.

[0143] In step S2, widths of a matte area and a gloss area are set. In a case of multi-pass printing, the width of the gloss area is set to be the same as the linefeed width or larger than the linefeed width that is set in step S1. In a case of single scan printing, the width of the gloss area is set to be the same as a scan area excluding an overlapped area between scans, or larger than the scan area.

[0144] In step S3, the position of the lamp groups 401L and 401R of the light emitting module 400 are moved. In a case where this step is unnecessary because, e.g., the linefeed width is the same as that in the previous scan, this step may be omitted.

[0145] In step S3, the lamp groups 401L and 401R are set so that an area that can be irradiated by the lamp groups 401L and 401R in a single scan movement is set so as to extend longer by at least the linefeed width toward the rear end of the head unit 300 in the sub scan direction than an area in which the clear ink is discharged to the recording medium 101 from the plurality of heads.

[0146] In step S4, an adjusted discharge pattern is selected for the front clear head 301CL1. More specifically, any one of adjusted discharge patterns is selected and set for the front clear head 301CL1. The adjusted discharge patterns include gradation, interleaving, and droplet size adjustment as illustrated in the drawings (b) to (d) in FIG. 10, in which the application amounts of the liquid at both end portions in the sub scan direction are less than the application amount of the liquid in the central portion.

[0147] In step S5, the lamps are turned on and off in the light emitting module 400 according to configured control information so as to be in conformity with the lengths of the matte area and the gloss area in the sub scan direction that are set in step S2. In the example as illustrated in FIG. 7, the lamps 401R1, 401R2, 401R3, 401R4, and 401R9 are turned on, and the lamps 401R5, 401R6, 401R7, and 401R8 are turned off.

[0148] In step S6, at a position closer to the front end of the head unit 300 relative to the area where the clear ink is discharged by the clear heads 301CL1 and 301CL2 while the head unit 300 moves in the main scan direction, the color head (e.g., 301K1, 301Y1, 301M1, and 301C1) for discharging color ink discharges the color ink through the gradation mask for each head.

[0149] In S7, while the head unit 300 moves in the main scan direction, the front clear head 301CL1 for discharging clear ink discharges the clear ink through a mask of

the adjusted discharge pattern which has been set, and the rear clear head 301CL2 discharges the clear ink with a uniform pattern.

[0150] Here, for example, where there are, in the sub scan direction, m rows of heads discharging the color ink and two rows of heads discharging the clear ink, and the number of scans per each head area is n times, the clear ink is not discharged up to the discharging in the $(m \times n)$ -th scan (e.g., in the case of the drawing (a) of FIG. 9, the $(m \times n)$ -th scan is the first scan because $m=1$ and $n=1$) in which a head closest to the rear end of the head unit 300 starts to scan the recording medium 101.

[0151] Up to the $\{(m+1) \times n\}$ -th scan (e.g., in the case of the drawing (b) of FIG. 9, the $\{(m+1) \times n\}$ -th scan is the second scan) on the recording medium 101, the clear ink is discharged only by the front clear head 301CL1, and is not discharged by the rear clear head 301CL2.

[0152] In step S8, at the end of the movement in the main scan direction, predetermined blocks of the lamp group 401 of the light emitting module 400 emit light to the area in which the liquid is applied to the recording medium 101 by the front clear head 301CL1. As described above, the area to which the liquid is applied by the front clear head 301CL1 to the recording medium 101 is irradiated with the light and cured to become matte, immediately after the liquid is discharged.

[0153] It should be noted that steps S6 to S8 are executed in a single scan in the main scan direction (see the drawing (c) of FIG. 9). The area to which the rear clear head 301CL2 discharges the clear ink in the $\{(m+1) \times n + 1\}$ -th scan (e.g., in the example of the drawing (c) of FIG. 9, the $\{(m+1) \times n + 1\}$ -th scan is the third scan) and subsequent scans starts to be irradiated to form the gloss area in the $\{(m+2)n + 1\}$ -th scan (e.g., in the example of the drawing (d) of FIG. 9, the $\{(m+2)n + 1\}$ -th scan is the fourth scan). More specifically, the gloss area starts to be irradiated after main scans are performed n times ($\{(m+2)n + 1\} - \{(m+1) \times n + 1\} = n$) or more as of the main scan in which the rear clear head 301CL2 starts to discharge the clear ink.

[0154] In step S9, the carriage 200 is moved for the linefeed width in the sub scan direction.

[0155] The above operation is repeated until the print stops in step S10.

[0156] The color heads 301K1, 301Y1, 301M1, 301C1, and 301S1 and the like disposed closest to the front end of the head unit 300 reach a position facing the end of the discharge area on the recording medium 101 defined based on the image data before the clear heads 301CL1 and 301CL2 reach the position facing the end of the discharge area. For this reason, when the color heads 301K1, 301Y1, 301M1, 301C1, and 301S1 reach a position facing the end of the discharge area on the recording medium 101, the nozzles are stopped from discharging the color ink in an order from the nozzles located at the more upstream side. After the color head stops discharging the color ink, the clear heads 301CL1 and 301CL2 continue to discharge the clear ink so as to cover

the entire area in which the color ink droplets are landed on the recording medium 101 by the color heads 301K1, 301Y1, 301M1, 301C1, and 301S1. Further, the light is emitted with a time difference to the clear ink droplets discharged from the rear clear head 301CL2 so that the entire uppermost layer of all the discharge area becomes the gloss area.

[0157] When the printing stops, the lamps 401R1, 401R2, 401R3, 401R4, and 401R9 which are the blocks in the "ON" state are turned off in the light emitting module 400.

[0158] According to such a control, with a series of operations (at a high speed), it can be achieved that the color and clear inks discharged by the color heads and the front clear head 301CL1 are smoothed by removing unevenness to become the matte area, and the ink discharged by the rear clear head 301CL2 attains a uniformly leveled state to become a beautiful gloss area.

[0159] Therefore, the matte layer and the overcoat layer are formed in a single job without generating data of the matte layer, and therefore, the productivity of the overcoat layer without any unevenness in luster can be enhanced. In other words, in the embodiment of the present invention, the overcoat layer without unevenness in luster can be formed while the productivity is enhanced.

[0160] In this flow, for the sake of simplifying the explanation, the front clear head 301CL1 is set as matte, and the rear clear head 301CL2 is set as gloss, but for example, as illustrated in FIG. 7, in the head discharging the clear ink, at least a part of the front side of the front clear head 301CL1 may be set as matte, and the rear clear head 301CL2 and a remaining portion at a rear side of the front clear head 301CL1 may be set as gloss.

[0161] In that case, in step S8, at the end of the movement in the main scan direction, predetermined blocks of the lamp group 401 of the light emitting module 400 emit light to the area in which the liquid is applied to the recording medium 101 by the front clear head 301CL1. As described above, the area to which the liquid is applied to the recording medium 101 is irradiated with the light by at least a part of a front side of the front clear head 301CL1 and cured to become matte, immediately after the liquid is discharged.

[0162] The area in which the liquid is applied to the recording medium 101 by the rear clear head 301CL2 and the remaining portion of the front clear head 301CL1 relatively close to the rear end of the head unit 300 in the sub scan direction is not irradiated in step S8 immediately after step S7, and then, a linefeed occurs (step S9), and in a scan after the area is left for multiple scans (i.e., n scans) to level the area, the area is irradiated by the lamp 401R9 in the "ON" state to become the gloss area.

[0163] In the above example, two types of inks, i.e., the color ink droplets and the clear ink droplets, are landed. However, the above control of the overcoat layer can also be performed in a print mode for forming a primer layer as a foundation between the recording medium 101 and the color ink droplets. In the case of the print mode

constituting the primer layer, control for the layers above the color ink droplets are similar to the above-explained FIG. 9, and the clear ink droplets and the color ink droplets discharged by the color heads and the front clear head 301CL1 are irradiated with the light in the same scan, and the clear ink droplets discharged by the rear clear head 301CL2 are irradiated with the light in subsequent scans, so that desired matte areas and gloss areas can be formed.

[0164] In the flow of FIG. 12, the front clear head 301CL1 is explained as "front nozzles", and the rear clear head 301CL2 is explained as "rear nozzles", but the "front nozzles" may be "some of nozzles of the front clear head relatively close to the front end of the head unit", and the "rear nozzles" may be "nozzles of the rear clear head and the remaining nozzles of the front clear head".

[0165] In a case where the matte area and the gloss area are set using only one clear head, the "front nozzles" are "some of the nozzles of the head relatively close to the front end of the head unit", and the "rear nozzles" are "nozzles in a remaining portion of the head relatively close to the rear end of the head unit". In this case, in the clear head, the adjusted discharge pattern is preferably configured in a different manner between the front side and the rear side. Alternatively, a uniform discharge pattern may be set.

<Scan position in second embodiment>

[0166] In FIG. 7 to FIG. 12, a light emission and discharge control example has been explained in a configuration for relatively moving the carriage 200 having the head unit 300 and the light emitting module 400 relative to the recording medium 101 in the sub scan operation according to the first embodiment. However, the above control can also be applied to the second embodiment illustrated in FIG. 5.

[0167] In the second embodiment, in illumination adjustment and discharge adjustment control in the sub scan direction, the matte area is formed by an upstream clear head disposed relatively close to the upstream side in the conveying direction of the recording medium 101, and the gloss area is formed by a downstream clear head disposed relatively close to the downstream side in the conveying direction of the recording medium 101.

[0168] Therefore, in the second embodiment, in the flow of FIG. 12, the "front clear head" in steps S4, S7, and S8 is assumed to be a "an upstream clear head in a conveying direction of a recording medium", and the "rear clear head" is assumed to be "a downstream clear head in the conveying direction of the recording medium". Instead of moving the carriage 200 for a number of linefeeds in the sub scan direction in step S9, the recording medium 101 is moved for a number of linefeeds in the sub scan direction by the conveying belt 71. Other than that, the second embodiment is similar to the first embodiment.

[0169] In the second embodiment, a plurality of heads

discharging clear ink are provided in the conveying direction of the recording medium 101, and the light emission start timing is differentiated between the upstream clear head and the downstream clear head in the conveying direction, so that the gloss layer is formed on the matte layer for each linefeed width in at least the second and subsequent scans, and therefore, the completed uppermost layer at the downstream-most side becomes the gloss layer at all times.

[0170] According to such control, also in the second embodiment, the matte area at the upstream side of the clear area is smoothed by removing unevenness caused by the color area, and the gloss area at the downstream side of the clear area attains a uniformly leveled state, and a beautiful gloss can be obtained in a series of operations (at a high speed). Therefore, without generating data of the matte layer, the matte layer and the overcoat layer are formed in a single job, and therefore, the productivity of the overcoat layer without unevenness in luster can be enhanced. In other words, the overcoat layer without unevenness in luster is formed while a high productivity is maintained.

[0171] In the above explanation, the upstream clear head is assumed to include "upstream nozzles", and the downstream clear head is assumed to include "downstream nozzles", but in the second embodiment, the "upstream nozzles" may be some of the nozzles of the upstream clear head relatively close to the upstream side, and the "downstream nozzles" may be nozzles of the downstream clear head and remaining nozzles of the upstream clear head relatively close to the downstream side.

[0172] In a case where the matte area and the gloss area are set using a single clear head, "the upstream nozzles" are some of the nozzles of the single clear head relatively close to the upstream side, and "the downstream nozzles" are remaining nozzles of the single clear head relatively close to the downstream side. In this case, in the single clear head, the adjusted discharge pattern is preferably configured differently between the upstream side and the downstream side. Alternatively, a uniform discharge pattern may be set for the single clear head.

[0173] According to an aspect of the present invention, a liquid discharge apparatus (10) includes:

a head unit (300) having a plurality of nozzles aligned in a sub scan direction, the nozzles configured to discharge liquid curable by light onto a recording medium;

a light emitting module (400) coupled to the head unit and having a plurality of light emitting elements aligned in the sub scan direction, the light emitting elements configured to emit light to irradiate the liquid on the recording medium to cure the liquid;

a scan unit (71, 19) configured to perform a main scan movement and a sub scan movement, the main scan movement causing the head unit and the light emitting module to move in a main scan direction

perpendicular to the sub scan direction, and the sub scan movement causing the recording medium to move in the sub scan direction; and

a light-emission control unit (28) configured to control on-and-off states of at least one of the light emitting elements independently,

wherein the nozzles discharge the liquid and the light emitting module emits light during at least a part of the scan movements, and

wherein a time interval between a discharge and a start of irradiation of the liquid discharged by the nozzle relatively close to a downstream end of the head unit in the sub scan direction is longer than a time interval between a discharge and a start of irradiation of the liquid discharged by the nozzle relatively close to an upstream end of the head unit in the sub scan direction.

[0174] The preferred embodiments of the present invention have been described in detail above, but the present invention is not limited to the specific embodiments, and various modifications and changes can be made within the scope of the gist of the embodiments of the present invention described in the claims.

[0175] For example, in the above embodiments, the inkjet recording apparatus having the recording head according to the present invention has been explained, but the liquid discharge head and the control thereof according to the present invention can be widely applied to apparatuses for discharging liquid including inkjet recording apparatuses.

[0176] In the present application, the "liquid discharge apparatus" is an apparatus having a liquid discharge head or a liquid discharge unit and discharging liquid by driving the liquid discharge head.

[0177] The recording media on which the liquid discharge apparatus can print include things to which the liquid can be attached at least temporarily, and include those to which the liquid is attached and fixed and those to which the liquid is attached and permeates. Specific examples of recording media include: media in which an image is recorded such as a sheet, a recording sheet, recording paper, a film, and cloth; electronic components such as an electronic circuit board and a piezoelectric device; and media such as a powder bed, an organ model, and a test cell. Unless otherwise specified, the recording media on which the liquid discharge apparatus can print include all those to which the liquid can be attached.

[0178] The recording media on which the liquid discharge apparatus can print may be things to which the liquid can be attached even temporarily, such as paper, thread, fiber, fabric, leather, metal, plastic, glass, wood, ceramics, and the like.

[0179] Pressure generating means to be used in the "liquid discharge head" is not limited. For example, the liquid discharge head may use a piezoelectric actuator (which may be an actuator using a laminated piezoelectric element), a thermal actuator using an electrothermal

conversion element such as a heating resistor, and an electrostatic actuator composed of a vibration plate, a counter electrode, and the like.

[0180] All of the terms "image formation", "recording", "printing", "modeling", and the like in this application are to be considered as synonyms.

Claims

1. A liquid discharge apparatus (10) comprising:

a head unit (300) having a plurality of nozzles aligned in a sub scan direction, the nozzles configured to discharge liquid curable by light onto a recording medium;

a light emitting module (400) coupled to the head unit and having a plurality of light emitting elements aligned in the sub scan direction, the light emitting elements configured to emit light to irradiate the liquid on the recording medium to cure the liquid;

a scan unit (71, 19) configured to perform a main scan movement and a sub scan movement, the main scan movement causing the head unit and the light emitting module to move in a main scan direction perpendicular to the sub scan direction, and the sub scan movement causing the head unit and the light emitting module to move in the sub scan direction; and

a light-emission control unit (28) configured to control on-and-off states of at least one of the light emitting elements independently, wherein the nozzles discharge the liquid and the light emitting module emits light during at least a part of the scan movements, and wherein a time interval between a discharge and a start of irradiation of the liquid discharged by the nozzle located relatively close to a rear end of the head unit in the sub scan direction is longer than a time interval between a discharge and a start of irradiation of the liquid discharged by the nozzle located relatively close to a front end of the head unit in the sub scan direction.

2. The liquid discharge apparatus (10) according to claim 1, wherein the liquid discharged, in a first main scan movement, onto the recording medium by the nozzle located relatively close to the front end of the head unit in the sub scan direction is irradiated in the first main scan movement, and the liquid discharged, in the first main scan movement, onto the recording medium by the nozzle located relatively close to the rear end of the head unit in the sub scan direction is irradiated in a second main scan movement that is performed after sub scan movement is performed one or more times since the first main scan movement.

3. The liquid discharge apparatus (10) according to claim 2, wherein an irradiation area on the recording medium to which the light emitting module (400) is capable of emitting light in the main scan movement is configured to extend longer toward a rear end in the sub scan direction than a liquid discharge area on the recording medium to which the plurality of nozzles are capable of discharging liquid in the main scan movement, and

wherein in the main scan movement, the light emitting control unit is configured to turn on at least one of the plurality of light emitting elements (401R1 to 401R4) corresponding to, in the sub scan direction, a position of the nozzle located relatively close to the front end of the head unit in the sub scan direction and at least one of the plurality of light emitting elements (401R9) disposed closer to, in the sub scan direction, the rear end of the head unit than the rear nozzles, and is configured to turn off at least one of the plurality of light emitting elements (401R5 to 401R8) corresponding to, in the sub scan direction, a position of the nozzle located relatively close to the rear end of the head unit in the sub scan direction.

4. The liquid discharge apparatus (10) according to any one of claims 1 to 3, wherein the head unit (300) includes a plurality of heads provided with the plurality of nozzles, the plurality of heads including a front clear head (301CL1) and a rear clear head (301CL2), the front clear head being relatively close to the front end of the head unit in the sub scan direction, and the rear clear head being relatively close to the rear end of the head unit in the sub scan direction,

wherein the nozzle located relatively close to the front end of the head unit in the sub scan direction constitute the front clear head, and the nozzle located relatively close to the rear end of the head unit in the sub scan direction constitute the rear clear head.

5. The liquid discharge apparatus (10) according to any one of claims 1 to 3, wherein the head unit (300) includes a plurality of heads provided with the plurality of nozzles, the plurality of heads including a front clear head (301CL1) and a rear clear head (301CL2), the front clear head being relatively close to the front end of the head unit in the sub scan direction, and the rear clear head being relatively close to the rear end of the head unit in the sub scan direction,

the nozzle located relatively close to the front end of the head unit in the sub scan direction include some of nozzles of the front clear head relatively close to the front end of the head unit in the sub scan direction, and

the nozzle located relatively close to the rear end of the head unit in the sub scan direction include noz-

- zles in an entire area of the rear clear head and remaining nozzles of the front clear head relatively close to the rear end of the head unit in the sub scan direction.
6. The liquid discharge apparatus (10) according to claim 4 or 5, further comprising a liquid discharge amount adjusting unit (27B, 27C, 27D, 27E) for adjusting an application amount of liquid onto the recording medium by the front clear head to be less than an application amount of liquid onto the recording medium by the rear clear head.
 7. The liquid discharge apparatus (10) according to claim 6, wherein the liquid discharge amount adjusting unit (27B, 27C, 27D, 27E) causes the front clear head to discharge liquid so that application amounts of liquid at both end portions are less than an application amount in a central portion in the sub scan direction, and the liquid discharge amount adjusting unit causes the rear clear head to uniformly discharge the liquid.
 8. The liquid discharge apparatus (10) according to claim 7, wherein the liquid discharge amount adjusting unit (27B, 27C, 27D, 27E) adjusts a discharge amount of the liquid by the front clear head in a manner of a gradation in which an application amount gradually decreases toward both end portions in the sub scan direction.
 9. The liquid discharge apparatus (10) according to claim 7, wherein the liquid discharge amount adjusting unit (27B, 27C, 27D, 27E) adjusts a discharge amount of the liquid by the front clear head so that a number of dots to be discharged is interleaved and reduced in predetermined areas at both end portions in the sub scan direction.
 10. The liquid discharge apparatus (10) according to claim 7, wherein the liquid discharge amount adjusting unit (27B, 27C, 27D, 27E) adjusts a discharge amount of the liquid by the front clear head so that droplet sizes of dots to be discharged are reduced in predetermined areas at both end portions in the sub scan direction.
 11. The liquid discharge apparatus (10) according to any one of claims 4 to 10, wherein in a case where an image is formed by multi-pass printing in which scanning is performed n times per each head area, a liquid discharged, in a first pass of the multi-pass printing, onto the recording medium by the nozzle located relatively close to the rear end of the head unit in the sub scan direction is irradiated in a main scan movement that is performed after main scan movement is performed n times as of the first pass of the multi-pass printing.
 12. The liquid discharge apparatus (10) according to any one of claims 1 to 4, wherein the head unit (300) includes a head provided with the plurality of nozzles, the nozzle located relatively close to the front end of the head unit in the sub scan direction include some of the nozzles of the head relatively close to the front end of the head unit in the sub scan direction, and the nozzle located relatively close to the rear end of the head unit in the sub scan direction include remaining nozzles of the head relatively close to the rear end of the head unit in the sub scan direction.
 13. A light emission control method performed by a liquid discharge apparatus (10), wherein the liquid discharge apparatus includes:
 - a head unit (300) having a plurality of nozzles aligned in a sub scan direction, the nozzles configured to discharge liquid curable by light onto a recording medium;
 - a light emitting module (400) coupled to the head unit and having a plurality of light emitting elements aligned in the sub scan direction, the light emitting elements configured to emit light to irradiate the liquid on the recording medium to cure the liquid; and
 - a scan unit (71, 19) configured to perform a main scan movement and a sub scan movement, the main scan movement causing the head unit and the light emitting module to move in a main scan direction perpendicular to the sub scan direction, and the sub scan movement causing the head unit and the light emitting module to move in the sub scan direction,
 wherein the light emission control method comprises:
 - discharging, at a first point in time, liquids onto the recording medium;
 - irradiating, at a second point in time, the liquid discharged onto the recording medium by the nozzle located relatively close to a front end of the head unit in the sub scan direction; and
 - irradiating, at a third point in time, the liquid discharged onto the recording medium by the nozzle located relatively close to a rear end of the head unit in the sub scan direction,
 wherein an interval between the first point in time and the third point in time is longer than an interval between the first point in time and the second point in time.
 14. A light emission control program for a liquid discharge apparatus (10), wherein the liquid discharge apparatus includes:

a head unit (300) having a plurality of nozzles aligned in a sub scan direction, the nozzles configured to discharge liquid curable by light onto a recording medium;

a light emitting module (400) coupled to the head unit and having a plurality of light emitting elements aligned in the sub scan direction, the light emitting elements configured to emit light to irradiate the liquid on the recording medium to cure the liquid; and

a scan unit (71, 19) configured to perform a main scan movement and a sub scan movement, the main scan movement causing the head unit and the light emitting module to move in a main scan direction perpendicular to the sub scan direction, and the sub scan movement causing the head unit and the light emitting module to move in the sub scan direction,

wherein the light emission control program causes the liquid discharge apparatus to perform operations comprising:

discharging, at a first point in time, liquids onto the recording medium;

irradiating, at a second point in time, the liquid discharged onto the recording medium by the nozzle located relatively close to a front end of the head unit in the sub scan direction; and

irradiating, at a third point in time, the liquid discharged onto the recording medium by the nozzle located relatively close to a rear end of the head unit in the sub scan direction,

wherein an interval between the first point in time and the third point in time is longer than an interval between the first point in time and the second point in time.

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FIG.1

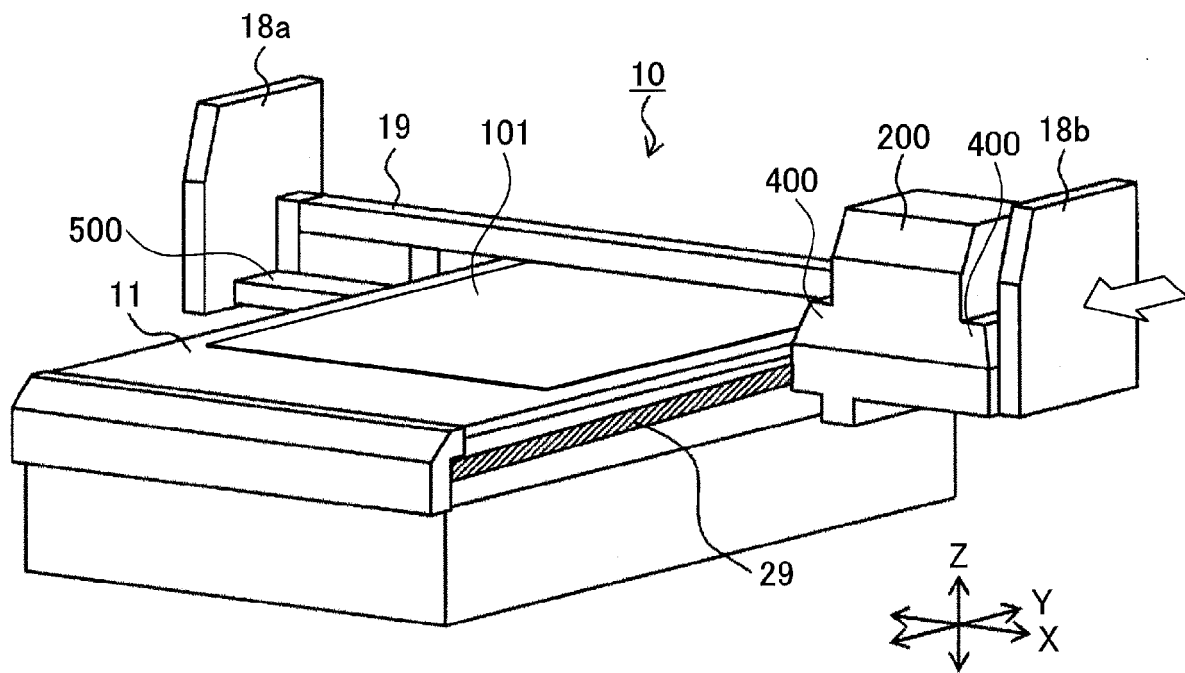


FIG.2

200

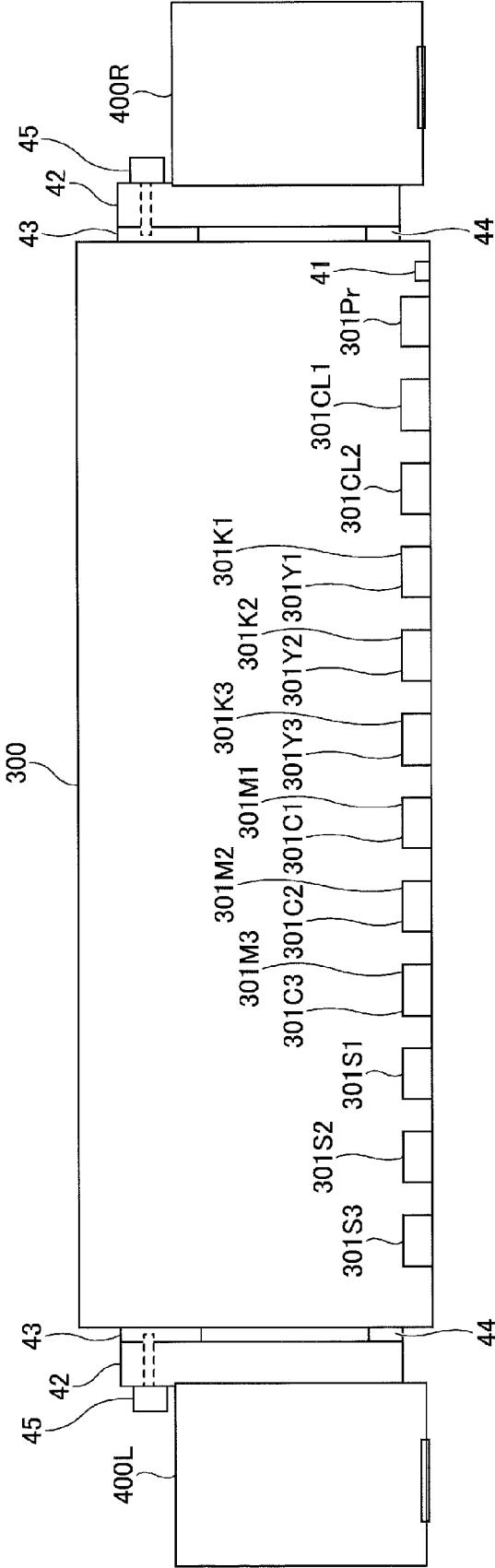


FIG.3

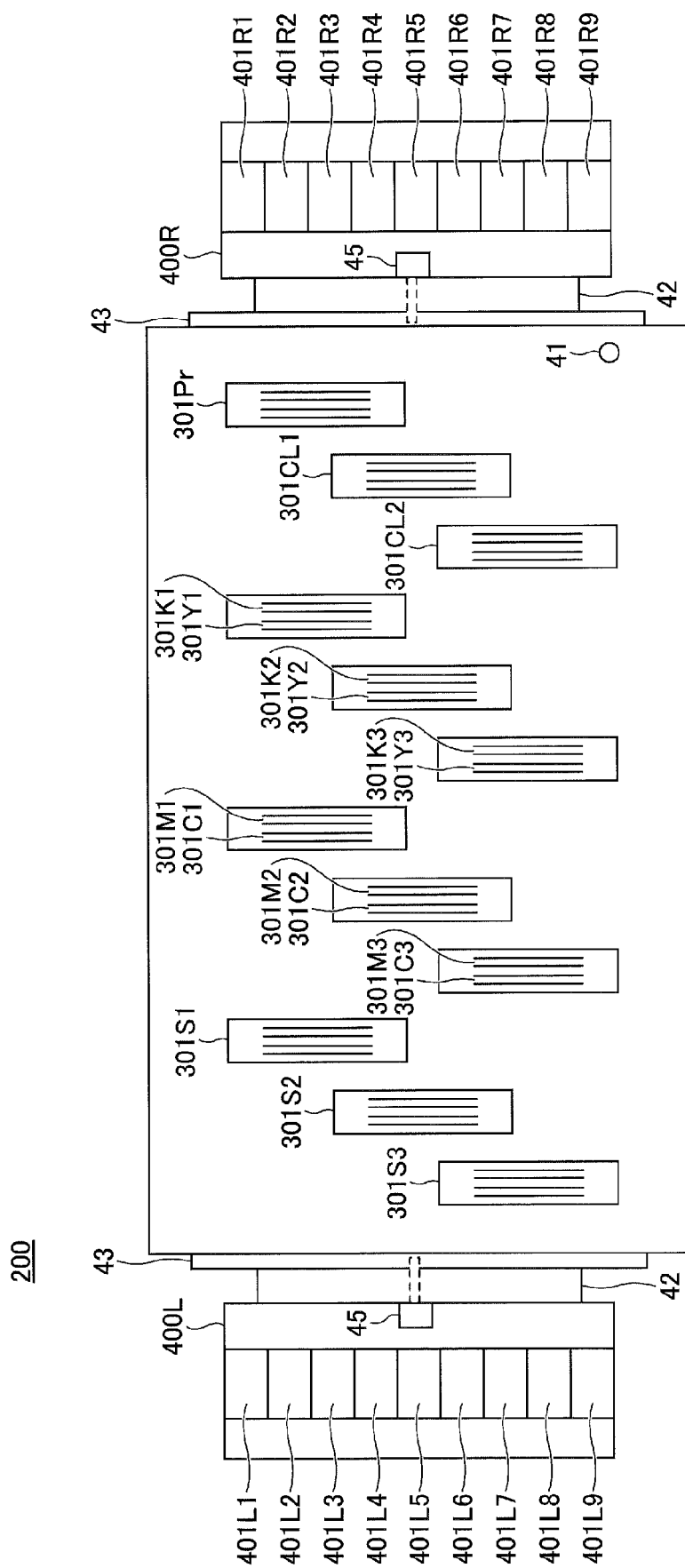
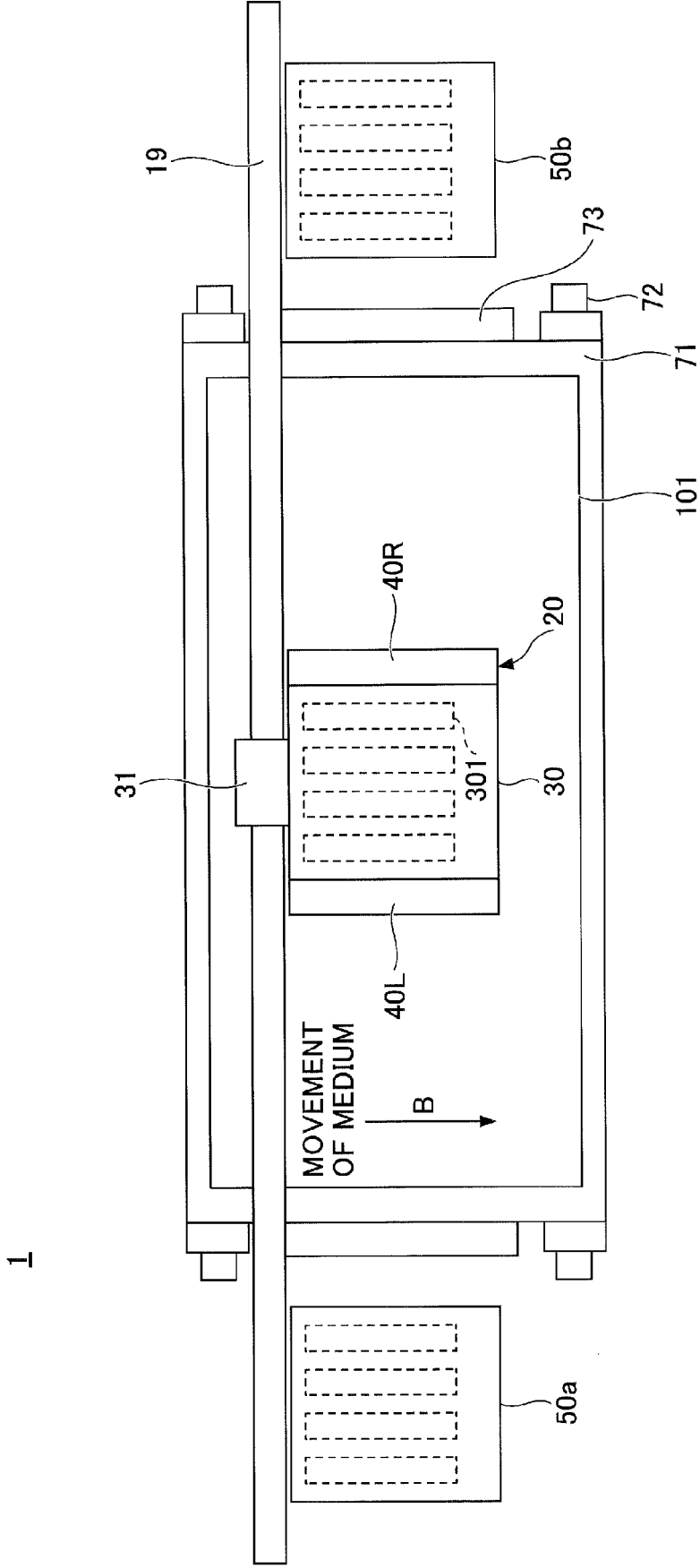


FIG.4



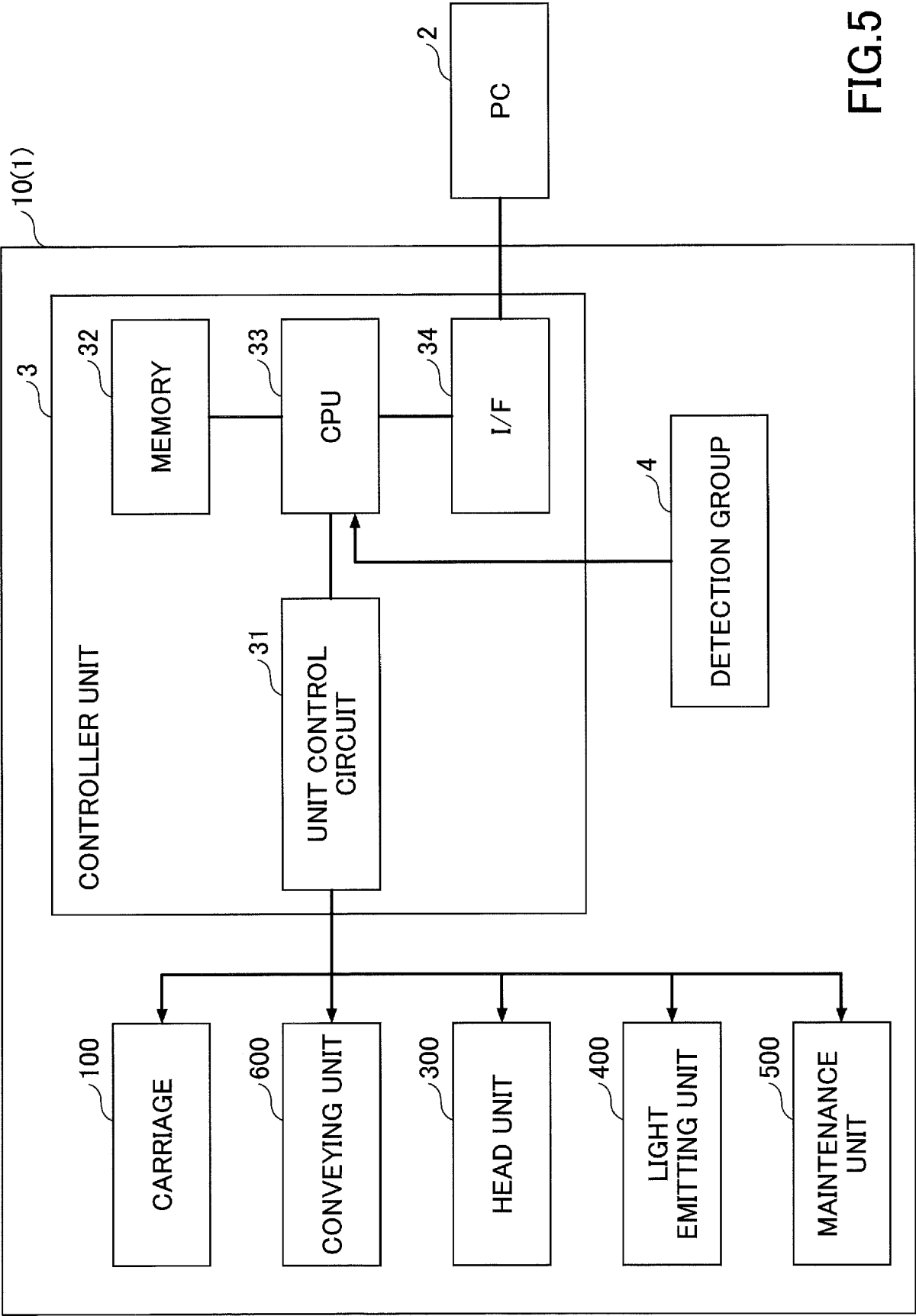


FIG.5

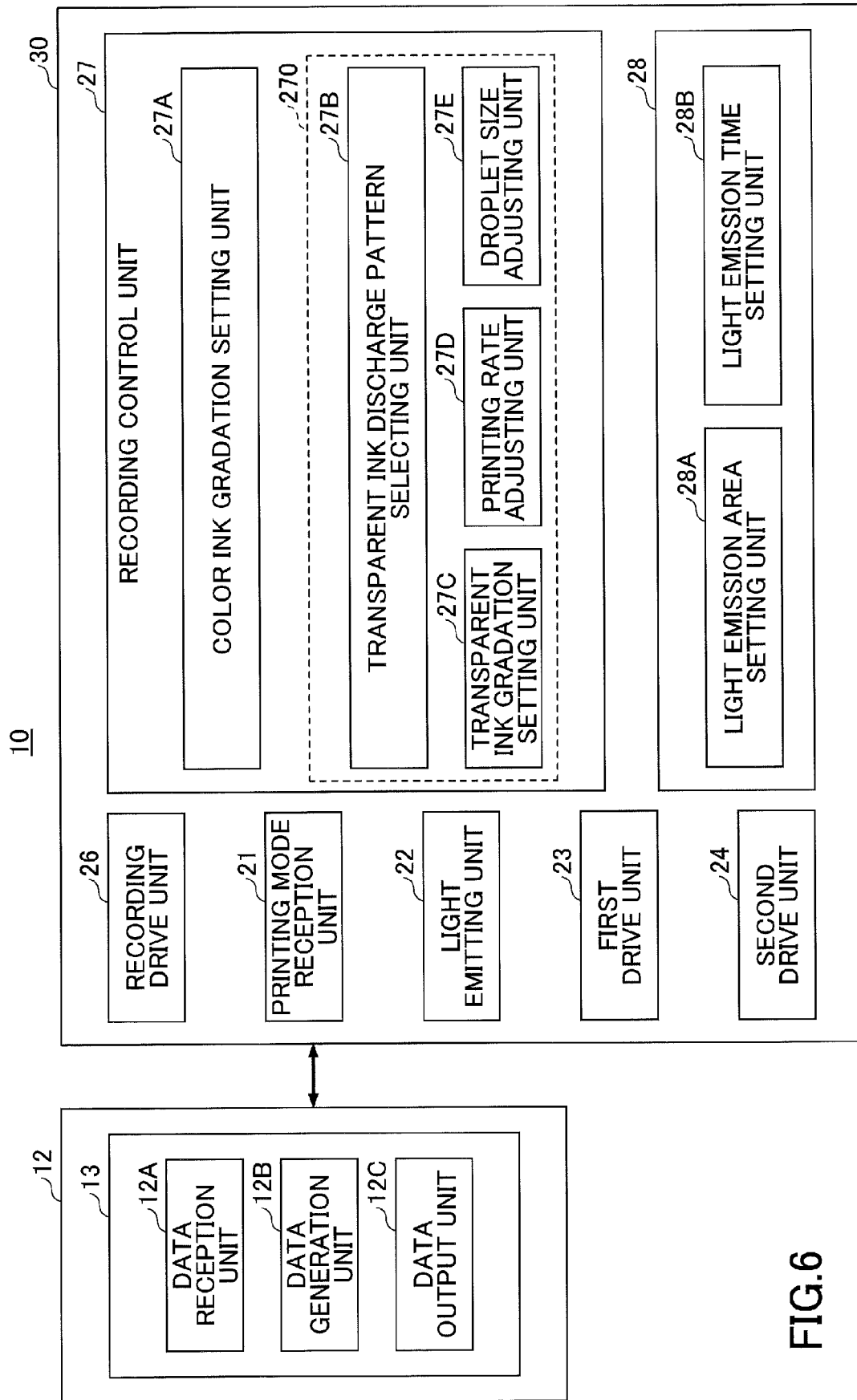


FIG.6

FIG.7

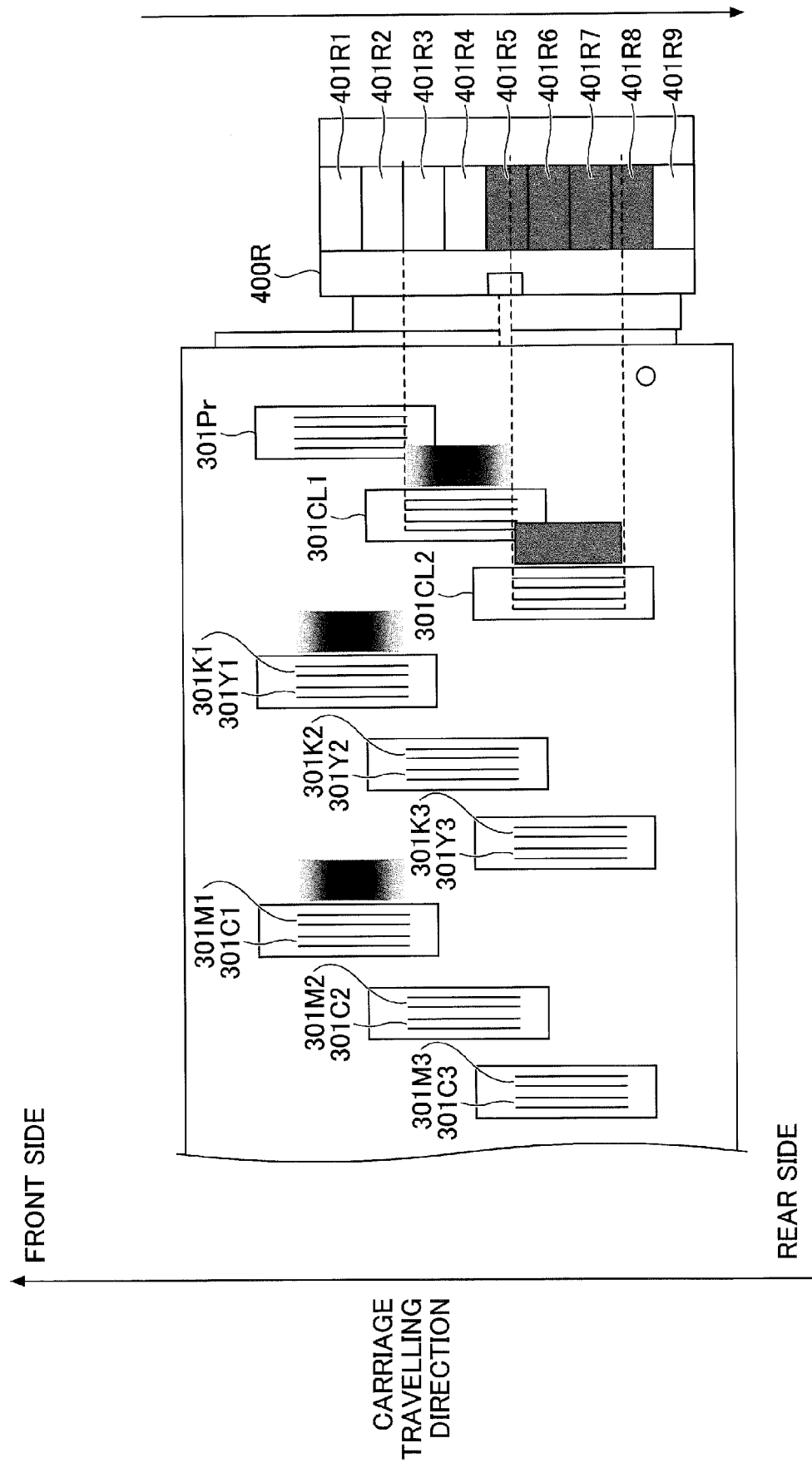


FIG.8

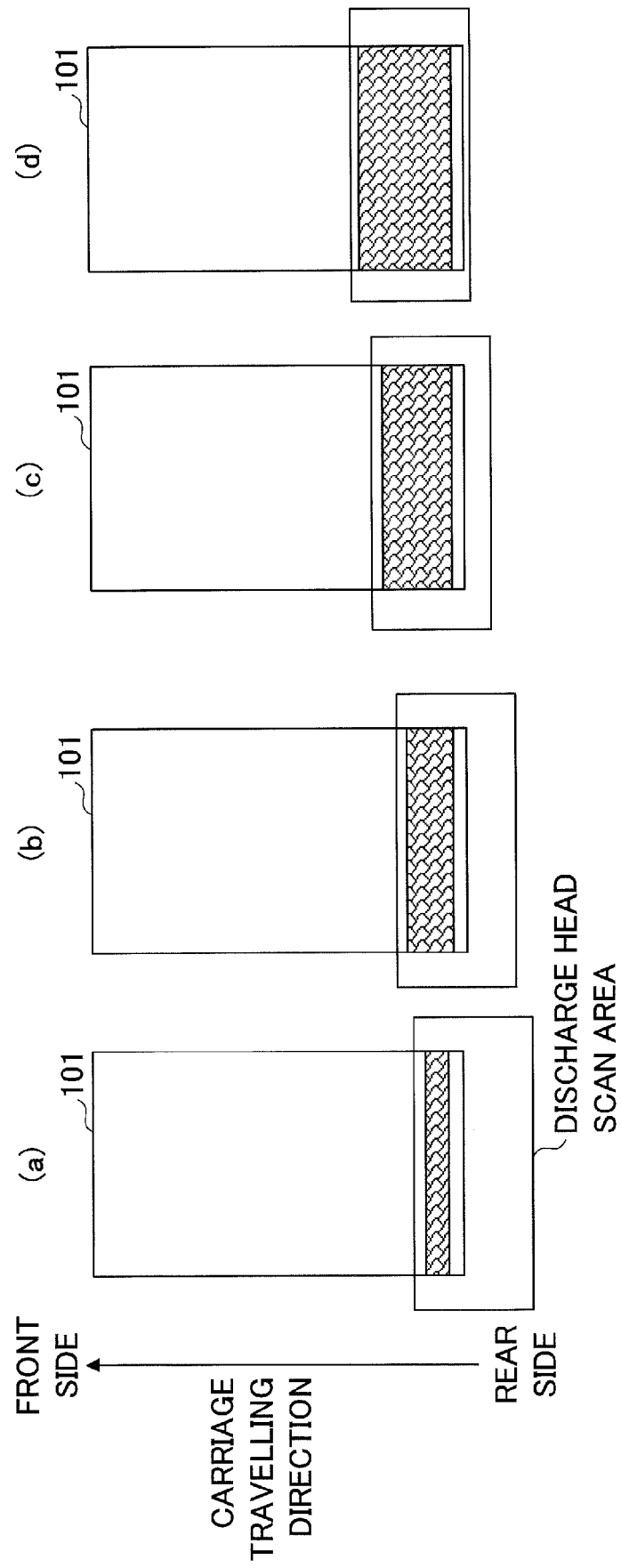


FIG.9

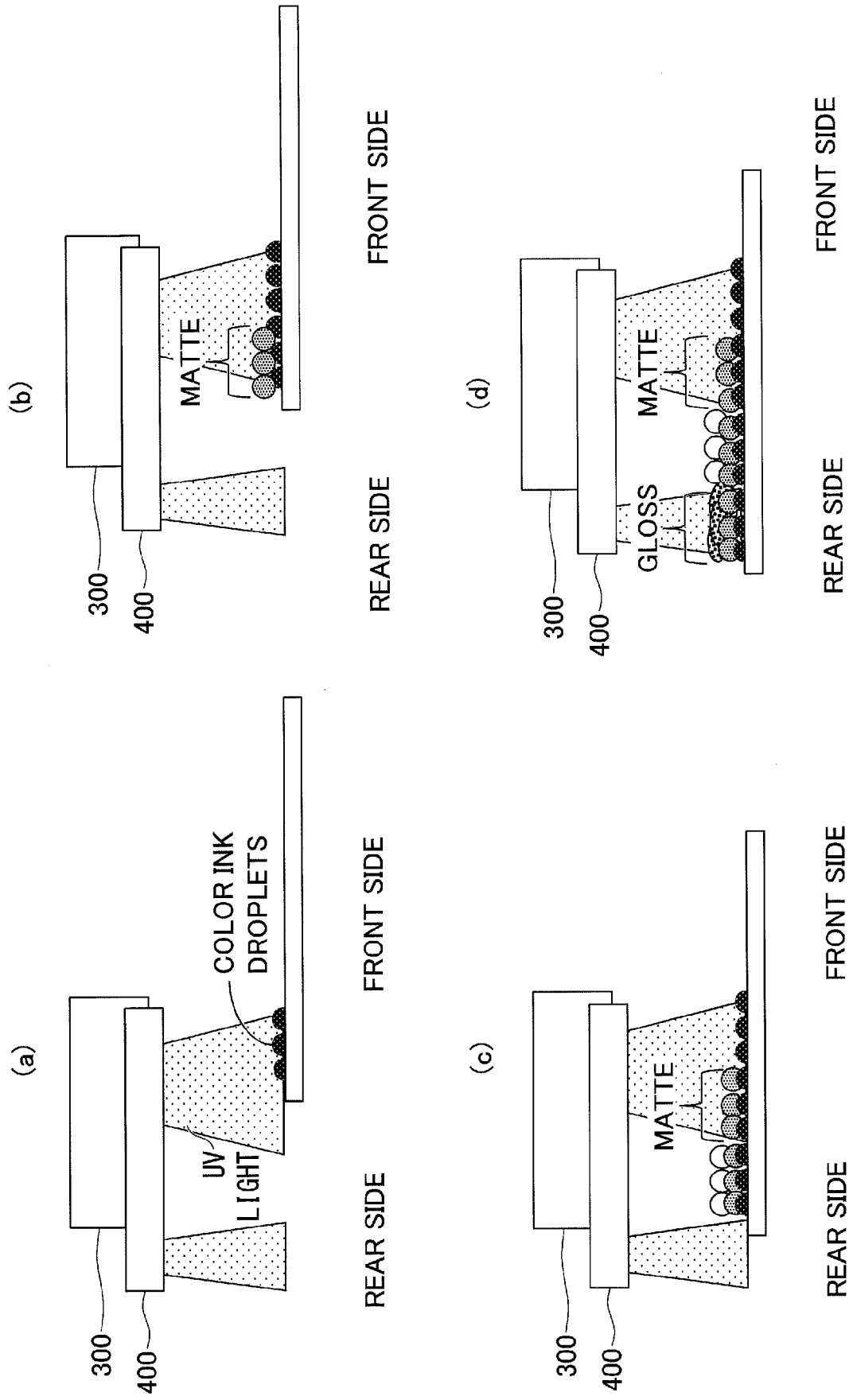


FIG.10

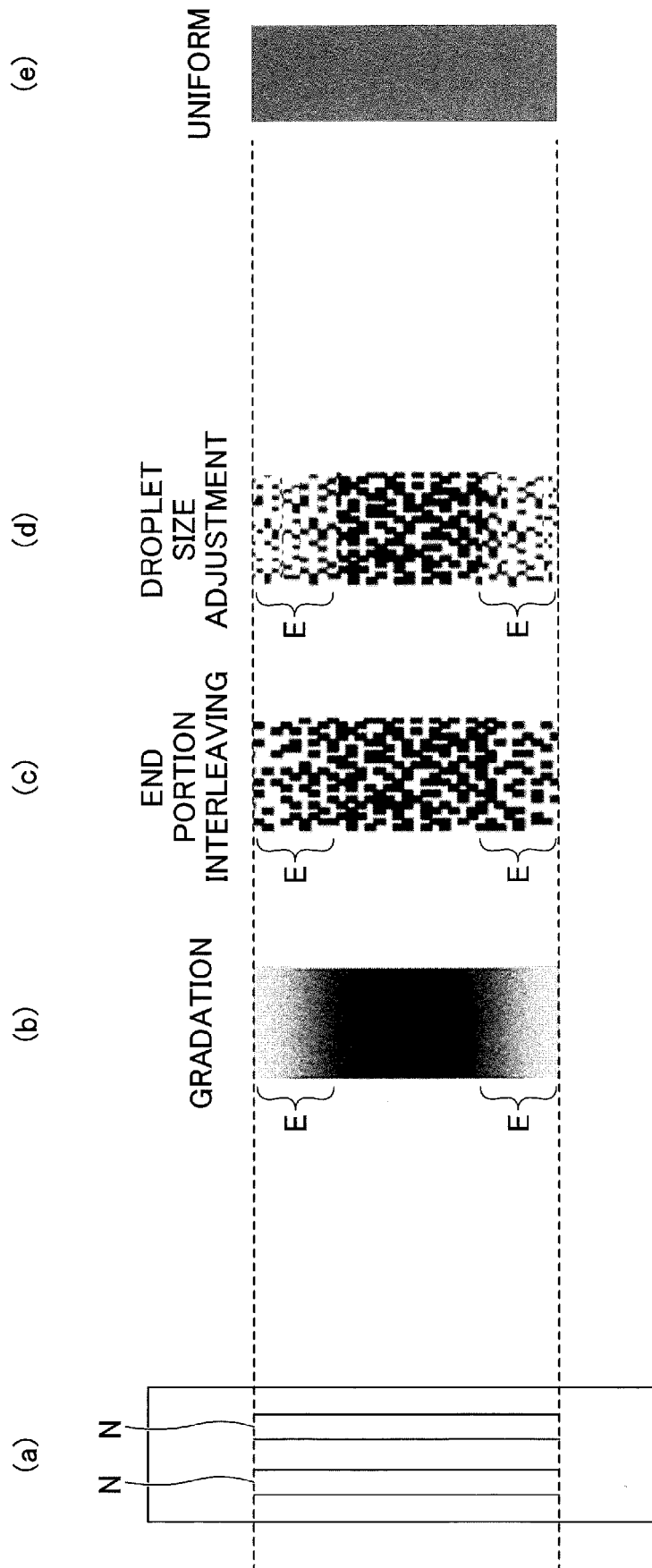


FIG.11

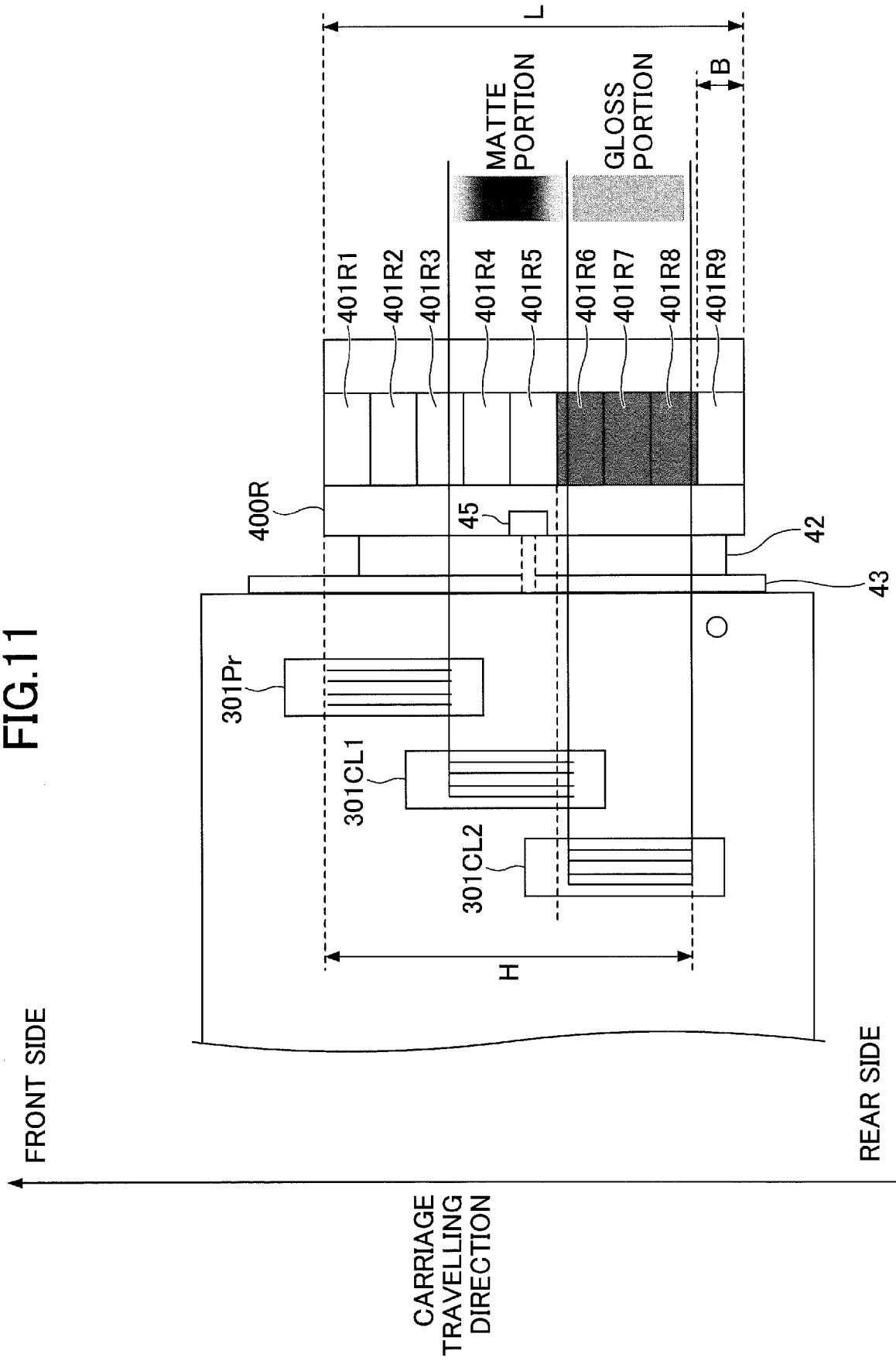
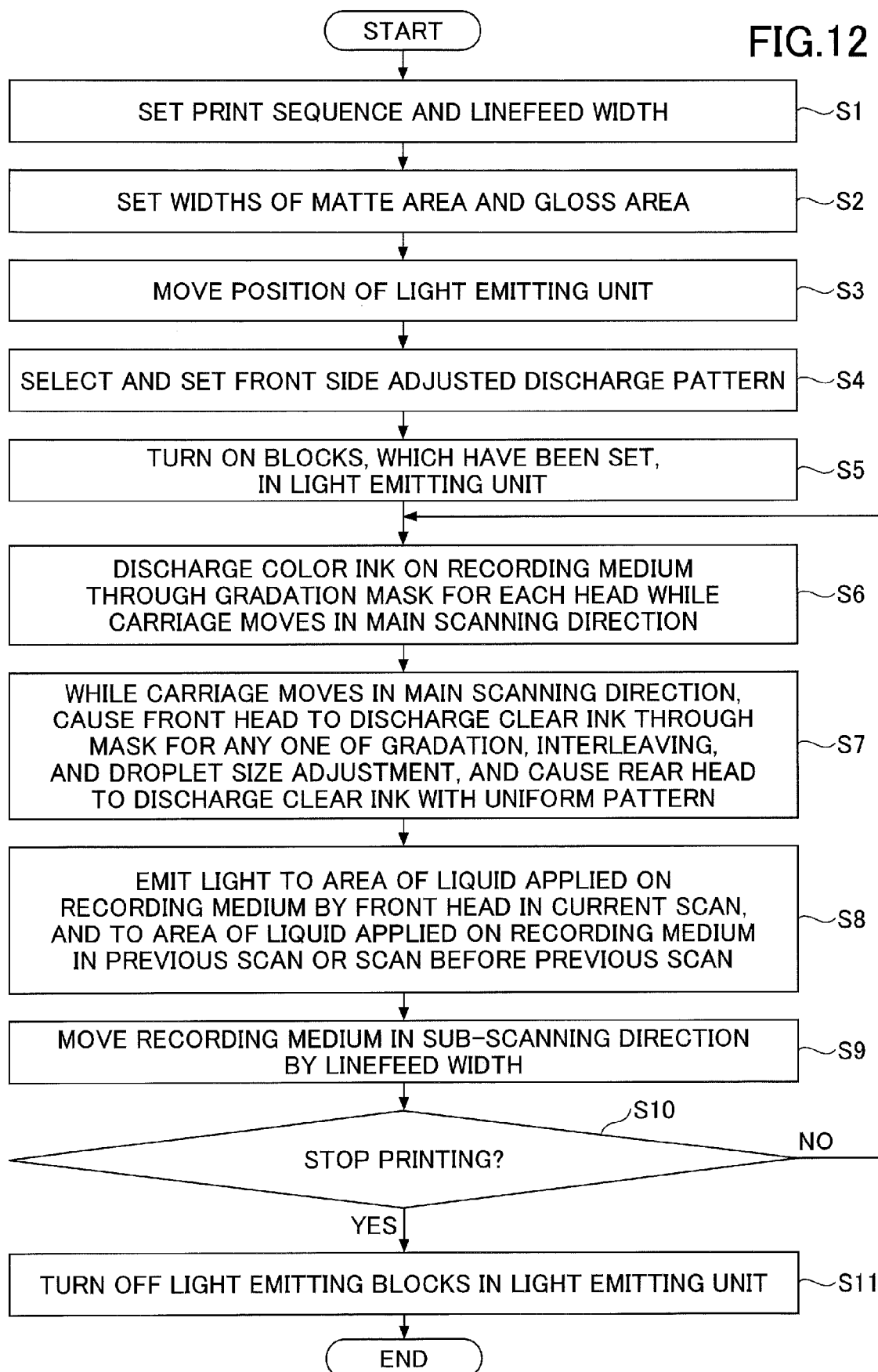


FIG.12





EUROPEAN SEARCH REPORT

Application Number
EP 20 15 4557

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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 A	US 9 290 014 B2 (OHKAWA MASAKATSU [JP]; FURUHATA TOMOTAKA [JP]; MIMAKI ENG KK [JP]) 22 March 2016 (2016-03-22) * column 15, line 30 - last line; figures 12,13 *	1,2,12 3-11,13,14	INV. B41J11/00 B41J3/28 B41M7/00
			TECHNICAL FIELDS SEARCHED (IPC)
			B41J B41M
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 10 July 2020	Examiner Wehr, Wolfhard
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)

10-07-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 9290014	B2	22-03-2016	CN 103269860 A 28-08-2013
			JP W02012053647 A1 24-02-2014
			US 2013271541 A1 17-10-2013
			WO 2012053647 A1 26-04-2012

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

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Patent documents cited in the description

- JP 2015214133 A [0007]