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(71) Applicant: **Seiko Epson Corporation**
Tokyo 160-8801 (JP)

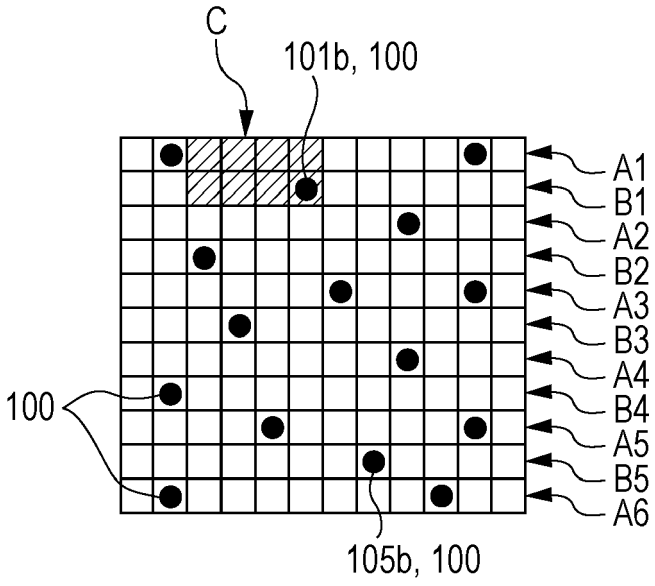
(72) Inventors:
- **TANASE, Kazuyoshi**
  Suwa-shi, Nagano 392-8502 (JP)
- **FUJITA, Toru**
  Suwa-shi, Nagano 392-8502 (JP)

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

(54) PRINTING APPARATUS AND PRINTING METHOD

(57) A printing apparatus is provided with a printing mechanism section that forms an image by discharging an ink toward a recording medium while reciprocating with respect to the recording medium, a pass analysis section that specifies a discharge position of the ink in an outgoing path and a return path of the printing mechanism section, an execution section that executes discharge position alteration correction, which alters the discharge position so that ink to be discharged in one path of either the outgoing path or the return path, is discharged in the other path, and a determination section that performs determination of whether or not the execution section performs the discharge position alteration correction.

FIG. 4



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Description

BACKGROUND

1. Technical Field

[0001] The present invention relates to a printing apparatus and a printing method.

2. Related Art

[0002] Printing apparatuses that print by applying ink onto a recording medium have been used in the related art (for example, refer to JP-A-2006-239866). The printing apparatus disclosed in JP-A-2006-239866 is provided with a transport unit that transports a recording medium, and a printing section that includes multiple nozzles that discharge ink onto the recording medium, which is transported, while reciprocating along a direction that intersects a transport direction of the recording medium.

[0003] In this kind of printing apparatus, depending on the separation distance between the recording medium and the printing section, the material of the recording medium, and the like, shifting of the landing positions of ink is significant in the outgoing path and the return path of the printing section, and therefore, there is a concern that there will be a deterioration in the image quality of an obtained image. In such an instance, in the printing apparatus disclosed in JP-A-2006-239866, it is possible to switch the mode to a mode for performing printing using either one of the outgoing path or the return path of the printing section only.

[0004] However, in the printing apparatus disclosed in JP-A-2006-239866, in a case in which the mode is switched to a mode for performing printing using either one of the outgoing path or the return path only, there is a possibility that a partial amount of discharge of ink will be higher. In this case, in portions in which an amount of discharge of ink is high, an air stream between the recording medium and the printing section becomes irregular, there is a reduction in the accuracy of the landing positions of ink, and as a result, there is a possibility that there will be a deterioration in the image quality of an obtained image.

SUMMARY

[0005] An advantage of some aspects of the invention is to provide a printing apparatus and a printing method that can prevent or reduce a deterioration in the image quality of an obtained image.

Solution to Problem

[0006] The advantage can be achieved by the following aspects of the invention.

[0007] According to an aspect of the invention, there is provided a printing apparatus including a printing section that forms an image by discharging an ink toward a recording medium while reciprocating with respect to the recording medium, a specification section that specifies a discharge position of the ink in an outgoing path and a return path of the printing section, an execution section that executes discharge position alteration correction, which alters the discharge position so that the ink that is discharged in one path of either the outgoing path or the return path, is discharged in the other path, and a determination section that performs determination of whether or not the execution section performs the discharge position alteration correction.

[0008] As a result of this, for example, it is possible to omit the discharge position alteration correction in a case in which a deterioration in image quality occurs if the discharge position alteration correction is performed. Accordingly, it is possible to prevent or suppress the occurrence of a deterioration in image quality due to the discharge position alteration correction. As a result of this, it is possible to enhance the image quality of an obtained image.

[0009] In the printing apparatus according to the aspect, it is preferable that the printing section discharge the ink as first liquid droplets and second liquid droplets, the volume of which is larger than that of first liquid droplets, and that the determination section perform determination such that the discharge position alteration correction is performed in a case in which a target of the discharge position alteration correction is the first liquid droplets.

[0010] Since, for the first liquid droplets, there are comparatively few deteriorations in the image quality of an image even if the discharge position alteration correction is performed, it is possible to prevent or suppress a deterioration in image quality due to the discharge position alteration correction.

[0011] In the printing apparatus according to the aspect, it is preferable that the determination section perform the determination based on a discharge amount of the ink per unit area of a peripheral region of liquid droplets of the ink that corresponds to the target of the discharge position alteration correction.

[0012] As a result of this, it is possible to prohibit the discharge position alteration correction in a case in which the discharge amount per unit area of liquid droplets of ink is comparatively high. Accordingly, it is possible to prevent or suppress a deterioration in image quality due to the discharge position alteration correction.

[0013] In the printing apparatus according to the aspect, it is preferable that the peripheral region include the other path. As a result of this, it is possible to perform determination of whether or not to perform the discharge position alteration correction based on the discharge amount of ink per unit area of a movement destination to which the liquid droplets are moved.

[0014] In the printing apparatus according to the aspect, it is preferable that the peripheral region include the one path. As a result of this, it is possible to set the pe-

ripheral region to be larger.

[0015] It is preferable that the printing apparatus according to the aspect further include a transport section that transports the recording medium in a direction that intersects a movement direction of the printing section, and that the execution section move the discharge position along the transport direction of the recording medium or the movement direction of the printing section.

[0016] As a result of this, it is possible to move the discharge position to the other path while keeping the movement amount of liquid droplets due to discharge position alteration correction as small as possible. Accordingly, it is possible to prevent or suppress a deterioration in image quality due to the discharge position alteration correction.

[0017] In the printing apparatus according to the aspect, it is preferable that the execution section move the discharge position of each liquid droplet of the ink in the same direction in a case in which there is a plurality of liquid droplets of the ink that corresponds to the target of the discharge position alteration correction.

[0018] As a result of this, it is possible to simplify a control operation of the discharge position alteration correction.

[0019] In the printing apparatus according to the aspect, it is preferable that the execution section perform alteration of the discharge position so that liquid droplets of the ink that corresponds to the target of the correction do not overlap with liquid droplets of the ink that is discharged in the one path.

[0020] As a result of this, it is possible to prevent or suppress a deterioration in image quality due to the discharge position alteration correction.

[0021] According to another aspect of the invention, there is provided a printing apparatus including a printing section that forms an image by discharging an ink toward a recording medium while reciprocating with respect to the recording medium, and a specification section that specifies a discharge position of the ink in an outgoing path and a return path of the printing section, in which the printing section discharges the ink to be discharged in one path of either the outgoing path or the return path, in the other path based on the discharge amount of ink per unit area of the ink in the image.

[0022] As a result of this, it is possible to discharge the ink that is to be discharged in the one path, in the other path in a case in which the discharge amount per unit area of liquid droplets of ink is comparatively small. As a result of this, it is possible to prevent or suppress a deterioration in image quality.

[0023] According to still another aspect of the invention, there is provided a printing method for performing printing using a printing apparatus that forms an image by discharging an ink toward a recording medium while reciprocating with respect to the recording medium, the method including specifying the discharge position of the ink in the outgoing path and the return path, and performing determination of whether or not to perform discharge position alteration correction, which alters the discharge position so that ink to be discharged in one path of either the outgoing path or the return path is discharged in the other path.

[0024] As a result of this, for example, it is possible to not perform the discharge position alteration correction in a case in which a deterioration in image quality occurs if the discharge position alteration correction is performed. Accordingly, it is possible to prevent or suppress the occurrence of a deterioration in image quality due to the discharge position alteration correction. As a result of this, it is possible to enhance the image quality of an obtained image.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] 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 side view that schematically shows a printing apparatus according to a first embodiment of the invention.

Fig. 2 is a block diagram of the printing apparatus shown in Fig. 1.

Fig. 3 is a view that shows image data in which pass analysis has been performed by a control section of the printing apparatus shown in Fig. 1.

Fig. 4 is a view that shows image data in which pass analysis has been performed by the control section of the printing apparatus shown in Fig. 1.

Fig. 5 is a view that shows image data in which pass analysis has been performed by the control section of the printing apparatus shown in Fig. 1.

Fig. 6 is a view that shows image data in which pass analysis has been performed by the control section of the printing apparatus shown in Fig. 1.

Fig. 7 is a view that shows image data in which pass analysis has been performed by the control section of the printing apparatus shown in Fig. 1.

Fig. 8 is a view that shows image data in which pass analysis has been performed by the control section of the printing apparatus shown in Fig. 1.

Fig. 9 is a view for describing the risk of rippling.

Fig. 10 is a view for describing the risk of rippling.

Fig. 11 is a flowchart for describing a control operation of the control section of the printing apparatus shown in Fig. 1.

Fig. 12 is a view for describing discharge position alteration correction that is performed by a control section of a printing apparatus according to a second embodiment of the invention.

Fig. 13 is a view for describing discharge position alteration correction that is performed by the control section of the printing apparatus according to the second embodiment of the invention.

Fig. 14 is a view for describing discharge position

alteration correction that is performed by a control section of a printing apparatus according to a third embodiment of the invention.

Fig. 15 is a view for describing discharge position alteration correction that is performed by the control section of the printing apparatus according to the third embodiment of the invention.

Fig. 16 is a view for describing discharge position alteration correction that is performed by a control section of a printing apparatus according to a fourth embodiment of the invention.

Fig. 17 is a view for describing discharge position alteration correction that is performed by the control section of the printing apparatus according to the fourth embodiment of the invention.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0026] Hereinafter, a printing apparatus and a printing method of the invention will be described in detail based on preferred embodiments that are shown in the appended drawings.

First Embodiment

[0027] Fig. 1 is a side view that schematically shows a printing apparatus according to a first embodiment of the invention. Fig. 2 is a block diagram of the printing apparatus shown in Fig. 1. Figs. 3 to 8 are views that show image data in which pass analysis has been performed by a control section of the printing apparatus shown in Fig. 1. Figs. 9 and 10 are views for describing the risk of rippling. Fig. 11 is a flowchart for describing a control operation of the control section of the printing apparatus shown in Fig. 1.

[0028] Additionally, hereinafter, for the convenience of description, in Fig. 1, an x axis, a y axis, and a z axis are illustrated as three axes, which are mutually orthogonal to one another. The x axis is an axis along a direction (a width (depth) direction of the printing apparatus) in the horizontal direction, the y axis is an axis along a direction (a longitudinal direction of the printing apparatus), which is a horizontal direction, and is perpendicular to the x axis, and the z axis is an axis along a vertical direction (an up-down direction). In addition, a leading end section of each arrow that is shown in the drawings is set as a "positive side (a + side)", and a base end side is set as a "negative side (a - side)". In addition, the upper sides in Figs. 1 and 3 to 8 will be referred to as the "top (upper regions)", and lower sides thereof will be referred to as the "bottom (lower regions)".

[0029] As shown in Figs. 1 and 2, a printing apparatus 1 executes a printing method of the invention, and is provided with a machine platform 11, a transport mechanism section (a transport section) 12 that transports work W, as a recording medium, a printing mechanism section (a recording section) 13 that carries out printing by applying an ink 100 to the work W, a drying section 2 that dries the ink 100 on the work W and an elevation mechanism 14.

[0030] In the present embodiment, a direction that is orthogonal to a transport direction, in which the work W is transported, is an x axis direction, a direction that is parallel to the transport direction is a y axis direction, and a direction that is orthogonal to the x axis direction and the y axis direction is a z axis direction.

[0031] The transport mechanism section 12 is provided with a reel-out device 3 that reels out the longitudinal work W, which is wound around in roll form, a winding device 4 that winds up the work W, on which printing is finished, and a support device 5 that is installed on the machine platform 11, and that supports the work W during printing.

[0032] The reel-out device 3 is installed further on an upstream side than the machine platform 11 in a feed direction of the work W (the y axis direction). The reel-out device 3 includes a feed-out roller (a reel-out reel) 31 around which the work W is wound in roll form, and that feeds the work W out, and a tensioner 32 that generates tension in the work W between the feed-out roller 31 and the support device 5. A motor (not illustrated in the drawings) is connected to the feed-out roller 31, and the feed-out roller 31 can rotate as a result of the action of the motor.

[0033] In addition, it is possible to use a target textile printing material as the work W. A target textile printing material refers to cloth, clothing, other garments, and the like that correspond to targets of textile printing. Cloth includes natural fibers such as cotton, silk and wool, chemical fibers such as nylon, and woven fabrics, knitted fabrics, non-woven fabrics, and the like, of composite fibers in which the above materials are combined. In addition, clothing and other garments includes post fabrication T-shirts, handkerchiefs, scarves, towels, carrier bags, fabric bags, furnishings such as curtains, sheets, and bed covers, and cloths, and the like, before and after cutting as parts in a pre-fabrication state.

[0034] Furthermore, in addition to the above-mentioned target textile printing materials, it is possible to use special purpose paper for ink jet recording such as normal paper, wood free paper, and glossy paper. In addition, as the work W, it is possible to use a plastic film on which a surface treatment for ink jet printing has not been performed (that is, on which an ink-absorbing layer is not formed), a recording medium in which a plastic is coated onto, or in which a plastic film is bonded to a base material such as a paper. The corresponding plastic is not particularly limited, and for example, examples thereof include polyvinyl chloride, polyethylene terephthalate, polycarbonate, polystyrene, polyurethane, polyethylene, and polypropylene.

[0035] The winding device 4 is installed further on a downstream side than the machine platform 11 in a feed direction of the work W (the y axis direction) with respect to the reel-out device 3. The winding device 4 includes a winding roller (a winding reel) 41 onto which the work

W is wound in roll form, and tensioners 42, 43 and 44 that generate tension in the work W between the winding roller 41 and the support device 5. A motor (not illustrated in the drawings) is connected to the winding roller 41, and the winding roller 41 can rotate as a result of the action of the motor. The tensioners 42 to 44 are respectively disposed in this order at intervals in a direction of separation from the winding roller 41.

[0036] The support device 5 is disposed between the reel-out device 3 and the winding device 4. The support device 5 includes a main driving roller 51 and a driven roller 52, which are disposed separated from one another in the y axis direction, an endless belt 53, which is stretched between the main driving roller 51 and the driven roller 52, and which supports the work W on an upper surface (a support surface) thereof, and tensioners 54 and 55 that generate tension in the work W between the main driving roller 51 and the driven roller 52.

[0037] A motor (not illustrated in the drawings) is connected to the main driving roller 51, and the main driving roller 51 can rotate as a result of the action of the motor. In addition, a rotational force of the main driving roller 51 is transmitted to the driven roller 52 via the endless belt 53, and the driven roller 52 can rotate in an interlocked manner with the main driving roller 51.

[0038] The endless belt 53 is a belt on which an adhesive layer, which has an adhesive property, is formed on a surface of an outer side thereof. A portion of the work W is adhered and fixed to the adhesive layer, and the work W is transported in the y axis direction. Further, printing is carried out on the work W during the transport. In addition, after the printing has been carried out, the work W peels away from the endless belt 53.

[0039] In the same manner as the main driving roller 51 and the driven roller 52, the tensioners 54 and 55 are disposed separated from one another in the y axis direction.

[0040] It is possible to interpose the work W between the tensioner 54 and the main driving roller 51 on the endless belt 53, and it is possible to interpose the work W between the tensioner 55 and the driven roller 52 on the endless belt 53. As a result of this, the work W, in which tension is generated by the tensioners 54 and 55, is fixed to the endless belt 53 and transported in a state in which the tension is generated. As a result of such a state, in the work W, for example, the generation of wrinkles, or the like, during transport is reduced, and accordingly, in a case in which printing is carried out, and therefore, the printing is accurate and high-quality.

[0041] The printing mechanism section 13 is provided with a carriage unit 132, which has a plurality of ink jet heads 131 that perform recording through printing by discharging the ink 100 onto the work W, and an X axis table (not illustrated in the drawing) that supports the carriage unit 132 in a manner in which the carriage unit 132 is capable of moving in the x axis direction. For example, each ink jet head 131 respectively includes a head main body, in which an internal head flow channel, an inner section of which is filled with the ink 100, is formed, and multiple nozzle groups 6, which have an opening.

[0042] Piezoelectric elements (piezoelectric bodies), which correspond to each discharge nozzle, are configured in the head main body, and when a voltage is applied to the piezoelectric elements, the ink 100 is discharged from a nozzle group 6 as liquid droplets.

[0043] Additionally, in a state in which the ink 100 is not being discharged, the ink jet heads 131 are on stand-by in a position (a stand-by position) that is shifted from the work W (the endless belt 53) when viewed from the z axis direction.

[0044] In the printing apparatus 1, the work W, which is reeled out by the reel-out device 3, is intermittently fed (a sub-scan) in the y axis direction in a fixed state of being adhered to and fixed by the endless belt 53, and the ink 100 is discharged from the nozzle groups 6 onto the work W in the fixed state, while the carriage unit 132 is reciprocated (a main scan) in the x axis direction. It is possible to perform the above-mentioned actions until printing is completed and an image pattern is formed on the work W. Additionally, the image pattern may be an image pattern that results from polychromatic printing (color printing), or may be an image pattern that results from monochromatic printing.

[0045] The ink 100 contains a dye or a pigment, as a coloring agent, in water, as a solvent, and for example, there are four colors of cyan (C), magenta (M), yellow (Y) and black (K). Further, the ink 100 of each color is respectively discharged from the ink jet heads 131 in an independent manner.

[0046] The elevation section 14, which is shown in Figs. 1 and 2 can adjust the height of the nozzle groups 6. The elevation section 14 can, for example, be set to a configuration that includes a motor, a ball screw and a linear guide. In addition, the motor is equipped with an encoder. It is possible to detect the height of the ink jet head 131 based on the amount of rotation that is detected by the encoder. This kind of elevation section 14 is also electrically connected to a control section 15.

[0047] In this manner, it is possible to change a separation distance between the nozzle groups 6 and the work W using the elevation section 14. Accordingly, it is possible to perform favorable printing depending on a quality of the material of the work W.

[0048] As shown in Fig. 1, the drying section 2 is disposed between the support device 5 and the winding roller 41 of the winding device 4, which is further on a downstream side than the printing mechanism section 13 in the transport direction of the work W.

[0049] The drying section 2 includes a chamber 21, and a coil 22, which is disposed inside the chamber 21. The coil 22 is, for example, configured by a nichrome wire, and is a heating element that heats as a result of power being supplied thereto. Further, it is possible to dry the ink 100 on the work W that is passing through the chamber 21 as a result of heat that is generated by the coil 22.

[0050] As shown in Fig. 2, the control section (an adjustment section) 15 is electrically connected to the drying section 2, the transport mechanism section 12, the printing mechanism section 13 and the elevation section 14, and has a function of respectively controlling the actions of the above-mentioned components. In addition, the control section 15 includes a central processing unit (CPU) 151, and a storage section 155.

[0051] The CPU 151 executes programs for various processes such as a printing process such as that mentioned above. In addition, the CPU 151 functions as a pass analysis section (specification section) 152, a determination section 153, and an execution section 154.

[0052] The storage section 155, for example, includes electrically erasable programmable read-only memory (EEPROM), which is a type of non-volatile semiconductor memory, or the like, and can store various programs, or the like.

[0053] The pass analysis section 152 performs a pass analysis that specifies which position in the outgoing path and the return path at which to discharge the ink based on input image data.

[0054] Fig. 3 is a view that shows a section of an image showing a state in which a pass analysis has been performed. The image is divided in grid form, and a single divided square corresponds to one pixel.

[0055] In addition, in Figs. 3 to 8, the divided squares are aligned from the upper side in the order of an outgoing path printing region A1, a return path printing region B1, an outgoing path printing region A2, a return path printing region B2, an outgoing path printing region A3, a return path printing region B3, an outgoing path printing region A4, a return path printing region B4, an outgoing path printing region A5, a return path printing region B5, and an outgoing path printing region A6. In addition, in Figs. 3 to 8, circles are placed in positions in which ink is discharged.

[0056] In this manner, the pass analysis section 152 performs a pass analysis, and printing is performed in accordance with the result.

[0057] In this instance, in a general printing apparatus, in a case in which the ink is discharged toward an arbitrary position, shift occurs in the landing position of the ink between an outgoing path and a return path. The reason for this is that the orientation of inertia forces that are connected to on the ink differ between the outgoing path and the return path. In particular, if the size of the liquid droplets of the ink is comparatively small, the separation distance between the nozzles and the recording medium is comparatively large, or the like, it is easy for shift in the landing position of the ink between the outgoing path and the return path to become significant. In a case in which this kind of shift occurs, a "pass approach", which is described below, can be considered as means for reducing such shift.

[0058] The "pass approach" refers to only ejecting liquid droplets in one of the outgoing path and the return path. If described using the printing apparatus 1 as an example, for example, as shown in Fig. 5, the ink that should be discharged in the return path printing region B1, is discharged in the outgoing path printing region A1. That is, discharge position alteration correction, which alters the discharge positions, is performed so that the ink to be discharged in the return path printing region B1, is discharged in the outgoing path printing region A1. As a result of this, it is possible to prevent shift of the landing positions of the ink between the outgoing path and the return path. Additionally, in the configurations that are shown in Figs. 3 to 8, since the shift of liquid droplets of the ink 100 to be discharged to the outgoing path being shifted upward by 1 pixel in Figs. 3 to 8 is less than the shift in the landing positions of the ink between the outgoing path and the return path (the lateral direction in Figs. 3 to 8), consequently, it is possible to suppress a deterioration in image quality of an image.

[0059] However, as a result of performing the pass approach, it is likely that the air stream between the printing section and the work W will become irregular if the discharge density (the discharge amount of ink per unit area in the image) of the ink 100 is comparatively high. In this case, it is likely that the landing positions of the ink will be shifted from reference positions.

[0060] For example, Fig. 9 is a view that shows the ink 100 that is discharge without the pass approach being performed, and Fig. 10 is a view that shows the density of the ink 100 that is discharged as a result of performing the pass approach. As shown in Fig. 10, as a result of the gaps between liquid droplets of the ink being comparatively small, there is a concern that the ink will be displaced by the air that passes through the gaps, and that the landing positions of the ink will be shifted from the reference positions as a result (hereinafter, the likelihood that this phenomenon will occur is referred to as the "risk of rippling").

[0061] In such an instance, in the printing apparatus 1, in the following manner, it is possible to avoid the risk of rippling. Additionally, in the following description, a case in which the pass approach alters the discharge positions of the ink in the outgoing path to the return path will be described in a representative manner.

[0062] As shown in Fig. 2, the control section 15 includes the determination section 153 and the execution section 154. The determination section 153 performs the determination of whether or not to perform the pass approach. The execution section 154 perform the pass approach based on the determination result of the determination section 153.

[0063] As shown in Fig. 4, when performing determination, firstly, the determination section 153 sets a rectangular peripheral region C in the periphery of a liquid droplet of the ink (hereinafter, referred to as ink 101b) within the return path printing region B1, which corresponds to a target of the determination. In the configuration that is illustrated, the peripheral region C is set to four pixels of the outgoing path printing region A1 on the upper side of the ink 101b and four pixels of the return

path printing region B1 on the lower side thereof. As shown in Figs. 4 and 5, as long as there is not a liquid droplet of the ink 100 other than the ink 101b within the peripheral region C, the determination section 153 determines that it is possible to perform the pass approach with respect to the ink 101b. Further, the execution section 154 executes the pass approach.

[0064] In addition, the determination section 153 also performs determination in a similar manner to that above for the return path printing region B2 to the return path printing region B5, and the execution section 154 performs the pass approach based on the determination results thereof.

[0065] In this instance, as shown in Figs. 7 and 8, since there is a liquid droplet of the ink 100 (the liquid droplet of the ink 100 of the outgoing path printing region A5) other than the ink 105b within the peripheral region C of the liquid droplet (hereinafter, referred to as the "ink 105b") of the ink that is positioned within the return path printing region B5, the determination section 153 determines that it is not possible to perform the pass approach. Further, the execution section 154 omits performance of the pass approach of the ink.

[0066] In this manner, in the printing apparatus 1, when performing the pass approach, it is determined whether or not to perform the pass approach for each liquid droplet of the ink 100 of each return path. In addition, the determination is preferably performed based on the discharge amount per unit area of the ink 100 that corresponds to the target of the determination, so that in some cases it is possible for one or more droplets to be deposited in the peripheral region C, so long as the total number and/or volume of the droplets is below a predetermined threshold. As a result of this, by performing the pass approach, it is possible to prevent an increase in the discharge amount per unit area of the ink 100. It is possible to avoid the risk of rippling such as that mentioned above. As a result of this, it is possible to prevent a deterioration in image quality of an image as a result of performing the pass approach.

[0067] In addition, in the printing apparatus 1, the movement direction of the ink 100 during the pass approach is the up direction (a direction that follows the transport direction of the work W) in Figs. 3 to 8. As a result of this, it is possible to keep the movement amount of the liquid droplets of the ink 100 due to the pass approach as small as possible. Accordingly, it is possible to effectively prevent or suppress a deterioration in image quality due to the pass approach.

[0068] Furthermore, in the printing apparatus 1, when the pass approach is performed, the liquid droplets of the ink 100 in the return path printing region B1 to the return path printing region B5 are respectively configured so as to move in the same direction. As a result of this, it is possible to simplify the control operation when the execution section 154 executes the pass approach.

[0069] In addition, as shown in Figs. 4 and 6, the peripheral region C of the ink 101b of the return path printing region B1 is set to include the outgoing path printing region A1. That is, a region of a movement destination is included in the pass approach. As a result of this, the determination section 153 can perform accurate determination, and as a result of this, it is possible to more effectively prevent a deterioration in image quality of an image due to the pass approach being performed. In addition, the peripheral region C can be changed, for example by being set to also include the return path printing region B2, so it is possible to make the peripheral region C larger or otherwise changed. Accordingly, it is possible for the determination section 153 to perform more accurate determination.

[0070] The printing apparatus 1 has been described above. In the present embodiment, the pass approach performs correction that moves the ink 100 of the return path printing region B1 to the return path printing region B5 to the outgoing path printing region A1 to the outgoing path printing region A5, but the invention is not limited to this configuration, and may perform correction that moves the ink 100 of the outgoing path printing region A1 to the outgoing path printing region A5 to the return path printing region B1 to the return path printing region B5.

[0071] In addition, in the present embodiment, the pass approach moves the ink 100 to the upper side in Figs. 3 to 8, but the invention is not limited to this configuration, and may move the ink 100 to the lower side in Figs. 3 to 8.

[0072] In addition, in the above-mentioned description, among the colors of cyan (C), magenta (M), yellow (Y) and black (K), cyan (C) ink 100 was described in a representative manner, but it is possible to perform the pass approach in a similar manner for magenta (M), yellow (Y), and black (K) ink 100. In this case, for example, it is possible to skip the pass approach for colors such as yellow (Y) that stand out comparatively poorly, and perform the pass approach for colors such as black (K) that stand out comparatively well.

[0073] Next, a control operation of the control section 15 will be described based on the flowchart shown in Fig. 11.

[0074] Firstly, in Step S101, the discharge positions of the ink 100 are determined in the outgoing path printing region A1 to the outgoing path printing region A6 and the return path printing region B1 to the return path printing region B5 by performing a pass analysis based on the data of an image to be formed on the work W (refer to Fig. 3).

[0075] Further, in Step S102, it is determined whether or not to perform the pass approach based on a work gap, or the like. In Step S102, in a case in which it is determined that there is a concern that there will be a deterioration in image quality if the pass approach is not performed, as shown in Figs. 4 and 6, in data in which a pass analysis has been completed, the peripheral region C is respectively set (Step S103) for the ink 100 that is positioned in the return path printing region B1 to the return path printing region B5.

[0076] Further, in Step S104, as shown in Fig. 4, it is determined whether or not ink 100 other than a target ink 100 is positioned within the peripheral region C of the ink 101b. In Step S104, in a case in which it is determined that ink 100 other than a target ink 100 is not positioned within the peripheral region C of the ink 101b, it is set so that the pass approach will be performed for the ink 101b in Step S105.

[0077] Further, in Step S106, it is determined whether or not the above-mentioned determination has been completed for all of the ink 100 of the return path printing regions B1 to B5. In Step S106, in a case in which it is determined that the determination of all of the ink 100 has not been completed, the process returns to Step S104, and a similar determination to that above is repeated in order for the ink 100 for which determination is yet to be completed.

[0078] In addition, as shown in Fig. 8, in a case in which it is determined that ink 100 other than a target ink 105b is positioned within the peripheral region C of the ink 105b, it is set so that the pass approach will not be performed for the ink 105b in Step S107.

[0079] Further, in Step S108, printing is performed with the above-mentioned settings.

[0080] Additionally, in Step S102, in a case in which it is determined that there is not a concern that there will be a deterioration in image quality even if the pass approach is omitted, the pass approach is omitted for all of the ink 100 (Step S109), and printing is performed (Step S108).

Second Embodiment

[0081] Figs. 12 and 13 are views for describing discharge position alteration correction that is performed by a control section that a second embodiment of the printing apparatus of the invention is provided with.

[0082] Hereinafter, the second embodiment of the printing apparatus of the invention will be described with reference to the above-mentioned drawings, but description will be given focusing on the differences from the above-mentioned embodiment, and the description of like matters will be omitted.

[0083] Apart from the fact that the control program is different, the present embodiment is the same as the first embodiment.

[0084] As shown in Figs. 12 and 13, in the present embodiment, the determination of whether or not it is possible to perform the pass approach is performed depending on the size of the liquid droplets of the ink 100. The printing apparatus 1 discharges the ink 100 as small dots (first liquid droplets) 100a, medium dots (second liquid droplets) 100b and large dots 100c.

[0085] As shown in Fig. 12, the determination section 153 determines that it is possible to perform the pass approach as long as the target of the determination is the small dots 100a. In addition, as shown in Fig. 13, the pass approach is omitted in a case in which the target of the determination is the medium dots 100b or the large dots 100c.

[0086] For the small dots 100a, even if the pass approach is performed, it is comparatively difficult to tell that the pass approach has been carried out when the entire image is viewed. In contrast to this, for the medium dots 100b and the large dots 100c, when the pass approach is performed, the fact that the pass approach has been carried out stands out more than for the small dots 100a. In the present embodiment, since the pass approach is only performed for the small dots 100a for which it is comparatively difficult to tell that the pass approach has been carried out, it is possible to prevent or suppress a deterioration in image quality.

[0087] Additionally, in the above-mentioned description, in a case in which the pass approach is performed for the small dots 100a is described, but the pass approach may also be performed for the medium dots 100b depending on the volume of the liquid droplets. In this case, the large dots 100c are the second liquid droplets, and the medium dots 100b correspond to the first liquid droplets.

Third embodiment

[0088] Figs. 14 and 15 are views for describing discharge position alteration correction that is performed by a control section that a third embodiment of the printing apparatus of the invention is provided with.

[0089] Hereinafter, the third embodiment of the printing apparatus of the invention will be described with reference to the above-mentioned drawings, but description will be given focusing on the differences from the above-mentioned embodiments, and the description of like matters will be omitted.

[0090] Apart from the fact that the control program is different, the present embodiment is the same as the first embodiment.

[0091] As shown in Figs. 14 and 15, in the present embodiment, the movement destination when the pass approach is performed differs from that of each of the above-mentioned embodiments. For example, a case of performing the pass approach of the ink 100 of the return path printing region B1 (hereinafter, referred to as the "ink 101b") to the outgoing path printing region A1 will be described. As shown in Fig. 14, in a case in which the ink 100 of the outgoing path printing region A1 (hereinafter, referred to as a "ink 101a") is positioned directly above the ink 101b in Fig. 14, the discharge position of the ink 101b is moved to a pixel that is adjacent (the right side in the illustrated configuration) to the discharge position of the ink 101a. As a result of this, it is possible to prevent a circumstance in which the discharge positions of the ink 101a and the ink 101b overlap. Accordingly, it is possible to prevent a circumstance in which the color variation occurs as a result of the ink 101a and the ink 101b overlapping on the work W. Accordingly, it is possible to prevent a circumstance in which there is a dete-

rioration in image quality as a result of the pass approach.

[0092] Additionally, in the present embodiment, the pass approach moves the discharge position of the ink 101b to the pixel on the right side of the discharge position of the ink 101a as one example, but the invention is not limited to this configuration, and may move the discharge position of the ink 101b to the pixel on the left side of the ink 101a.

Fourth Embodiment

[0093] Figs. 16 and 17 are views for describing discharge position alteration correction that is performed by a control section that a fourth embodiment of the printing apparatus of the invention is provided with.

[0094] Hereinafter, the fourth embodiment of the printing apparatus of the invention will be described with reference to the above-mentioned drawings, but description will be given focusing on the differences from the above-mentioned embodiment, and the description of like matters will be omitted.

[0095] Apart from the fact that the control program is different, the present embodiment is the same as the first embodiment.

[0096] As shown in Figs. 16 and 17, in the present embodiment, the pass approach alters the size of the liquid droplets of the ink 100 to be discharged. For example, as shown in Fig. 16, in a case in which a medium dot 100b is positioned in the outgoing path printing region A1 and a small dot 100a is positioned in the return path printing region B1, as shown in Fig. 17, discharge of the small dot 100a in the return path printing region B1 is omitted and the medium dot 100b is altered to a large dot 100c in the outgoing path printing region A1. That is, an amount that is equivalent to the small dot 100a, which is omitted in the return path printing region B1, is discharged in the outgoing path printing region A1. As a result of this, when viewed from the outgoing path printing region A1 and the return path printing region B1, it is possible to set the discharge amount of the ink 100 to be substantially the same, and it is possible to prevent a circumstance in which the small dots 100a and the medium dots 100b overlap. Accordingly, it is possible to prevent a circumstance in which there is a deterioration in image quality as a result of the pass approach.

[0097] Embodiments of the drawings that show the printing apparatus and the printing method of the invention have been described above, but the invention is not limited to these embodiments, and it is possible to substitute each section that configures the printing apparatus for a section that has an arbitrary configuration that is capable of exhibiting the same function. In addition, arbitrary components may be added.

[0098] In addition, the printing apparatus of the invention may be a printing apparatus in which two or more arbitrary configurations (features) of each of the above-mentioned embodiments are combined.

[0099] In addition, in each of the above-mentioned embodiments, liquid droplets of ink of the three sizes of small dots, medium dots and large dots are discharged, but the invention is not limited to this configuration, and for example, liquid droplets of the ink of one, two or four or more sizes may be discharged.

[0100] In addition, a single droplet of a large dot may be three droplets of small dots, or may be a combination of single droplet of a medium dot and a single droplet of a small dot.

[0101] In addition, in each of the above-mentioned embodiments, a case in which the discharge position alteration correction is performed along the transport direction of the recording medium is described, but the invention is not limited to this configuration, and may be performed along a direction that intersects the transport direction of the recording medium, that is, the movement direction of the printing section.

[0102] The skilled addressee will also appreciate that any or all of the different embodiments may be combined. For example, the peripheral region C of the first embodiment may be used in the other embodiments (or no peripheral region may be used). Likewise, the second embodiment may be combined with the third and fourth embodiments.

Claims

1. A printing apparatus (1) comprising:

a printing section (13) configured to form an image by discharging an ink (100) toward a recording medium (W) while reciprocating with respect to the recording medium; and
a specification section configured to specify a discharge position of the ink in an outgoing path and a return path of the printing section;
wherein the printing section is arranged to discharge the ink to be discharged in one path of either the outgoing path or the return path, in the other path based on the discharge amount of ink per unit area of the ink in the image.

2. A printing apparatus according to claim 1, further comprising:

an execution section (154) configured to execute discharge position alteration correction, which alters the discharge position so that the ink that is discharged in the one path is discharged in the other path; and
a determination section (153) configured to perform determination of whether or not the execution section performs the discharge position alteration correction.

3. The printing apparatus according to Claim 1 or Claim 2,

wherein the printing section is configured to discharge the ink as first liquid droplets (100a) and second liquid droplets (100c), the volume of which is larger than that of first liquid droplets, and
wherein the determination section is configured to perform determination such that the discharge position alteration correction is performed in a case in which a target of the discharge position alteration correction is the first liquid droplets.

4. The printing apparatus according to any one of the preceding claims,
wherein the determination section is configured to perform the determination based on a discharge amount of the ink per unit area of a peripheral region of liquid droplets of the ink that corresponds to the target of the discharge position alteration correction.

5. The printing apparatus according to Claim 4,
wherein the peripheral region includes the other path.

6. The printing apparatus according to Claim 4 or Claim 5,
wherein the peripheral region includes the one path.

7. The printing apparatus according to any one of the preceding claims, further comprising a transport section (12) configured to transport the recording medium in a direction that intersects a movement direction of the printing section,
wherein the execution section is configured to move the discharge position along the transport direction of the recording medium or the movement direction of the printing section.

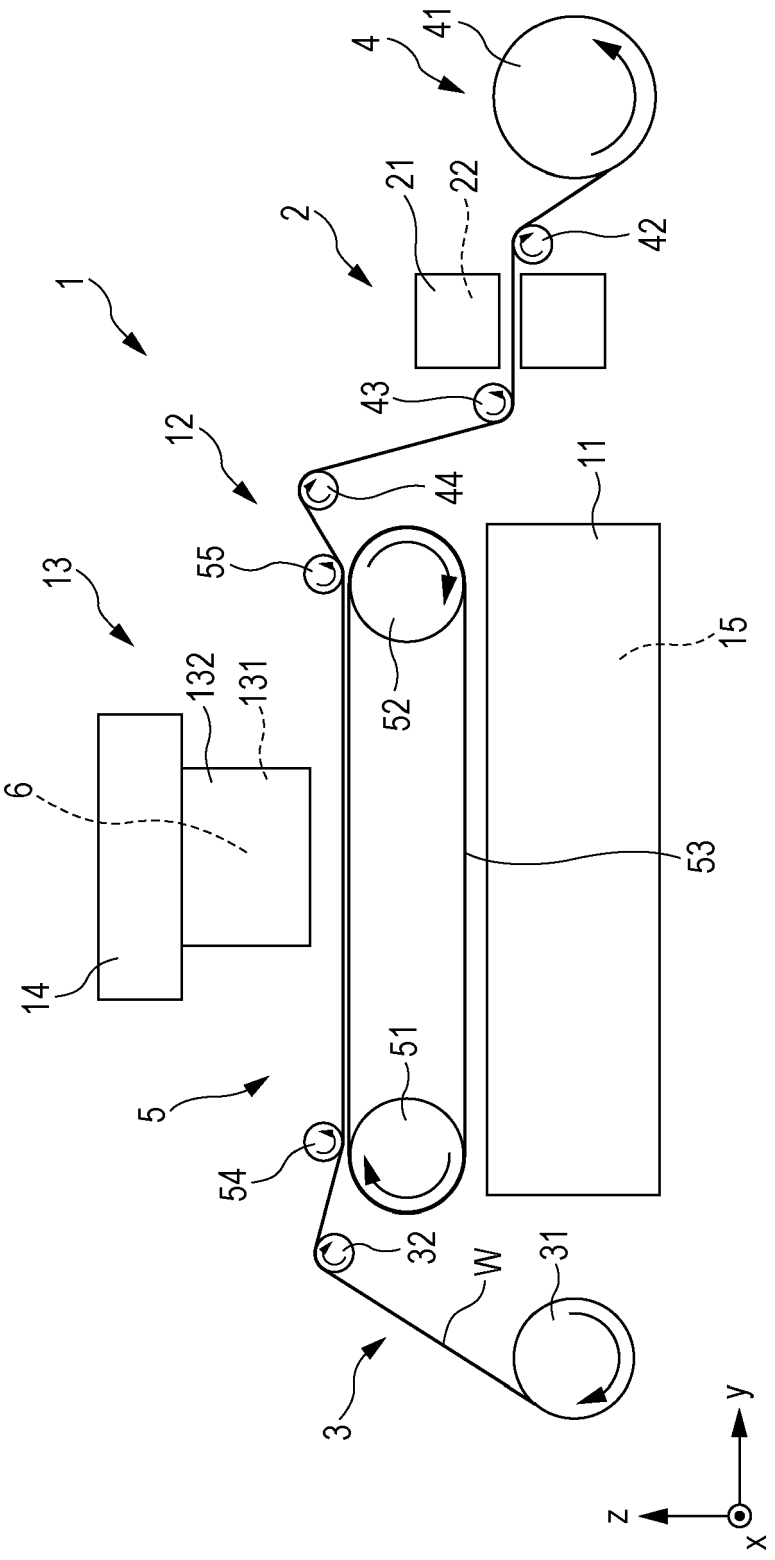
8. The printing apparatus according to any one of the preceding claims,
wherein the execution section is configured to move the discharge position of each liquid droplet of the ink in the same direction in a case in which there is a plurality of liquid droplets of the ink that corresponds to the target of the discharge position alteration correction.

9. The printing apparatus according to any one of the preceding claims,
wherein the execution section is configured to perform alteration of the discharge position so that liquid droplets of ink that correspond to the target of the discharge position alteration correction do not overlap with liquid droplets of the ink that is discharged in the one path.

10. A printing method for performing printing using a printing apparatus (1) including a printing section (14) that forms an image by discharging an ink toward a recording medium (W) while reciprocating with respect to the recording medium,
the method comprising:

specifying the discharge position of the ink in the outgoing path and the return path of the printing section; and
performing determination of whether or not to perform discharge position alteration correction, which alters the discharge position so that ink to be discharged in one path of either the outgoing path or the return path, is discharged in the other path.

FIG. 1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22
4
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43
12
44
11
13
55
15
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132
131
6
53
14
5
51
54
32
W
31
3
y
z
x

FIG. 2

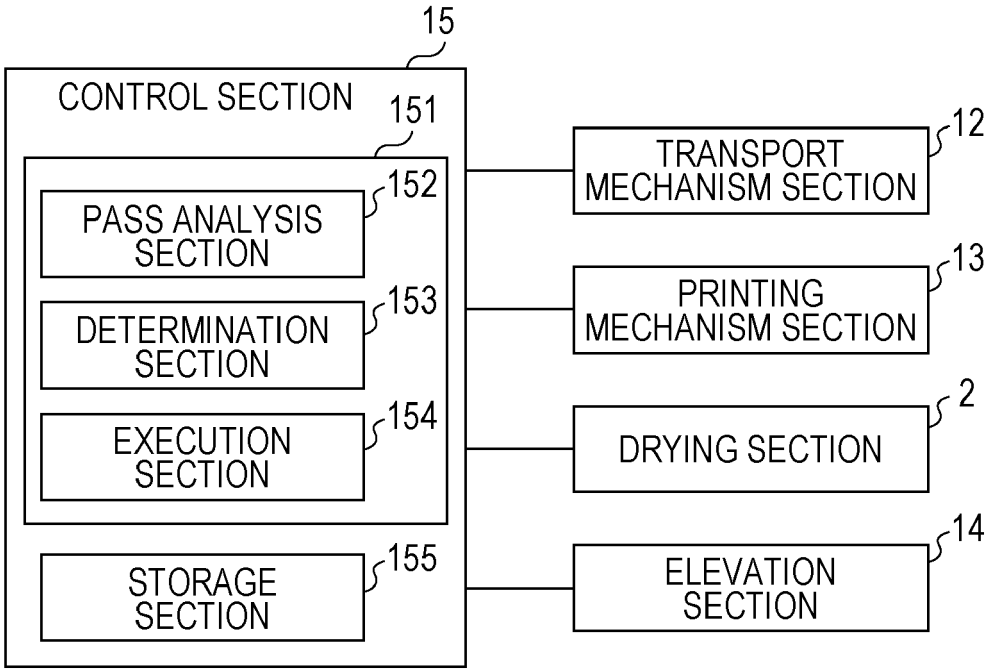

15
CONTROL SECTION
151
PASS ANALYSIS SECTION
152
DETERMINATION SECTION
153
EXECUTION SECTION
154
STORAGE SECTION
155
TRANSPORT MECHANISM SECTION
12
PRINTING MECHANISM SECTION
13
DRYING SECTION
2
ELEVATION SECTION
14

FIG. 3

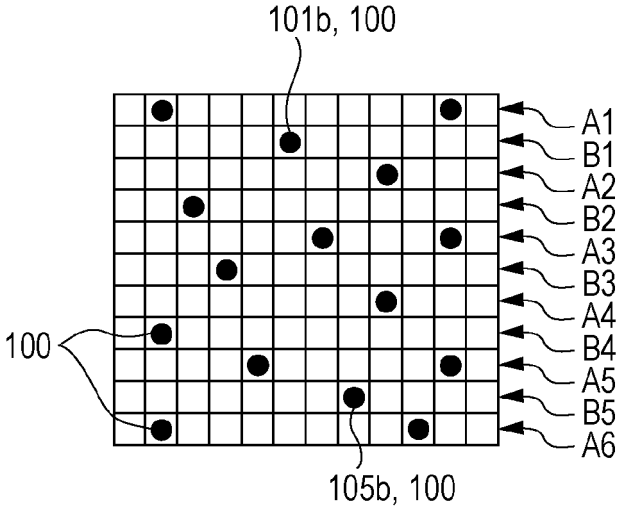


FIG. 4

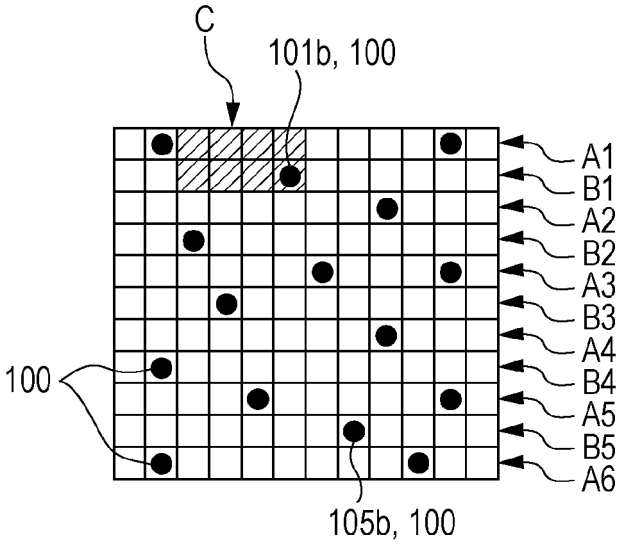


FIG. 5

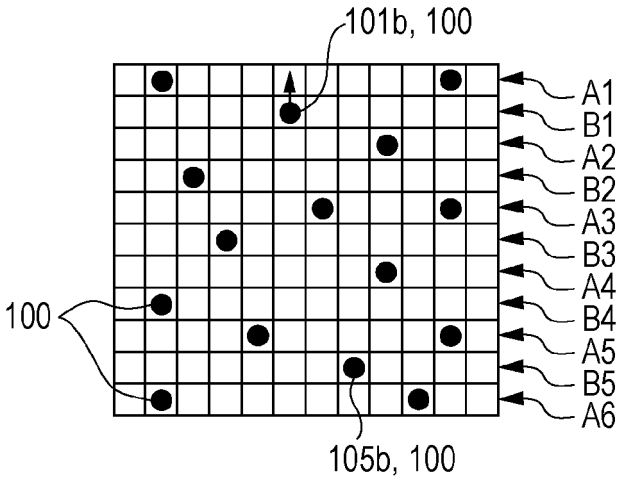


FIG. 6

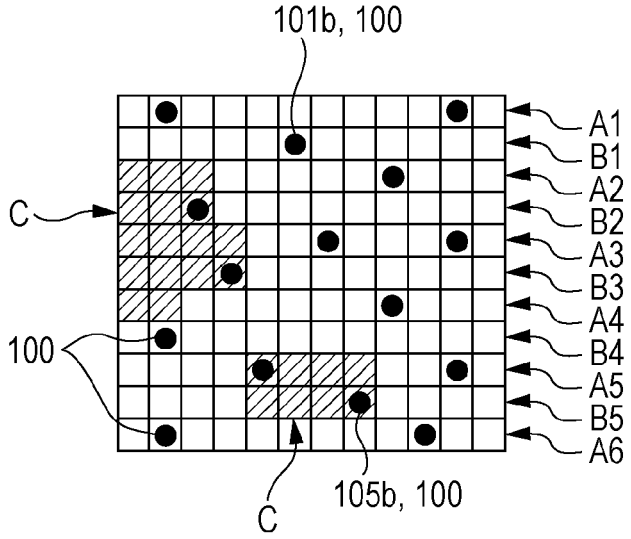


FIG. 7

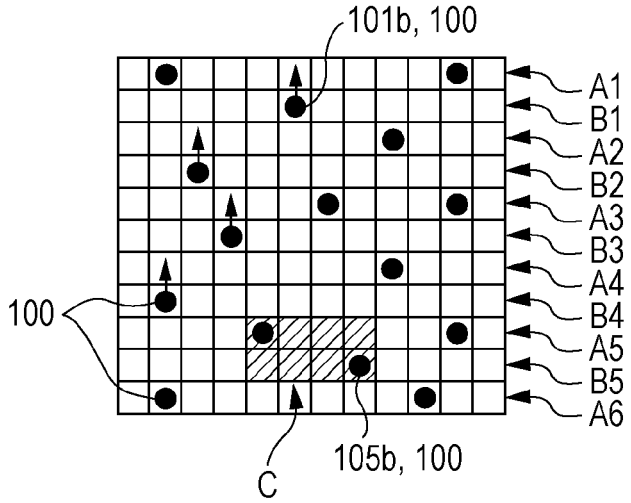


FIG. 8

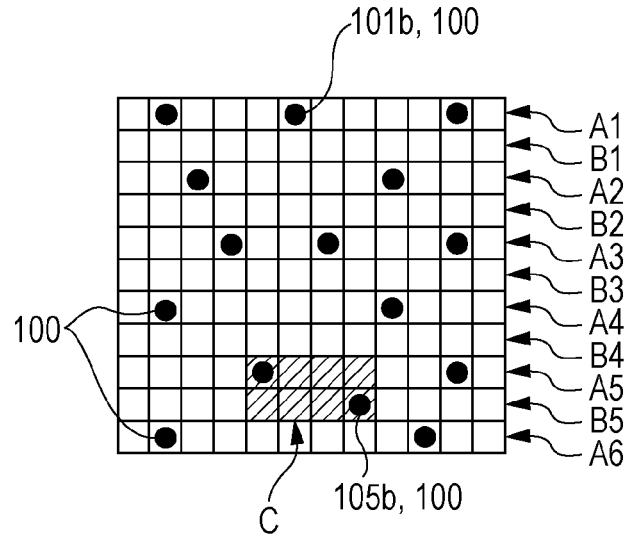


FIG. 9

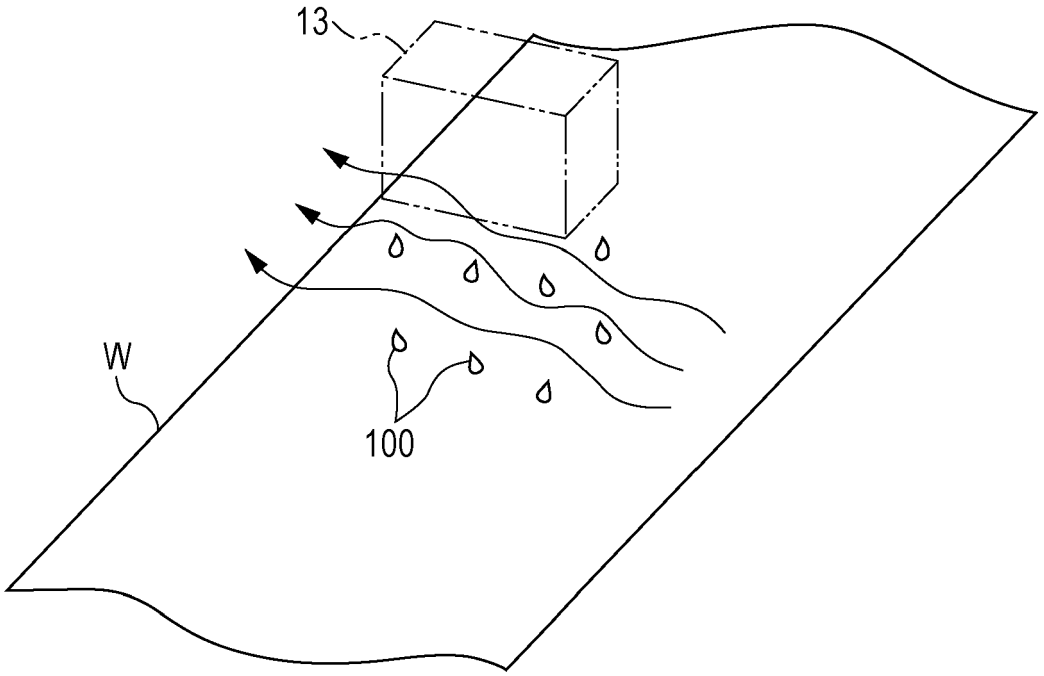


FIG. 10

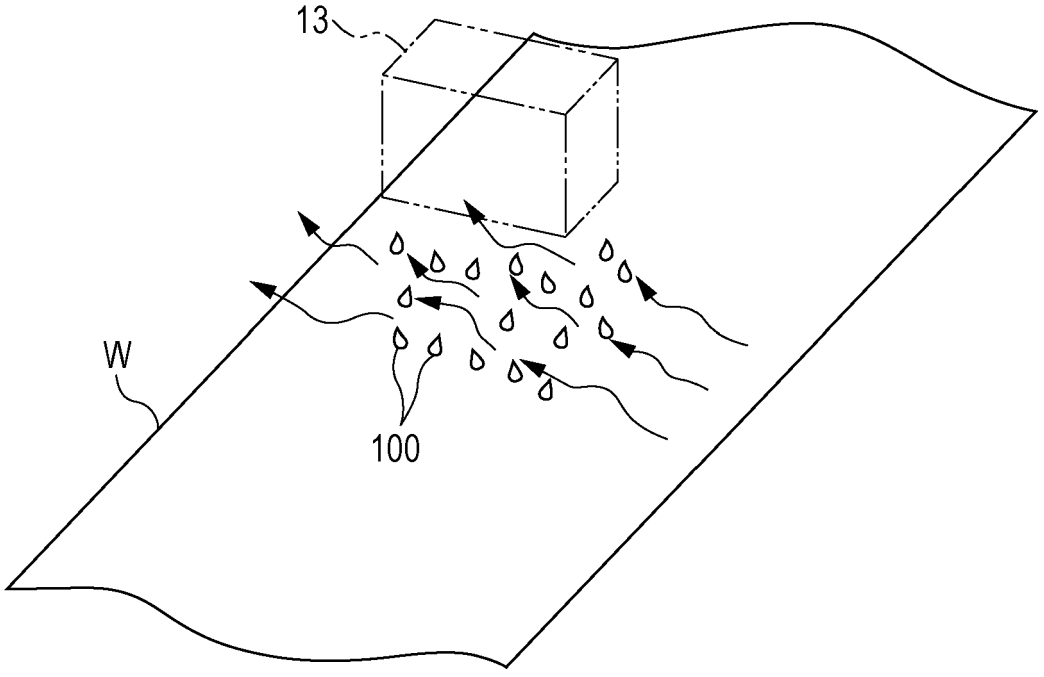


FIG. 11

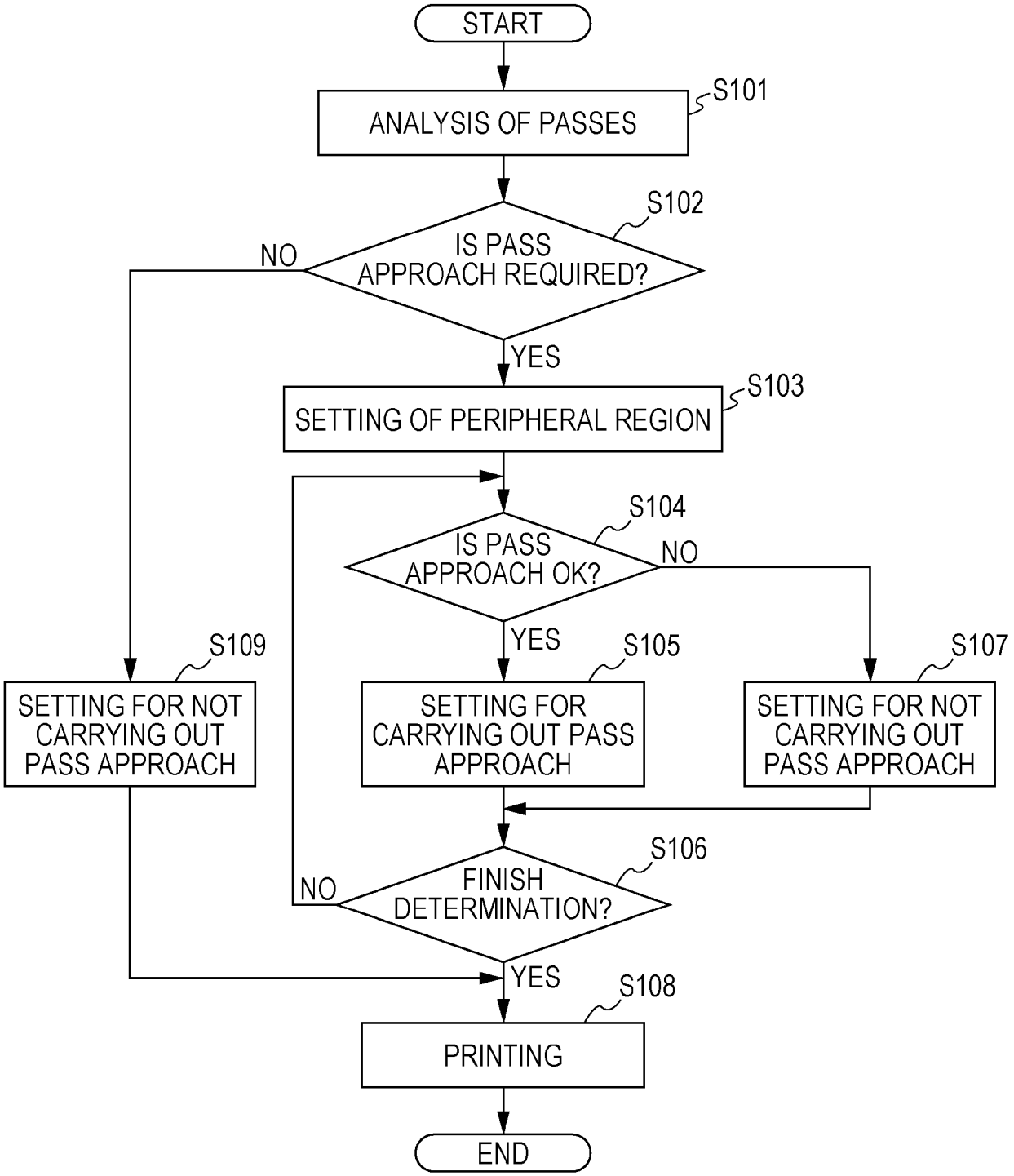

START
ANALYSIS OF PASSES
S101
IS PASS APPROACH REQUIRED?
S102
NO
YES
SETTING OF PERIPHERAL REGION
S103
IS PASS APPROACH OK?
S104
NO
YES
SETTING FOR NOT CARRYING OUT PASS APPROACH
S109
SETTING FOR CARRYING OUT PASS APPROACH
S105
SETTING FOR NOT CARRYING OUT PASS APPROACH
S107
FINISH DETERMINATION?
S106
NO
YES
PRINTING
S108
END

FIG. 12

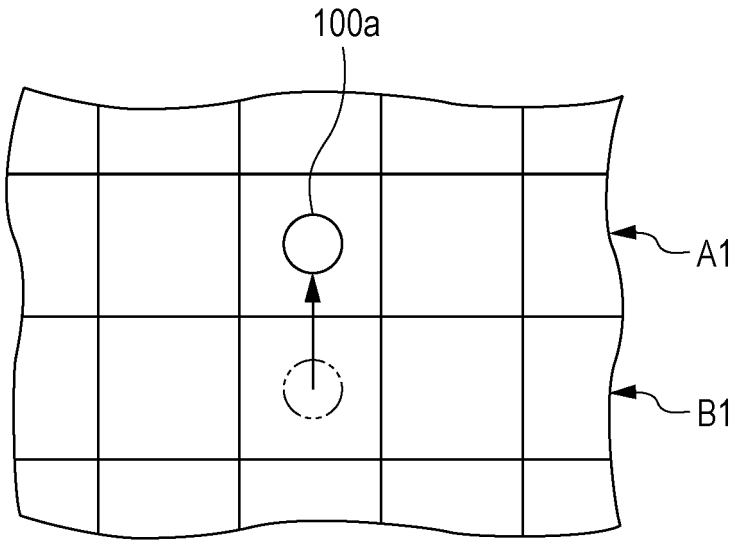


FIG. 13

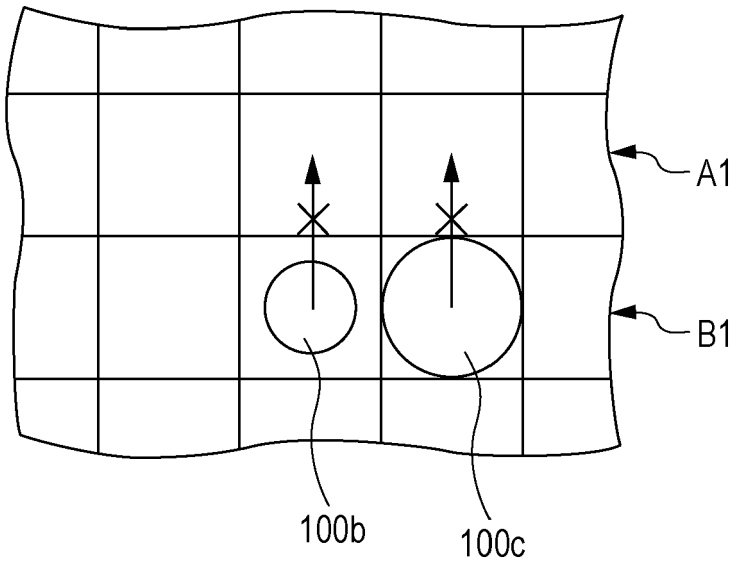


FIG. 14

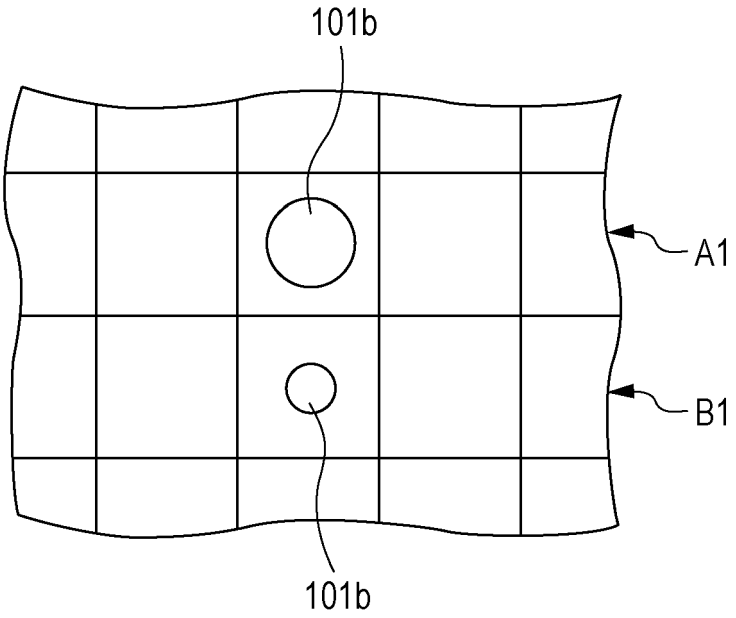


FIG. 15

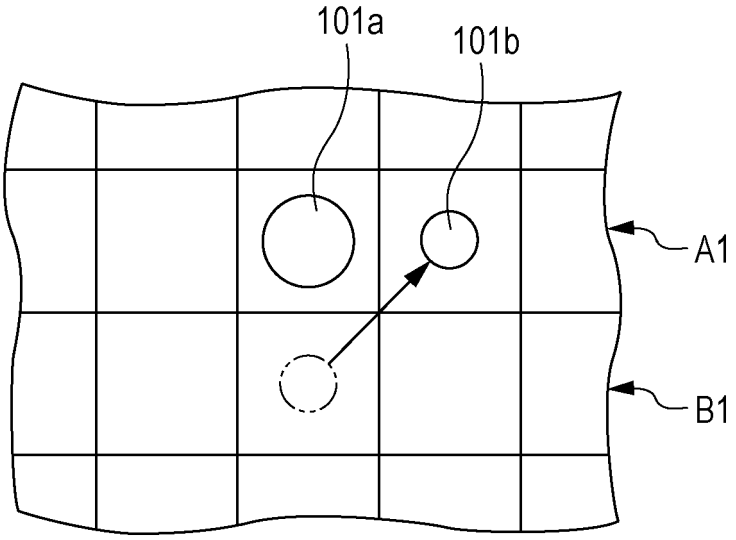


FIG. 16

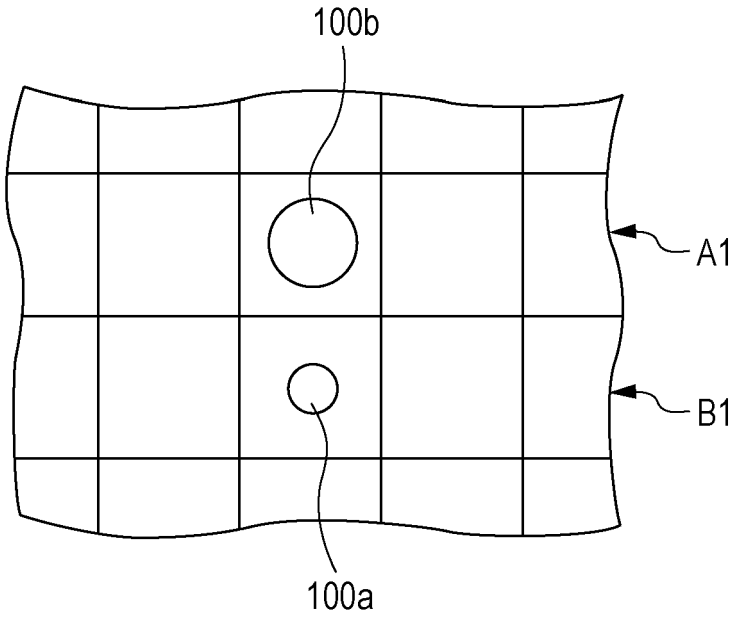
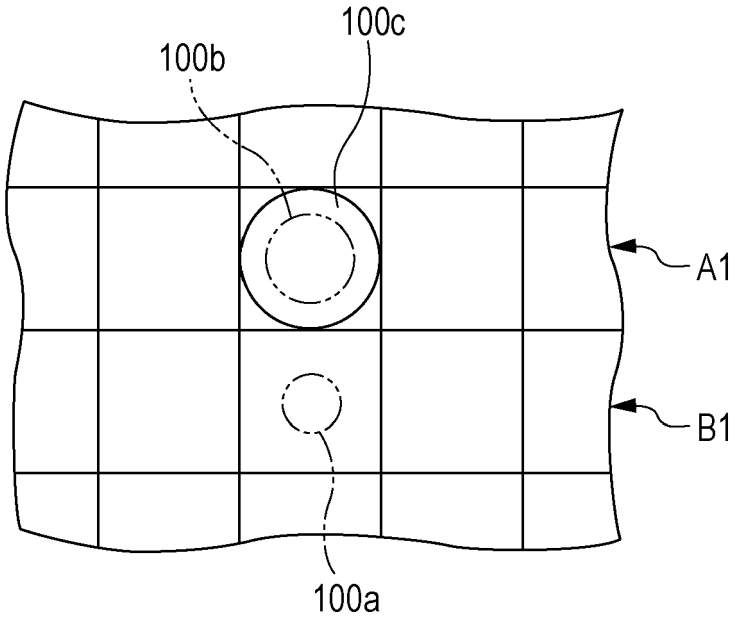


FIG. 17



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2006239866 A **[0002] [0003] [0004]**