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

(11) EP 3 095 609 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
23.11.2016 Bulletin 2016/47

(51) Int Cl.:
B41J 3/407 *(2006.01)* ***B41J 19/14*** *(2006.01)*
B41J 2/205 *(2006.01)*

(21) Application number: **16157692.1**

(22) Date of filing: **26.02.2016**

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

(30) Priority: **12.03.2015 JP 2015049142**

(71) Applicant: **Seiko Epson Corporation**
Shinjuku-ku
Tokyo (JP)

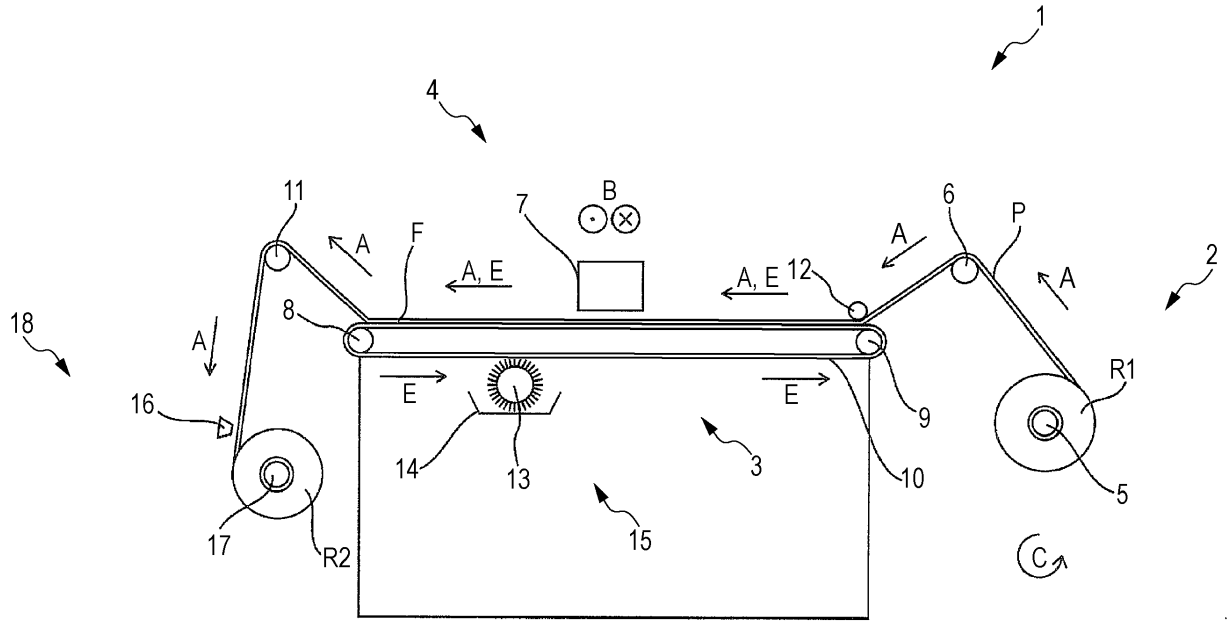
(72) Inventor: **TADA, Keiichi**
Suwa-shi, Nagano 392-8502 (JP)

(74) Representative: **Miller Sturt Kenyon**
9 John Street
London WC1N 2ES (GB)

(54) RECORDING APPARATUS

(57) Provided is a recording apparatus (1) provided with a recording head (7) that includes a nozzle (N) and discharges liquid through the nozzle on the basis of image data, and when the recording head discharges the liquid onto a recorded medium (P) on the basis of pixel data constituting the image data and corresponding to any one of recording target pixels, the liquid is discharged such that the liquid landed on the recorded medium indicates any one of a plurality of image density levels. The recording apparatus configured in this manner makes it possible to perform recording at a plurality of image density levels on the basis of only a single set of image data.

FIG. 1



EP 3 095 609 A1

Description

BACKGROUND

1. Technical Field

[0001] The present invention relates to a recording apparatus.

2. Related Art

[0002] Heretofore, recording apparatuses each provided with a recording head that includes nozzles and executes recording by discharging liquid, such as ink, through the nozzles have been widely used. Among such recording apparatuses, recording apparatuses each capable of recording at different resolutions have been disclosed. For example, in JP-A-2002-19100, a recording apparatus (an image formation apparatus) provided with a plurality of recording modes each associated with a corresponding one of a plurality of resolutions is disclosed.

[0003] Meanwhile, in recent years, recording has been performed on various types of recorded media by using a recording apparatus. Further, the landing diameter of an ink droplet that is discharged from a recording head and lands on a recorded medium for use in recording differs in accordance with the type of the recorded medium. For this reason, in conventional recording apparatuses, a recording operation has been performed by, for example, allowing the recording operation to be executed in a recording mode that enables the recording operation to be executed at a desired image density level on the basis of a set of converted image data obtained by causing a PC or the like to convert an original set of image data in accordance with the type of a recorded medium for use in the recording operation in a way that allows the PC or the like to use a driver software program.

[0004] When, however, causing a PC or the like to convert an original set of image data into an additional set of converted image data, a period of time required to fully perform the conversion depends on the process performance of the PC or the like, the size of the original set of image data, and/or the like, and thus is likely to become long. For this reason, there has been desired the advent of a recording apparatus capable of performing recording at a plurality of image density levels on the basis of only a single set of image data without causing a PC or the like to convert the set of image data to obtain an additional set of converted image data.

SUMMARY

[0005] An advantage of some aspects of the invention is that a recording apparatus is provided, which makes it possible to perform recording at a plurality of image density levels on the basis of only a single set of image data.

[0006] A recording apparatus according to a first aspect of the invention includes a recording head that includes a nozzle and discharges liquid through the nozzle on the basis of image data, and when the recording head discharges the liquid onto a recorded medium on the basis of pixel data constituting the image data and corresponding to any one of recording target pixels, the liquid is discharged such that the liquid landed on the recorded medium indicates any one of a plurality of image density levels.

[0007] According to a second aspect of the invention, in the first aspect, the recording apparatus further includes a movement portion that causes the recording head to move relative to the recorded medium in a direction intersecting a nozzle row direction in which a plurality of the nozzles are arranged, and when the recording head discharges the liquid onto the recorded medium on the basis of the pixel data corresponding to any one of the recording target pixels, in a case where the liquid is discharged at a plurality of times through one of the nozzles during one movement of the recording head, the movement portion makes a speed of the movement of the recording head lower, as compared with a case where the liquid is discharged only once through the one of the nozzles during the one movement of the recording head.

[0008] According to a third aspect of the invention, in the first aspect, the recording apparatus further includes a movement portion that causes the recording head to move relative to the recorded medium in a direction intersecting a nozzle row direction in which a plurality of the nozzles are arranged, and when the recording head discharges the liquid onto the recorded medium on the basis of the pixel data corresponding to any one of the recording target pixels, in a case where the liquid is discharged at a plurality of times through one of the nozzles, the movement portion causes the recording head to move at a plurality of times.

[0009] According to a fourth aspect of the invention, in the first aspect, the recording apparatus further includes a movement portion that causes the recording head to move relative to the recorded medium in a direction intersecting a nozzle row direction in which a plurality of the nozzles are arranged, and in any one of the first to third aspects, when the recording head discharges the liquid onto the recorded medium on the basis of the pixel data corresponding to any one of the recording target pixels, in a case where the liquid is discharged at a plurality of times from the recording head, the liquid is discharged through each of plural ones of the nozzles.

[0010] According to a fifth aspect of the invention, in any one of the first to fourth aspects, when the recording head discharges the liquid onto the recorded medium on the basis of the pixel data corresponding to any one of the recording target pixels, in a case where the liquid is discharged at a plurality of times from the recording head, a landing position of the liquid on the recorded medium at each of the plurality of times differs from a landing position of the liquid on the recorded medium at any other

of the plurality of times.

[0011] According to the above first to fifth aspects of the invention, it is possible to provide a recording apparatus that makes it possible to perform recording at a plurality of image density levels on the basis of only a single set of image data.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings, wherein like numbers reference like elements.

Fig. 1 is a schematic side view illustrating a mechanical configuration of a recording apparatus according to an embodiment of the invention.

Fig. 2 is a block diagram illustrating an electrical configuration of a recording apparatus according to an embodiment of the invention.

Fig. 3 is a diagram illustrating a waveform of a driving voltage supplied to a recording head of a recording apparatus according to an embodiment of the invention.

Figs. 4A and 4B are schematic diagrams illustrating ink dots having been landed on a recorded medium for use in a recording apparatus according to an embodiment of the invention.

Figs. 5A and 5B are schematic diagrams illustrating ink dots having been landed on a recorded medium for use in a recording apparatus according to an embodiment of the invention.

Figs. 6A and 6B are schematic diagrams illustrating ink dots having been landed on a recorded medium for use in a recording apparatus according to an embodiment of the invention.

Figs. 7A and 7B are schematic diagrams illustrating ink dots having been landed on a recorded medium for use in a recording apparatus according to an embodiment of the invention.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0013] Hereinafter, a recording apparatus according to an embodiment of the invention will be described in detail with reference to the accompanying drawings.

[0014] First, the outline of a recording apparatus 1 according to this embodiment will be described.

[0015] Fig. 1 is a schematic side view of the recording apparatus 1 according to this embodiment.

[0016] As shown in Fig. 1, the recording apparatus 1 according to this embodiment includes an unwinding portion 2 capable of unwinding a recorded medium P for use in recording from a roll R1 of the recorded medium P. Further, the recording apparatus 1 includes a transport mechanism 3 as a transporting portion that transports the recorded medium P in a transport direction A in a state in which an adhesive belt 10 supports the recorded medium P on its supporting face F to which an adhesive agent is applied. Further, the recording apparatus 1 includes a recording mechanism 4 that executes recording by reciprocating a recording head 7 in a reciprocating direction B intersecting the transport direction A in which the recorded medium P is transported. Further, the recording apparatus 1 includes a cleaning mechanism 15 for cleaning the adhesive belt 10. Moreover, the recording apparatus 1 includes a winding mechanism 18 provided with a winding shaft 17 for winding the recorded medium P, and a cutter 16 for cutting the recorded medium P that is in a state of having been wound by the winding shaft 17.

[0017] The unwinding portion 2 includes a rotation shaft 5 that also functions as an attachment portion to which the roll R1 of the recorded medium P for use in recording is attached, and is configured to be capable of unwinding the recorded paper P from the roll R1, which is attached to the rotation shaft 5, toward the transport mechanism 3 via a driven roller 6. In addition, when the recorded paper P is unwound toward the transport mechanism 3, the rotation shaft 5 rotates in a rotation direction C.

[0018] The transport mechanism 3 includes the adhesive belt 10 that transports the recorded paper P in a state in which the recorded paper P having been unwound from the unwinding portion 2 is mounted on the adhesive belt 10 itself; a transport roller 8 as a driving roller that causes the adhesive belt 10 to move; and a driven roller 9. The recorded medium P is mounted on the supporting face F of the adhesive belt 10 in a state of being pressure-applied and adhered onto the supporting face F by a pressure applying roller 12. In addition, when the recorded paper P is transported, the transport roller 8 rotates in the rotation direction C and thereby the adhesive belt 10 is caused to move in a direction E.

[0019] In this regard, however, the transport belt is not limited to such an adhesive belt. For example, an electrostatic-absorption type transport belt may be employed as the transport belt.

[0020] The recording mechanism 4 includes the recording head 7 capable of discharging ink (liquid) through nozzles N (refer to Figs. 4A and 4B to Figs. 7A and 7B), and a carriage motor 30 (refer to Fig. 2) that causes a carriage, on which the relevant recording head 7 is mounted, to reciprocate in the reciprocating direction B relative to the recorded medium P. In addition, the reciprocating direction B is a direction perpendicular to the drawing surface on which Fig. 1 is represented.

[0021] When recording is performed, the recording is performed by causing the recording head 7 to execute reciprocating scanning, and during every recording scanning operation (i.e., during every movement of the recording head 7), the transport mechanism 3 halts the transport of the recorded paper P. In other words, when recording is performed, the reciprocating scanning of the recording head 7 and the transport of the recorded medium P are alternately executed. That is, when recording

is performed, the transport mechanism 3 intermittently transports the recorded medium P (that is, the transport mechanism 3 causes the adhesive belt 10 to move intermittently) in conjunction with the reciprocating scanning of the recording head 7.

[0022] The cleaning mechanism 15 for cleaning the adhesive belt 10 includes a cleaning brush 13 constituted of a plurality of cleaning rollers that are joined in a direction toward a rotation shaft of the cleaning brush 13, and a tray 14 in which a cleaning agent for use in cleaning of the cleaning brush 13 is contained.

[0023] The winding mechanism 18 is a mechanism for winding the recorded medium P that is already subjected to recording and that has been transported from the transport mechanism 3 via the driven roller 11, and is capable of winding the recorded medium P as a roll R2 by winding the relevant recorded medium P around a paper tube or the like that is for use in winding and that is in a state of being attached to the winding shaft 17.

[0024] In addition, the recording apparatus 1 according to this embodiment is a recording apparatus that causes the adhesive belt 10 to support and transport the recorded medium P of a roll-shaped type, but the invention is not limited to a recording apparatus configured in such a manner. For example, the recording apparatus 1 may be configured so as to be capable of transporting, not only the foregoing recorded medium P of a roll-shaped type, but also the recorded medium P of a sheet-shaped type, by causing a pair of rollers as a transporting portion to pinch the recorded medium P of the sheet-shaped type.

[0025] Next, an electrical configuration of the recording apparatus 1 according to this embodiment will be described.

[0026] Fig. 2 is a block diagram of the recording apparatus 1 according to this embodiment.

[0027] A control portion 23 includes a CPU 24 that performs control of the whole of the recording apparatus 1. The CPU 24 is electrically connected, via a system bus 25, to a ROM 26 that stores therein various control programs executed by the CPU 24, and the like, and a RAM 27 that is capable of temporarily storing data therein.

[0028] Further, the CPU 24 is electrically connected, via the system bus 25, to a head driving portion 28 for driving the recording head 7. Further, the CPU 24 is electrically connected, via the system bus 25, to a motor driving portion 29 for driving the carriage motor 30, a transporting motor 31, an unwinding motor 32, and a winding motor 33. Here, the carriage motor 30 is a motor for moving the carriage on which the recording head 7 is mounted. Further, the transporting motor 31 is a motor for driving the transport roller 8. Further, the unwinding motor 32 is a rotation mechanism for the rotation shaft 5, and is a motor for driving the rotation shaft 5 to unwind the recorded paper P toward the transport mechanism 3. Further, the winding motor 33 is a driving motor for rotating the winding shaft 17.

[0029] Further, the CPU 24 is electrically connected, via the system bus 25, to a cutter driving portion 19 for driving the cutter 16 to cut the recorded paper P.

[0030] Moreover, the CPU 24 is electrically connected, via the system bus 25, to an input/output portion 20 that is communicably connected to a PC 21 that transmits/receives signals and data, such as a set of image data, to/from the input/output portion 20.

[0031] The control portion 23 according to this embodiment is configured in such a manner as described above, and thereby is capable of performing driving control (recording control) of the recording apparatus 1.

[0032] Next, recording operation that is executable by the recording apparatus 1 according to this embodiment and that is executed under the control of the control portion 23 thereof will be described. Here, Fig. 3 is a diagram illustrating a waveform of a driving voltage supplied to the recording head 7 of the recording apparatus 1 according to this embodiment.

[0033] Further, Figs. 4A and 4B are schematic diagrams illustrating ink dots I having been landed on the recorded paper or other material P as a result of a recording operation that allows one ink dot to be discharged on the basis of pixel data corresponding to any one of recording target pixels, and are schematic diagrams when the recorded medium P of a type in which each of the ink dots I is easy to spread is used.

Fig. 4A out of these figures is a plan view illustrating the ink dots I having been landed on the recorded medium P, and Fig. 4B out of these figures is a front view illustrating the ink dots I having been landed on the recorded medium P.

[0034] Further, Figs. 5A and 5B are schematic diagrams illustrating ink dots I having been landed on the recorded medium P as a result of a recording operation that allows one ink dot to be discharged on the basis of pixel data corresponding to any one of recording target pixels, and are schematic diagrams when the recorded medium P of a type in which each of the ink dots I is hard to spread.

Fig. 5A out of these figures is a plan view illustrating the ink dots I having been landed on the recorded medium P, and Fig. 5B out of these figures is a front view illustrating the ink dots I having been landed on the recorded medium P.

[0035] Further, Figs. 6A and 6B are schematic diagrams illustrating ink dots I having been landed on the recorded paper P as a result of a recording operation that allows a plurality of ink dots to be discharged during one pass on the basis of pixel data corresponding to any one of recording target pixels, and are schematic diagrams when the recorded medium P of a type in which each of the ink dots I is hard to spread. Fig. 6A out of these figures is a plan view illustrating the ink dots I having been landed on the recorded medium P, and Fig. 6B out of these figures is a front view illustrating the ink dots I having been landed on the recorded medium P.

[0036] Further, Figs. 7A and 7B are schematic diagrams illustrating ink dots I having been landed on the

recorded medium P as a result of a recording operation that allows a plurality of dots to be discharged during a plurality of passes on the basis of pixel data corresponding to any one of recording target pixels, and are schematic diagrams when the recorded medium P of a type in which each of the ink dots I is hard to spread. Fig. 7A out of these figures is a plan view illustrating the ink dots I having been landed on the recorded medium P, and Fig. 7B out of these figures is a front view illustrating the ink dots I having been landed on the recorded medium P.

[0037] In addition, in Figs. 4A to 7B, a number denoting each of the ink dots I is associated with an address number indicating pixel data corresponding to one of recording target pixels and constituting a set of pixel data transmitted from the PC 21. Thus, in Figs. 4A to 5B, ink dots I each associated with a corresponding one of address numbers "1" to "8" each indicating pixel data corresponding to one of recording target pixels are formed in a unit of a single ink dot I. Further, in Figs. 6A to 7B, ink dots I each associated with a corresponding one of address numbers "1" to "8" each indicating pixel data corresponding to one of recording target pixels are formed in unit of a plurality of (nine) ink dots I each associated with the same address number.

[0038] When recording is performed by executing a recording operation that allows one ink dot to be discharged on the basis of pixel data corresponding to any one of recording target pixels and constituting a set of image data transmitted from the PC 21, the landing diameter of each of the ink dots I having been landed on the recorded medium P largely varies in accordance with the type of the recorded medium P as shown in Figs. 4A to 5B. For example, when paper or the like is used as the recorded medium P, the landing diameter of each of the ink dots I tends to become large as shown in Figs. 4A and 4B; while, when cloth or the like is used as the recorded medium P, the landing diameter of each of the ink dots I tends to become small as shown in Figs. 5A and 5B. For this reason, heretofore, in order to suppress the occurrence of a phenomenon in which the image density level of a recorded image becomes excessively high or low in accordance with the type of the recorded medium P for use in recording, a process of converting a set of image data in accordance with the type of the recorded medium P for use in recording has been performed by the PC 21 in a way allowing the PC 21 to use a driver software program that is an attachment of the recording apparatus 1, or the like.

[0039] For example, when an image having a high image density is formed by using the recorded medium P of a type in which each of the ink dots I is hard to spread, a process of converting pixel data that is originally not to be used in recording in a pre-conversion set of image data into pixel data that is to be used in recording in a post-conversion set of image data has been performed. More specifically, such a conversion process has been performed on pixel data that is located in an area surrounding pixel data that is to be used in recording in a pre-conversion set of image data. In this regard, however, when the size of a set of image data is large and/or the process performance of the PC 21 for use in such a conversion process is low, a large amount of time has been required to fully perform such a conversion process on a set of image data. In addition, each of Figs. 4A, 4B, 5A, and 5B illustrates a state in which recording is performed by using both the second nozzle N from the top one of six nozzles N of the recording head 7 and the second nozzle N from the bottom one of the six nozzles N of the recording head 7.

[0040] Here, the recording apparatus 1 according to this embodiment makes it possible to, without performing such a conversion process on a set of image data, form an image such as shown in Figs. 4A and 4B by using the recorded medium P of a type in which each of the ink dots I is hard to spread. That is, the recording apparatus 1 according to this embodiment is configured to be capable of performing recording at a plurality of image density levels on the basis of only a single set of image data.

[0041] The recording apparatus 1 according to this embodiment includes the recording head 7 that includes the nozzles N and is capable of discharging ink through each of the nozzles N on the basis of image data, and is configured to, when discharging the ink onto the recorded medium P on the basis of pixel data constituting the image data and corresponding to any one of recording target pixels, be capable of discharging the ink such that the ink landed on the recorded medium P indicates a plurality of image density levels. That is, the recording apparatus 1 according to this embodiment is configured to receive a set of image data without causing the PC 21 or the like to convert the set of image data to obtain an additional set of converted image data, and be capable of adjusting the image density level of an image formed on the recorded medium P in accordance with the type of the recorded medium P for use in recording, and the like, on the basis of the received set of image data. Thus, the recording apparatus 1 according to this embodiment is configured to be capable of performing recording at a plurality of image density levels on the basis of only a single set of image data.

[0042] Hereinafter, it will be described how the recording apparatus 1 according to this embodiment performs recording at a plurality of image density levels on the basis of only a single set of image data.

[0043] As described above, the recording apparatus 1 according to this embodiment is configured to be capable of performing recording by causing the recording head 7 to reciprocate in the reciprocating direction B relative to the recorded medium P.

[0044] More specifically, the recording apparatus 1 according to this embodiment includes the carriage motor 30 as a movement portion capable of causing the recording head 7 to reciprocate in the reciprocating direction B via the carriage on which the recording head 7 is mounted. Here, in the recording head 7, there is provided a nozzle row which extends in the transport direction A and

in which the plurality of nozzles N, through each of which ink is able to be discharged, are arranged. That is, the carriage motor 30 is configured to cause the recording head 7 to move relative to the recorded medium P in a direction (corresponding to the reciprocating direction B) intersecting a nozzle row direction (corresponding to the transport direction A) in which the nozzles N of the recording head 7 are arranged.

[0045] Further, as shown in Figs. 6A and 6B, the recording apparatus 1 according to this embodiment is capable of discharging ink through one of the nozzles N a plurality of times (three times in Figs. 6A and 6B) on the basis of pixel data corresponding to any one of the recording target pixels, in conjunction with one movement of the recording head 7 across the width of the recording medium P (for example, one movement thereof in a direction B1) among reciprocating movements thereof in the reciprocating direction B. It should be appreciated that in this description it is not necessary for the recording head 7 to traverse across the whole width of the recording medium P.

[0046] Further, in addition thereto, as shown in Fig. 6A, the recording apparatus 1 according to this embodiment is capable of discharging ink a plurality of times through one of the six nozzles N composed of, not only both the second nozzle N from the top one of the six nozzles N of the recording head 7 and the second nozzle N from the bottom one of the six nozzles N thereof, but also remaining ones of the six nozzles N thereof, on the basis of pixel data corresponding to any one of the recording target pixels.

[0047] Further, as shown in Figs. 7A and 7B, the recording apparatus 1 according to this embodiment is capable of discharging ink through one of the nozzles N a plurality of times on the basis of pixel data corresponding to any one of recording target pixels, in conjunction with a plurality of movements of the recording head 7 across the width of the recording medium P (for example, totally three movements of the recording head 7, that is, one movement in the direction B1, one movement in a direction B2, and one movement in the direction B1) among the reciprocating movements of the recording head 7 in the reciprocating direction B. Figs. 7A and 7B illustrate a state in which, for rows "a", "b", and "c" each consisting of the ink dots I and extending in a vertical direction in Fig. 7A, recording is performed on the row "a" during a movement in the direction B1; the row "b" during a subsequent movement in the direction B2; and the row "c" during a further subsequent movement in the direction B1. In this regard, however, the recording apparatus 1 according to this embodiment is also capable of performing recording in different manners, such as a manner in which recording is performed on the rows "a" and "c" during a movement in the direction B1, and the row b in a subsequent movement in the direction B2.

[0048] Further, in addition thereto, as shown in Fig. 7A, the recording apparatus 1 according to this embodiment is also capable of discharging ink a plurality of times through one of the nozzles N composed of, not only both the second nozzle N from the top one of the six nozzles N of the recording head 7 and the second nozzle N from the bottom one of the six nozzles thereof, but also remaining ones of the six nozzles N thereof, on the basis of pixel data corresponding to any one of recording target pixels.

[0049] In addition, in the case where, as shown in Figs. 6A and 6B, ink is discharged through one of the nozzles a plurality of times N on the basis of pixel data corresponding to any one of recording target pixels in conjunction with one movement of the recording head 7 among reciprocating movements thereof in the reciprocating direction B, a discharge failure is likely to occur when the discharging frequency of discharging through each of the nozzles N (i.e., a frequency at which ink is discharged through each of the nozzles N) is made excessively high. In general, in order to discharge ink through each of the nozzles N at an appropriate discharging frequency, it is required to supply a voltage to a corresponding recording element such that the supplied voltage forms an appropriate waveform shown in Fig. 3. For this reason, it is required to cause the discharging frequency to be a frequency at which an appropriate waveform can be maintained, that is, a wavelength having an appropriate length can be maintained.

[0050] Thus, in the recording apparatus 1 according to this embodiment, when ink is discharged through one of the nozzles N on the basis of pixel data corresponding to any one of recording target pixels during one movement of the recording head 7, in a case where the ink is discharged at a plurality of times (refer to Figs. 6A and 6B), the carriage motor 30 moves the recording head 7 so as to make the speed of the movement of the recording head 7 in the reciprocating direction B lower, as compared with a case where the ink is discharged only once (refer to Figs. 5A and 5B), under the control of the control portion 23.

[0051] Specifically, when the speed of the movement of the recording head 7 in the case where, as shown in Fig. 5B, ink is discharged only once through one of the nozzles N is represented by v, the speed of the movement of the recording head 7 in the case where, as shown in Fig. 6B, ink is discharged at a plurality of times through the one of the nozzles N is made v/3. In this manner, when the liquid is discharged on the basis of the pixel data corresponding to any one of recording target pixels, even in the case where the liquid is discharged a plurality of times through an identical one of the nozzles N during one pass, the occurrence of a discharge failure is suppressed by making an adjustment so as to lower the speed of the movement of the recording head 7 and thereby suppress the discharging frequency from becoming high.

[0052] Further, in the recording apparatus 1 according to this embodiment, as shown in Figs. 7A and 7B, when ink is discharged on the basis of pixel data corresponding to any one of recording target pixels, in a case where the

ink is discharged a plurality of times through one of the nozzles N, the carriage motor 30 is capable of moving the recording head 7 a plurality of times under the control of the control portion 23. That is, the recording apparatus 1 according to this embodiment is configured to, when discharging ink a plurality of times through one of the nozzles N on the basis of pixel data corresponding to any one of recording target pixels, be capable of performing recording in a so-called multi-pass recording method. Thus, the recording apparatus 1 according to this embodiment is configured to, when discharging ink a plurality of times through an identical one of the nozzles N on the basis of pixel data corresponding to any one of recording target pixels, be capable of suppressing the occurrence of a discharge failure by performing recording in the multi-pass recording method, and thereby making an adjustment that suppresses the discharging frequency from becoming high without lowering the speed of the movement of the recording head 7.

[0053] Further, as shown in Figs. 6A to 7B, the recording apparatus 1 according to this embodiment is configured to, when discharging ink a plurality of times from the recording head 7 on the basis of pixel data corresponding to any one of recording target pixels, be capable of discharging the ink through each of plural ones of the nozzles N. Specifically, in Figs. 5A and 5B, nozzles for use in recording are only the second nozzle N from the top one of the six nozzles N of the recording head 7 and the second nozzle N from the bottom one of the six nozzles N thereof; while in contrast, in Figs. 6A to 7B, nozzles for use in recording include, not only the second nozzle N from the top one of the six nozzles of the recording head 7 and the second nozzle N from the bottom one of the six nozzles thereof, but also remaining ones of the six nozzles N of the recording head 7. More specifically, recording operations each based on pixel data associated with a corresponding one of address numbers 1, 2, 3, and 4 are performed by using three nozzles N up to a third nozzle N from the top one of the six nozzles N of the recording head 7, and recording operations each based on pixel data associated with a corresponding one of address numbers 5, 6, 7, and 8 are performed by using three nozzles N up to a third nozzle N from the bottom one of the six nozzles N of the recording head 7. The recording apparatus 1 according to this embodiment is configured to be capable of performing such recording operation described above, and thus, is capable of performing recording at a plurality of image density levels on the basis of pixel data corresponding to any one of recording target pixels by using plural ones of the nozzles N.

[0054] Further, as shown in Figs. 6A to 7B, the recording apparatus 1 according to this embodiment is configured to, when discharging ink a plurality of times from the recording head 7 on the basis of pixel data corresponding to any one of recording target pixels, discharge the ink such that the landing position of the ink on the recorded medium P at each of the plurality of times differs from the landing position of the ink on the recorded medium P at any other of the plurality of times.

[0055] When ink is discharged at a plurality of times from the recording head 7 on the basis of pixel data corresponding to any one of recording target pixels, in a case where the landing position of the ink at each of the plurality of times differs from the landing position of the ink at any other of the plurality of times, the image density level of an image formed on the recorded medium P can be effectively made higher, as compared with a case where the landing position of the ink at each of the plurality of times is the same position. Thus, the recording apparatus 1 according to this embodiment makes it possible effectively to perform recording at a plurality of image density levels on the basis of only a single set of image data. In this regard, however, the present invention is not limited to such a configuration, and the configuration may be made such that, when ink is discharged at a plurality of times from the recording head 7 on the basis of pixel data corresponding to any one of recording target pixels, the ink is discharged such that the landing position of the ink on the recorded medium P at each of the plurality of times becomes the same position.

[0056] In addition, the recording apparatus 1 according to this embodiment is configured such that, under the recording control shown in Figs. 6A to 7B, recording is performed on the basis of only a single set of image data at an image density level that is nine times the image density level under the recording control shown in Figs. 5A and 5B (i.e., three times the relevant image density level in the reciprocating direction B and three times the relevant image density level in the transport direction A). In addition to such a recording control method, however, it is also possible to employ a different recording control method that makes it possible to perform recording at an image density level that is other than the nine times the relevant image density level, and also or instead an image density level that is plural times the relevant image density level in only a single direction that is any one of the reciprocating direction B and the transport direction A, on the basis of only a single set of image data. Alternatively, the image density level may vary in the reciprocating direction B and the transport direction A.

[0057] It is to be noted, here, that the invention is not limited to the aforementioned embodiment, and various modifications can be made within a scope of the invention set forth in appended claims, but, naturally, the modifications are also included in the scope of the invention.

[0058] Hereinbefore, the invention has been described in detail on the basis of the specific embodiment. Here, the invention will be summarized and described once again.

[0059] A recording apparatus 1 according to a first aspect of the invention includes a recording head 7 that includes a nozzle N and discharges liquid through the nozzle N on the basis of image data, and when the recording head discharges the liquid onto a recorded medium P on the basis of pixel data constituting the image

data and corresponding to any one of recording target pixels, the liquid is discharged such that the liquid landed on the recorded medium P indicates any one of a plurality of image density levels.

[0060] According to this aspect, the recording apparatus 1 includes the recording head 7 that includes the nozzle N and discharges liquid through the nozzle N on the basis of image data, and is configured to, when discharging the liquid from the recording head 7 onto the recorded medium P on the basis of pixel data constituting the image data and corresponding to any one of recording target pixels, be capable of discharging the liquid such that the liquid landed on the recorded medium P indicates any one of a plurality of image density levels. That is, the recording apparatus 1 according to this aspect is configured to receive a set of image data without causing the PC 21 or the like to convert the set of image data to obtain an additional set of converted image data, and be capable of adjusting the image density level of an image formed on the recorded medium P in accordance with the type of the recorded medium P for use in recording, and the like, on the basis of the received set of image data. Thus, it becomes possible to perform recording at a plurality of image density levels on the basis of only a single set of image data.

[0061] According to a second aspect of the invention, in the first aspect, the recording apparatus 1 further includes a movement portion 30 that causes the recording head 7 to move relative to the recorded medium P in a direction intersecting a nozzle row direction in which a plurality of the nozzles N are arranged, and when the recording head 7 discharges the liquid onto the recorded medium P on the basis of the pixel data corresponding to any one of the recording target pixels, in a case where the liquid is discharged at a plurality of times through one of the nozzles N during one movement of the recording head 7, the movement portion 30 makes a speed of the movement of the recording head 7 lower, as compared with a case where the liquid is discharged only once through the one of the nozzles N during the one movement of the recording head 7.

[0062] In general, with respect to a discharging frequency (i.e., a frequency at which the liquid is discharged through each of the nozzles N), there is a preferable frequency range in accordance with the type of ink for use in recording, a nozzle diameter, and the like. Thus, when the number of discharging operations during one movement of the recording head 7 (i.e., during so-called one pass) is increased and thereby the discharging frequency is made high, a discharge failure is likely to occur.

[0063] According to this embodiment, the recording apparatus 1 includes the movement portion 30 that causes the recording head 7 to move relative to the recorded medium P in a direction intersecting a nozzle row direction in which the plurality of nozzles N are arranged. Further, when the recording head 7 discharges the liquid onto the recorded medium P on the basis of pixel data corresponding to any one of recording target pixels, in a case where the liquid is discharged at a plurality of times through one of the nozzles N during one pass, the movement portion 30 is capable of moving the recording head 7 so as to make the speed of the movement of the recording head 7 lower, as compared with a case where the liquid is discharged only once through the one of the nozzles N during the one pass. Thus, when the recording head 7 discharges the liquid onto the recorded medium P on the basis of the pixel data corresponding to any one of the recording target pixels, even in the case where the liquid is discharged at a plurality of times through an identical one of the nozzles N during one pass, it is possible to suppress the occurrence of a discharge failure by making an adjustment so as to lower the speed of the movement of the recording head 7 and thereby suppress the discharging frequency from becoming high.

[0064] According to a third aspect of the invention, in the first aspect, the recording apparatus 1 further includes a movement portion 30 that causes the recording head 7 to move relative to the recorded medium P in a direction intersecting a nozzle row direction in which a plurality of the nozzles N are arranged, and when the recording head discharges the liquid onto the recorded medium P on the basis of the pixel data corresponding to any one of the recording target pixels, in a case where the liquid is discharged at a plurality of times through one of the nozzles N, the movement portion 30 causes the recording head 7 to move at a plurality of times.

[0065] According to this embodiment, the recording apparatus 1 includes the movement portion 30 that causes the recording head 7 relative to the recorded medium P in a direction intersecting a nozzle row direction in which the plurality of nozzles N are arranged. Further, when the recording head 7 discharges the liquid onto the recorded medium P on the basis of the pixel data corresponding to any one of the recording target pixels, in a case where the liquid is discharged at a plurality of times through one of the nozzles N, the movement portion 30 causes the recording head 7 to move at a plurality of times (that is, the movement portion 30 causes the recording head 70 to perform recording in a so-called multi-pass recording method). Thus, when the recording head 7 discharges the liquid onto the recorded medium P on the basis of the pixel data corresponding to any one of the recording target pixels, in the case where the liquid is discharged at a plurality of times through an identical one of the nozzles N, it is possible to suppress the occurrence of a discharge failure by causing the recording head 7 to perform recording in the multi-pass recording method and thereby making an adjustment that suppresses the discharging frequency from becoming high without lowering the speed of the movement of the recording head 7.

[0066] According to a fourth aspect of the invention, in the first aspect, the recording apparatus 1 further includes a movement portion 30 that causes the recording head 7 to move relative to the recorded medium P in a direction intersecting a nozzle row direction in which a

plurality of the nozzles N are arranged, and in any one of the first to third aspects, when the recording head 7 discharges the liquid onto the recorded medium P on the basis of the pixel data corresponding to any one of the recording target pixels, in a case where the liquid is discharged at a plurality of times from the recording head 7, the liquid is discharged through each of plural ones of the nozzles N.

[0067] According to this embodiment, the recording apparatus 1 includes the movement portion 30 that causes the recording head 7 to move relative to the recorded medium P in a direction intersecting a nozzle row direction in which the plurality of nozzles N are arranged. Further, the recording apparatus 1 is configured to, when discharging the liquid at a plurality of times from the recording head 7 onto the recorded medium P on the basis of the pixel data corresponding to any one of the recording target pixels, be capable of discharging the liquid through each of plural ones of the nozzles N. Thus, it becomes possible to perform recording at a plurality of image density levels on the basis of only a single set of pixel data by using plural ones of the plurality of nozzles N.

[0068] According to a fifth aspect of the invention, in any one of the first to fourth aspects, when the recording head discharges the liquid onto the recording medium P on the basis of the pixel data corresponding to any one of the recording target pixels, in a case where the liquid is discharged at a plurality of times from the recording head 7, a landing position of the liquid on the recorded medium P at each of the plurality of times differs from a landing position of the liquid on the recorded medium P at any other of the plurality of times.

[0069] According to this embodiment, the recording apparatus 1 is configured to, when discharging the liquid at a plurality of times from the recording head 7 on the basis of the pixel data corresponding to any one of the recording target pixels, be capable of causing the landing position of the liquid on the recorded medium P at each of the plurality of times to differ from the landing position of the liquid on the recorded medium P at any other of the plurality of times. When the recording head 7 discharges the liquid at a plurality of times on the basis of the pixel data corresponding to any one of the recording target pixels, the configuration that causes the landing position of the liquid on the recorded medium P at each of the plurality of times to differ from the landing position of the liquid on the recorded medium P at any other of the plurality of times makes it possible effectively to make the image density level of an image formed on the recorded medium P higher, as compared with a configuration that causes the landing position of the liquid on the recorded medium P at each of the plurality of times to be the same position. Thus, it becomes possible effectively to perform recording at a plurality of image density levels on the basis of only a single set of image data.

[0070] The foregoing description has been given by way of example only and it will be appreciated by a person skilled in the art that modifications can be made without departing from the scope of the present invention as defined by the claims.

Claims

1. A recording apparatus (1) comprising:

a recording head (7) that includes a nozzle (N) and is configured to discharge liquid through the nozzle on the basis of image data,

the recording apparatus being configured such that, when the recording head discharges the liquid onto a recorded medium (P) on the basis of pixel data constituting the image data and corresponding to any one of recording target pixels, the liquid is discharged such that the liquid landed on the recorded medium indicates any one of a plurality of image density levels.

2. The recording apparatus according to claim 1 further comprising a movement portion (30) configured to cause the recording head to move relative to the recorded medium in a direction (B) intersecting a nozzle row direction (A) in which a plurality of the nozzles are arranged,
the recording apparatus being configured such that, when the recording head discharges the liquid onto the recorded medium on the basis of the pixel data corresponding to any one of the recording target pixels, in a case where the liquid is discharged a plurality of times through one of the nozzles during one movement of the recording head, the movement portion makes a speed of the movement of the recording head lower, as compared with a case where the liquid is discharged only once through the one of the nozzles during the one movement of the recording head.

3. The recording apparatus according to claim 1 further comprising a movement portion (30) configured to cause the recording head to move relative to the recorded medium in a direction (B) intersecting a nozzle row direction (A) in which a plurality of the nozzles are arranged,
the recording apparatus being configured such that, when the recording head discharges the liquid onto the recorded medium on the basis of the pixel data corresponding to any one of the recording target pixels, in a case where the liquid is discharged a plurality of times through one of the nozzles, the movement portion causes the recording head to move at a plurality of times.

4. The recording apparatus according to claim 1 further comprising a movement portion (30) configured to

cause the recording head to move relative to the recorded medium in a direction (B) intersecting a nozzle row direction (A) in which a plurality of the nozzles are arranged,
the recording apparatus being configured such that, when the recording head discharges the liquid onto the recorded medium on the basis of the pixel data corresponding to any one of the recording target pixels, in a case where the liquid is discharged a plurality of times from the recording head, the liquid is discharged through each of plural ones of the nozzles.

5. The recording apparatus according to any one of the preceding claims, the recording apparatus being configured such that, when the recording head discharges the liquid onto the recorded medium on the basis of the pixel data corresponding to any one of the recording target pixels, in a case where the liquid is discharged a plurality of times from the recording head, a landing position of the liquid on the recorded medium (P) at each of the plurality of times differs from a landing position of the liquid on the recorded medium at any other of the plurality of times.

FIG. 1

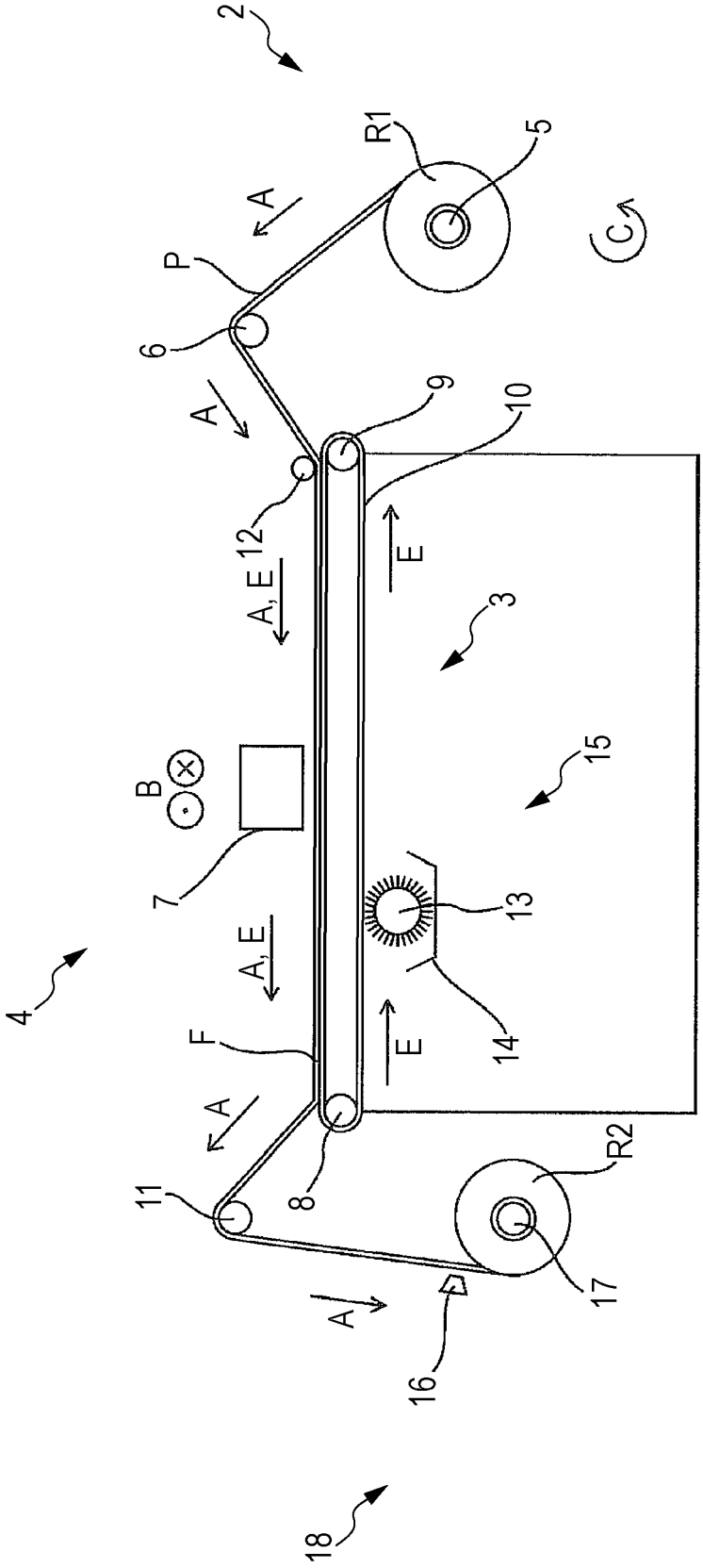


FIG. 2

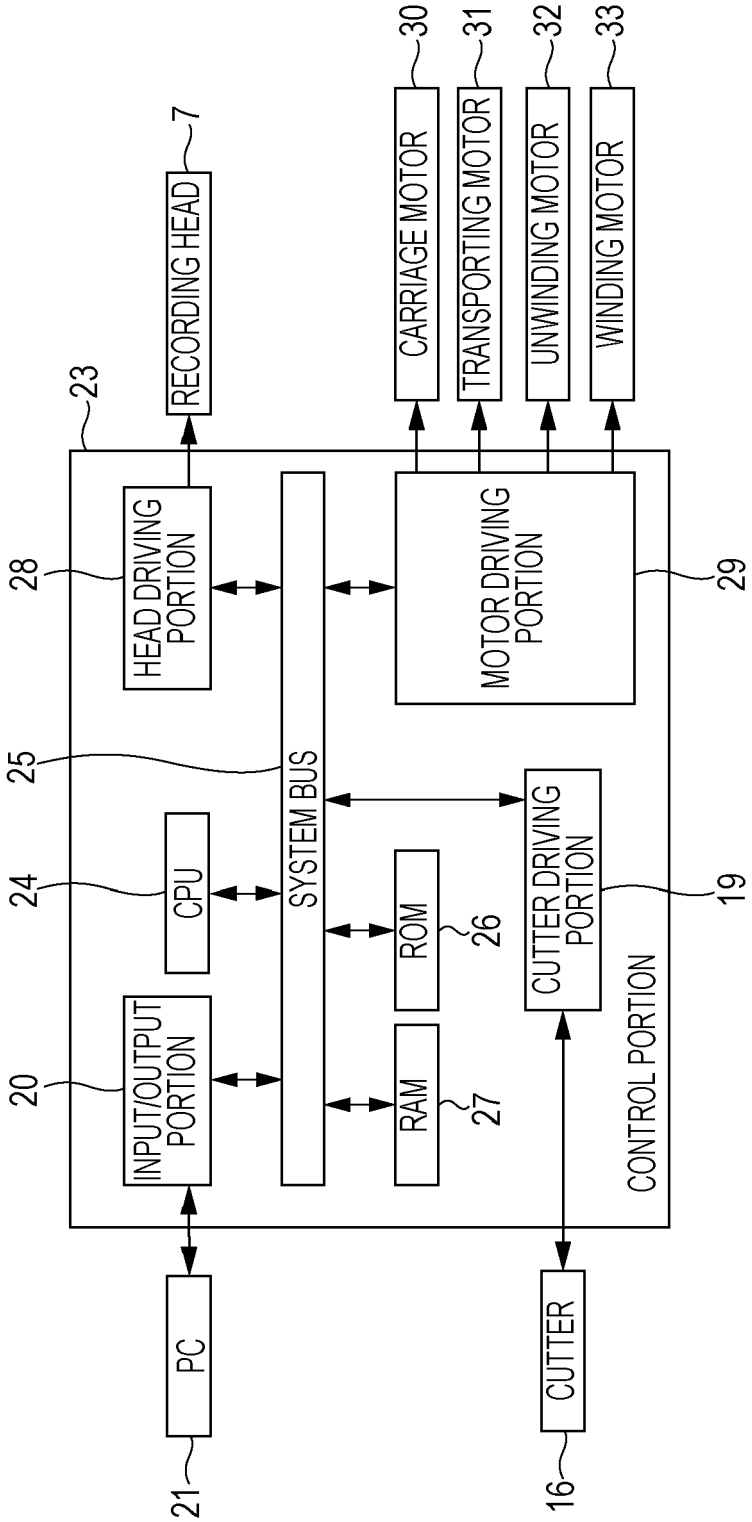

RECORDING HEAD
7
CARRIAGE MOTOR
30
TRANSPORTING MOTOR
31
UNWINDING MOTOR
32
WINDING MOTOR
33
23
HEAD DRIVING PORTION
28
MOTOR DRIVING PORTION
29
SYSTEM BUS
25
CPU
24
ROM
26
CUTTER DRIVING PORTION
19
INPUT/OUTPUT PORTION
20
RAM
27
CONTROL PORTION
PC
21
CUTTER
16

FIG. 3

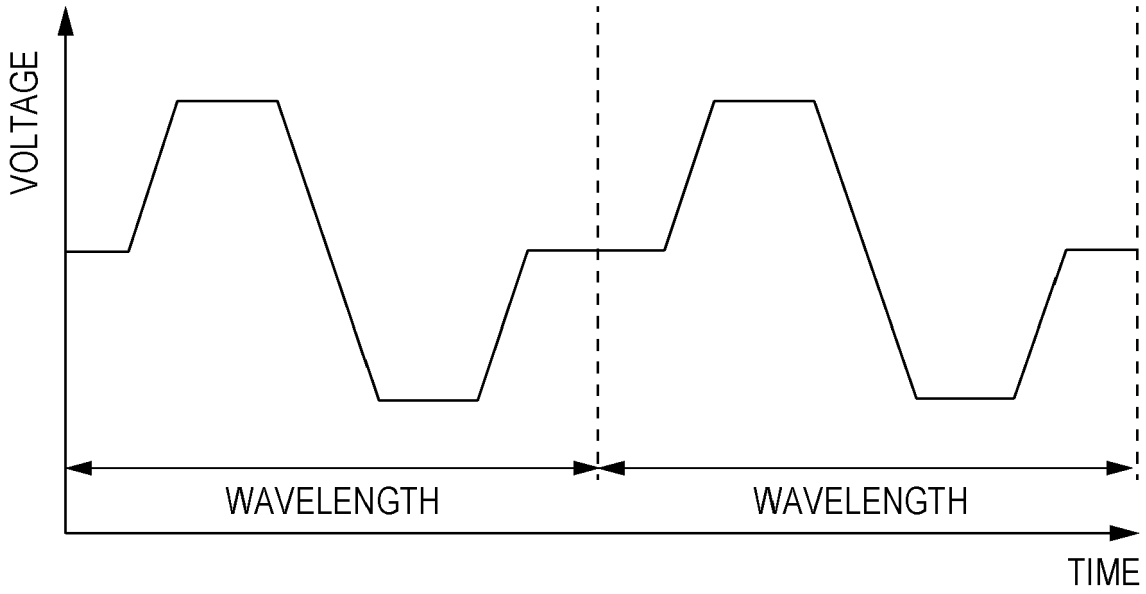


FIG. 4A

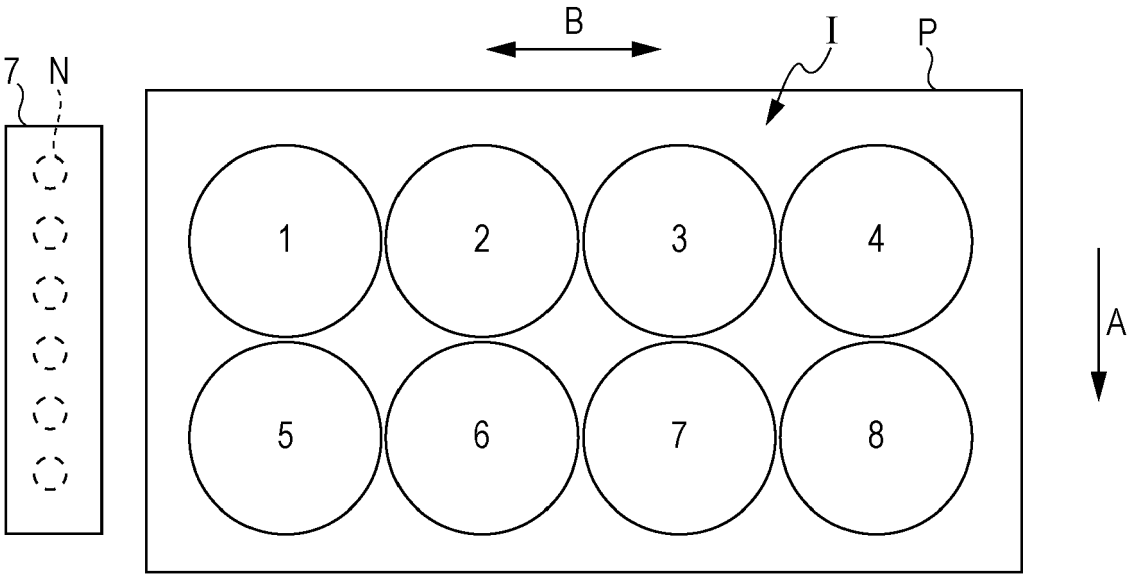


FIG. 4B

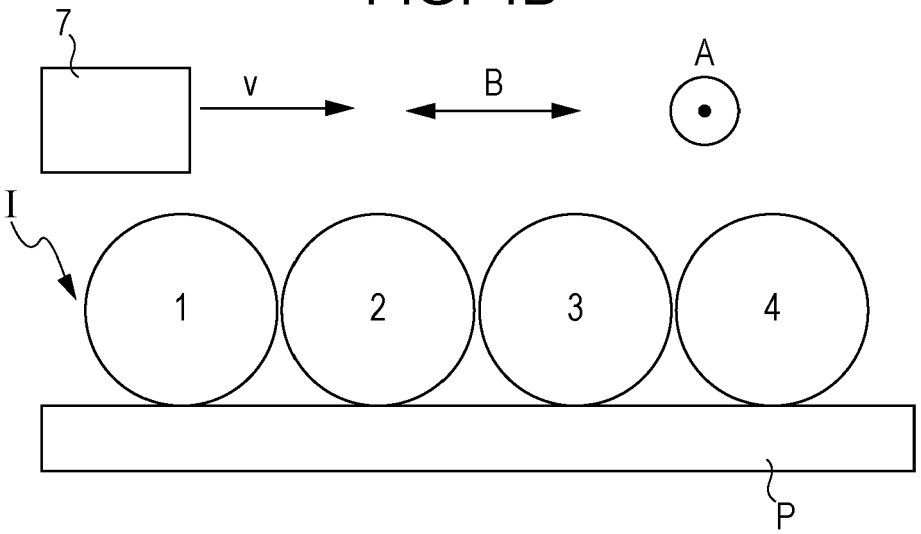


FIG. 5A

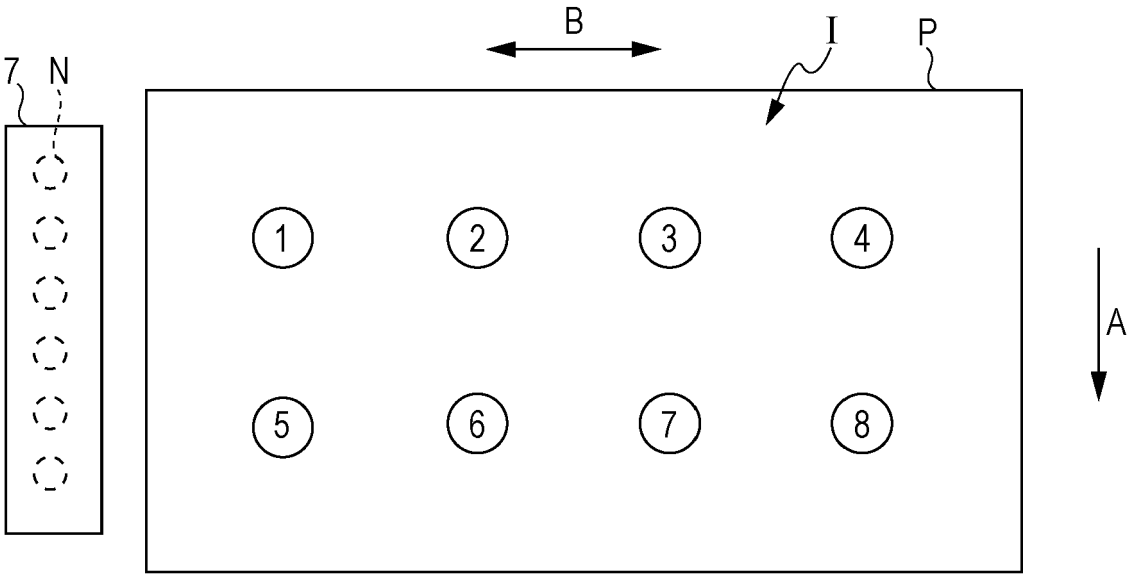


FIG. 5B

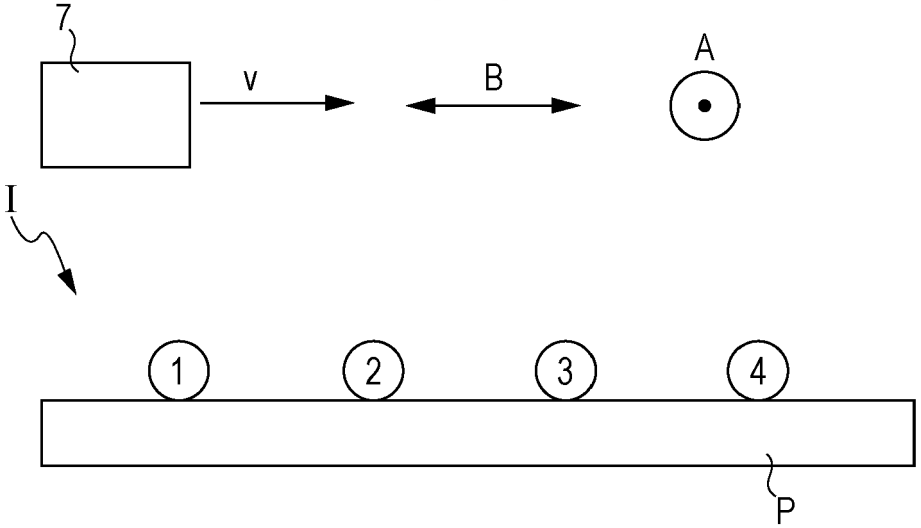


FIG. 6A

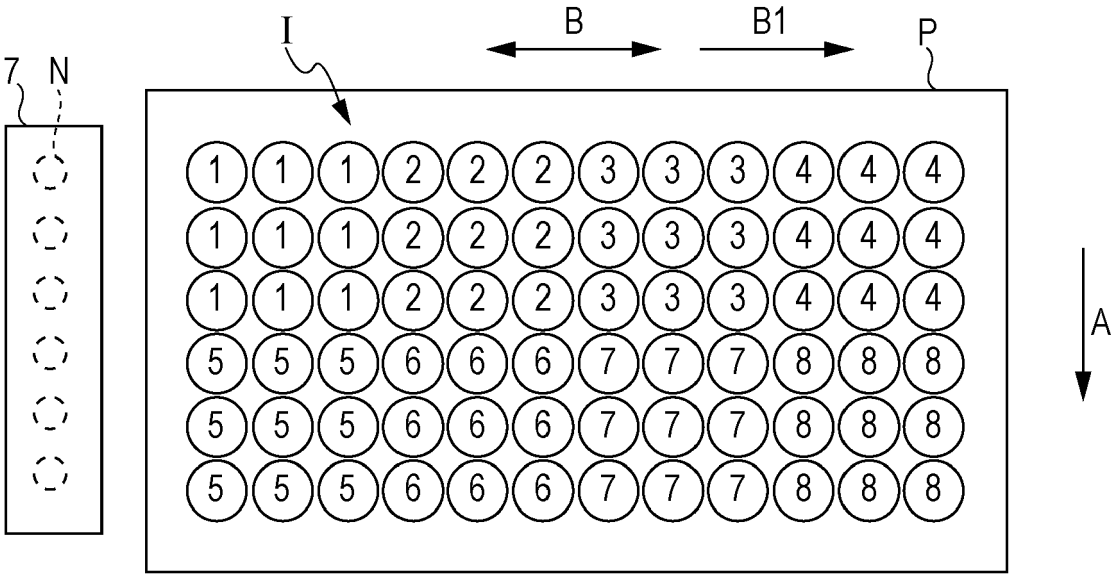

7
N
I
B
B1
P
A
1 1 1 2 2 2 3 3 3 4 4 4
1 1 1 2 2 2 3 3 3 4 4 4
1 1 1 2 2 2 3 3 3 4 4 4
5 5 5 6 6 6 7 7 7 8 8 8
5 5 5 6 6 6 7 7 7 8 8 8
5 5 5 6 6 6 7 7 7 8 8 8

FIG. 6B

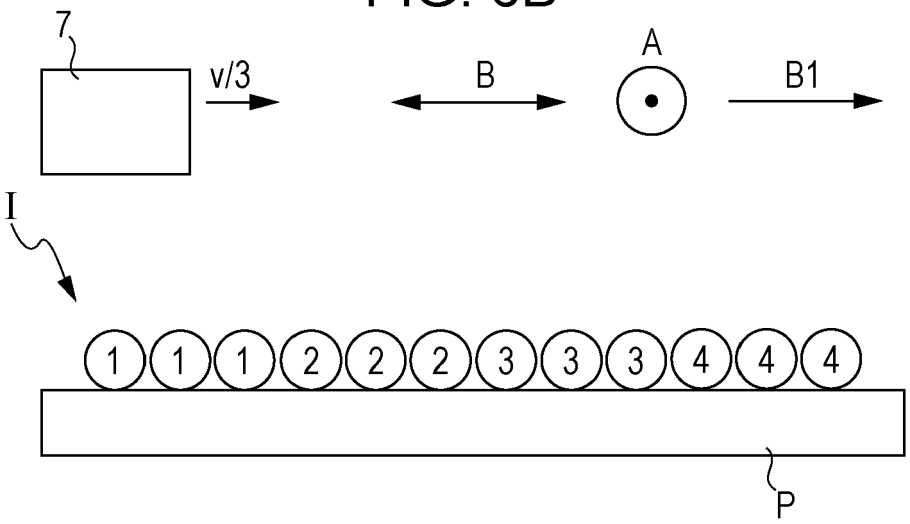

7
v/3
B
A
B1
I
1 1 1 2 2 2 3 3 3 4 4 4
P

FIG. 7A

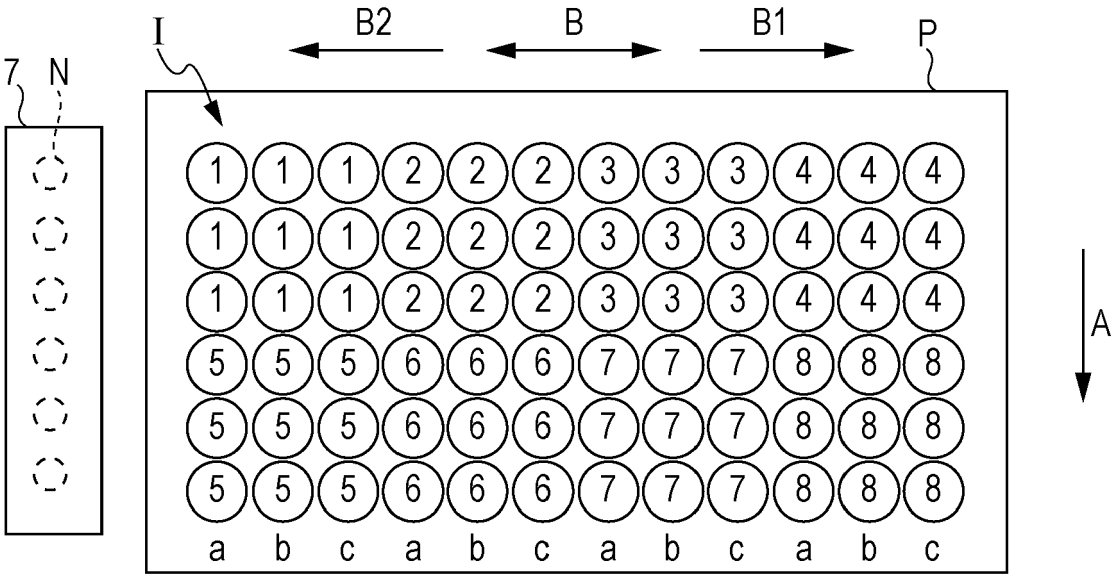
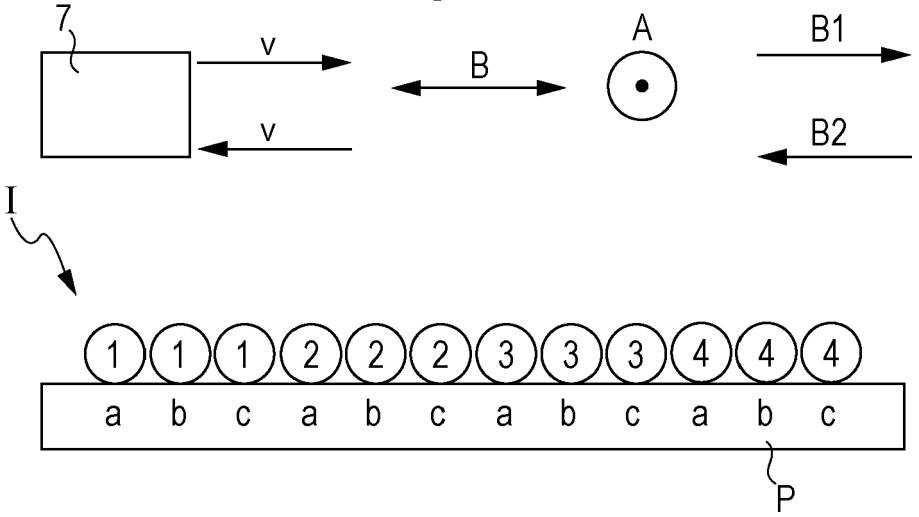

I
B2
B
B1
P
7
N
A
1 1 1 2 2 2 3 3 3 4 4 4
1 1 1 2 2 2 3 3 3 4 4 4
1 1 1 2 2 2 3 3 3 4 4 4
5 5 5 6 6 6 7 7 7 8 8 8
5 5 5 6 6 6 7 7 7 8 8 8
5 5 5 6 6 6 7 7 7 8 8 8
a b c a b c a b c a b c

FIG. 7B


7
v
v
B
A
B1
B2
I
1 1 1 2 2 2 3 3 3 4 4 4
a b c a b c a b c a b c
P

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 16 15 7692

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	US 6 705 717 B1 (FUJITA MIYUKI [JP] ET AL) 16 March 2004 (2004-03-16) * column 18, line 39 - column 21, line 45 * * column 37 *	1-5	INV. B41J3/407 B41J19/14 B41J2/205
X	US 5 610 637 A (SEKIYA TAKURO [JP] ET AL) 11 March 1997 (1997-03-11) * column 15, line 5 - line 61 *	1,2	
X	US 2005/007405 A1 (SHEPHERD MATTHEW A [US] ET AL) 13 January 2005 (2005-01-13) * paragraph [0016] *	1	

TECHNICAL FIELDS SEARCHED (IPC)

B41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	7 September 2016	Diaz-Maroto, V

CATEGORY OF CITED DOCUMENTS

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

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

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 16 15 7692

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

07-09-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6705717 B1	16-03-2004	DE 69423286 D1	13-04-2000
		DE 69423286 T2	10-08-2000
		DE 69433700 D1	13-05-2004
		DE 69433700 T2	10-03-2005
		EP 0646460 A1	05-04-1995
		EP 0962318 A1	08-12-1999
		US 6705717 B1	16-03-2004
US 5610637 A	11-03-1997	JP 3339724 B2	28-10-2002
		JP H06297717 A	25-10-1994
		US 5610637 A	11-03-1997
		US 5657060 A	12-08-1997
		US 5729257 A	17-03-1998
		US 5877786 A	02-03-1999
		US 6039425 A	21-03-2000
		US 6193348 B1	27-02-2001
		US 6227639 B1	08-05-2001
		US 6568778 B1	27-05-2003
		US 2003164865 A1	04-09-2003
		US 2004239709 A1	02-12-2004
		US 2005231539 A1	20-10-2005
		US 2005231559 A1	20-10-2005
		US 2008186347 A1	07-08-2008
US 2005007405 A1	13-01-2005	EP 1495875 A2	12-01-2005
		JP 2005032258 A	03-02-2005
		US 2005007405 A1	13-01-2005

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 2002019100 A **[0002]**