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RECORDING DEVICE AND METHOD OF CONTROLLING CARRIAGE

Abstract

A recording device includes a carriage in which a recording head and a light source are mounted. The carriage is configured to reciprocate in a main scanning direction. The recording head is configured to eject photocurable ink to a medium. The light source is configured to emit light that causes the photocurable ink ejected in an outward operation to be cured. The recording device also includes a control unit configured to control an operation of the carriage. In the recording device, the control unit determines a movement range in step S**140** so as to turn from the outward operation to a returning operation at a position at which an area irradiated with light by the light source does not deviate from a region of the medium where the photocurable ink is ejected, and controls movement of the carriage.

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Background/Summary

[0001] The present application is based on, and claims priority from JP Application Serial Number 2024-023555, filed on Feb. 20, 2024, the disclosure of which is hereby incorporated by reference herein in its entirety.

BACKGROUND

1. Technical Field

[0002] The present disclosure relates to a recording device and a method of controlling a carriage, and in particular, relates to a recording device and a method of controlling a carriage that are configured to perform recording using photocurable ink.

2. Related Art

[0003] JP-A-2006-26970 discloses a recording device configured to perform recording using photocurable ink.

[0004] JP-A-2006-26970 discloses an ink-jet recording device including a recording head 4 configured to eject photocurable ink on the recording medium, and a light source 5. The ink-jet recording device further includes a carriage 3 configured to be able to reciprocate in a main scanning direction. In this ink-jet recording device, the recording head 4 ejects the photocurable ink while the carriage 3 is moving in the outward direction, and the light source 5 emits curing light onto the photocurable ink.

[0005] After the area irradiated with light beam emitted from the light source 5 overpasses the recording medium, the carriage 3 turns back to operate in the returning direction. In this manner, the light source 5 moves in the outward direction until overpassing the recording medium. This makes it possible to reliably fix and cure the photocurable ink ejected by the recording head 4.

[0006] In a case of a typical ink-jet recording device, the light source of the carriage always moves until it overpasses the recording medium, in order to reliably cure the photocurable ink in the outward operation. This leads to an increase in the movement distance of the carriage in the main scanning direction, which makes it difficult to improve the throughput.

SUMMARY

[0007] The present disclosure provides a recording device including a carriage in which a recording head and a light source are mounted, the carriage being configured to reciprocate in a main scanning direction, the recording head being configured to eject photocurable ink to a medium, the light source being configured to emit light that causes the photocurable ink ejected in an outward operation to be cured, and a control unit configured to control an operation of the carriage, in which the control unit controls movement of the carriage so as to turn from the outward operation to a returning operation at a position at which an area irradiated with light by the light source does not deviate from a region of the medium where the photocurable ink is ejected.

[0008] In addition, the present disclosure provides a method of controlling a carriage of a recording device configured to control an operation of a carriage configured to reciprocate in a main scanning direction, the carriage being a carriage in which a recording head and a light source are mounted, the recording head being configured to eject photocurable ink to a medium, the light source being configured to emit light that causes the photocurable ink ejected in an outward operation to be cured, the method including acquiring a region of the medium where the photocurable ink is ejected, determining a turning position from the outward operation to a returning operation at a position at which an area irradiated with light by the light source does not deviate from a region

where the photocurable ink is ejected, and controlling movement of the carriage at the turning position.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** is a block diagram schematically illustrating an ink-jet recording device to which a recording device according to the present disclosure is applied.

[0010] FIG. **2** is a schematic view illustrating arrangement of a recording head and a light source mounted at a carriage.

[0011] FIG. **3** is a flowchart concerning a program used to control an operation of the carriage.

[0012] FIG. **4** is a diagram illustrating a process of moving the carriage.

[0013] FIG. **5** is a diagram illustrating a process of moving the carriage.

[0014] FIG. **6** is a diagram illustrating a process of moving the carriage.

[0015] FIG. **7** is a diagram illustrating a distance from the light source of the carriage to a medium and a movement range of the carriage.

[0016] FIG. **8** is a diagram illustrating a distance from the light source of the carriage to a medium and a movement range of the carriage.

[0017] FIG. **9** is a diagram illustrating a table for reference concerning the movement range of the carriage on the basis of the distance from the light source of the carriage to the medium.

[0018] FIG. **10** is a flowchart concerning a program according to a modification example of controlling of an operation of the carriage.

DESCRIPTION OF EMBODIMENTS

[0019] Below, embodiment according to the present disclosure will be described with reference to the drawings.

[0020] FIG. **1** is a block diagram schematically illustrating an ink-jet recording device to which a recording device according to the present disclosure is applied.

[0021] This recording device **10** includes: a recording head **20**; a carriage unit **40** on which a light source **30** is mounted, the carriage unit **40** being configured to reciprocate in a main scanning direction; a transport unit **50** configured to transport a medium in a direction substantially perpendicular to the main scanning direction; a PG sensor **60**; and a control unit **80** configured to receive print data through an interface unit **70** to control printing.

[0022] The recording head **20** is controlled by the control unit **80**, and is configured to eject photocurable ink to a medium transported by the transport unit **50**. The carriage unit **40** includes a carriage **41** on which the recording head **20** and the light source **30** are mounted in this order from the destination side at the time of outward movement toward the rearward side. The carriage unit **40** is driven by a driving unit **42** to reciprocate along a predetermined guide. The light source **30** emits light used to cure photocurable ink ejected from the preceding recording head **20** at the time of outward movement. The control unit **80** causes the transport unit **50** to move a medium in a sub scanning direction, and at the same time, controls ejection of the photocurable ink by the recording head **20** and fixing by the light source **30** while controlling an outward operation and a returning operation of the carriage unit **40**.

[0023] FIG. **2** is a schematic view illustrating arrangement of the recording head and the light source mounted at the carriage.

[0024] A head **21** and a head **22** as the recording head **20** are mounted at this carriage **41**. In the heads **21** and **22**, a nozzle row A to a nozzle row H each including 180 pieces of nozzles extending in parallel to the sub scanning direction are arrayed in parallel to the main scanning direction. The head **21** is disposed upstream of the head **22** in the sub scanning direction.

[0025] In addition, the head **21** is disposed downstream of the head **22** in the main scanning

direction. The “downstream in the main scanning direction” represents the destination side at the time of outward movement.

[0026] The light source **30** is disposed downstream of the heads **21** and **22** in the main scanning direction, and has a length that makes it possible to cover all the nozzles of the head **22** and the head **21** disposed so as to be positionally shifted from each other in the sub scanning direction. The light source **30** is divided into an area 1 to an area 8 in the length direction, and is also divided into five areas in the width direction. One LED configured to emit ultraviolet light is disposed for each of the divisions.

[0027] The distance from the H column of the head **22** to the light source **30** is 95.2 mm in a case of the recording device **10** of an A3 model device. Note that the recording device **10** of an A4 model device only includes one head, and the distance from the light source **30** to the H column that is the nearest to the light source **30** is 105.3 mm. LEDs of the light source **30** are arrayed in two stages and five columns in each of the areas. Each of the LEDs has a size of 3.5 mm×3.5 mm in length and width. The interval in the sub scanning direction (longitudinal direction) is 0.9 mm, and the interval in the main scanning direction (width direction) is 1.1 mm. Thus, the width of each of the areas is 21.9 mm.

[0028] At the time of the outward operation, a predetermined nozzle of the head **21**, **22** ejects photocurable ink. Once the photocurable ink is attached on the medium, the photocurable ink is irradiated with ultraviolet light emitted from the LED of the light source **30** disposed downstream in the main scanning direction, and is fixed. The movement distance until all the LEDs of five columns of the light source **30** face the photocurable ink ejected from the nozzle in the H column of the head **22** disposed most downstream in the main scanning direction is 117.1 mm obtained by adding 21.9 mm that is the length of five columns of LEDs serving as the light source **30**, to 95.2 mm that is the distance from the H column to the light source. In other words, when the carriage **41** is further moved by 117.1 mm after the photocurable ink is ejected by the H column of nozzles, all the LEDs of the five columns of the light source **30** emit the light onto the photocurable ink.

[0029] FIG. **3** illustrates a flowchart concerning a program for controlling the operation of the carriage. FIGS. **4** to **6** each illustrate a diagram illustrating a process of moving the carriage.

[0030] The control unit **80** performs control in accordance with the flowchart shown in FIG. **3**. First, in step S**100**, the control unit **80** acquires print data. After acquiring the print data, the control unit **80** generates control data for each pass that is used to cause the carriage **41** to reciprocate to proceed printing. Then, in step S**110**, processes of step S**120** and thereafter are repeated until it is determined that printing for all passes ends.

[0031] In step **120**, the control unit **80** calculates a printing region for the next pass. This printing region represents a region in which, when a starting position for the carriage **41** is set at the rightmost end of the movable range as illustrated in FIG. **4**, the carriage **41** moves toward the left direction in the outward path, and the recording head **20** ends ejecting the photocurable ink. Next, in step S**130**, the control unit **80** acquires a platen gap PG from the PG sensor **60**.

[0032] FIGS. **7** and **8** each illustrate a movement range of the carriage and a distance from the light source of the carriage to a medium.

[0033] The platen gap PG represents a distance between the recording head **20** and the medium B. This recording device **10** is configured such that the distances from the medium to the heads **21** and **22** of the recording head **20**, and to the light source **30** are all equal. That is, the distance from the light source **30** to the medium is the platen gap PG. The recording ink ejected from the nozzles of the heads **21** and **22** lands on the medium at a velocity and in a direction indicated by a composite vector made out of a movement component of the outward direction of the carriage **41** and a movement component of an ejection direction in which the ink is ejected from the nozzle. In addition, the ultraviolet light emitted from each of the LEDs of the light source **30** has a predetermined spreading angle. For example, in a case of a platen gap PG′ illustrated in FIG. **7**, the center of the light source **30** needs to move to a position of a distance LP′ from the end of the

medium B in order for the irradiated area to overpass the end portion of the medium B. In contrast, in a case of a platen gap PG″ illustrated in FIG. **8**, the center of the light source **30** needs to move to a position of a distance LP″ from the end of the medium B in order for the irradiated area to overpass the end portion of the medium B. That is, the amount of movement of the carriage **41** in the main scanning direction is smaller in the turning position in a case where the platen gap PG is small.

[0034] In this manner, in a case where the platen gap PG exists, the distance of movement (from the end portion of the medium B) of the light source **30** that is necessary to irradiate the end portion of the medium B changes depending on the platen gap PG. This relationship can be mutually obtained through calculation on the basis of the spreading angle from the light source **30** as illustrated in the drawing or the platen gap PG. Note that, as described later, the platen gap is used as one of parameters in calculating the turning position. This distance LP is referred to as an adjustment amount. This means that, even when the light source **30** is disposed at a position that does not overpass the predetermined position of the medium, it is possible to emit ultraviolet light to the range downstream by this distance LP.

[0035] In step S**140**, the control unit **80** acquires the necessary amount of movement of the carriage **41**. Information necessary to acquire this amount of movement includes the position of the printing end on the basis of the printing region calculated in step S**120**, the overlapping amount that is the width of the light source **30** and overlaps with the inner side of the printing region than the end portion of the printing region with this end portion being the reference, the size of and the number of LEDs mounted on the carriage **41**, and the arrangement positions of the heads **21** and **22**.

[0036] Calculation is performed in the following manner, as a specific example.

[0037] The most downstream nozzle that ejects photocurable ink exists in the H column of the head **22**. The distance from this position to the light source **30** is 95.2 mm in a case of the A3 model device, and the width of all the LEDs of the light source **30** is 21.9 mm. It is known that, in a certain environment, fixing can be sufficiently achieved even if the last photocurable ink is not irradiated with the emitted light of all the LEDs. In a case of the light source **30** of the present example, the irradiated area of the four LEDs is sufficient for the last photocurable ink. This means that, by leaving an overlapping amount OW having the width of one LED, the carriage **41** is allowed to turn to the returning operation from the outward operation.

[0038] Absence of overlapping amount means that the area irradiated with the light by the light source **30** deviates from a region of the medium B where the photocurable ink is ejected, and the printing region and the light source **30** do not overlap with each other. In addition, existence of the overlapping amount means that movement of the carriage **41** is controlled such that the outward operation is performed to a position at which the area irradiated with light by the light source **30** does not deviate from the region of the medium B where the photocurable ink is ejected, and then, operation is turned to the returning operation. However, the distance LP that is the adjustment amount based on the spreading angle of the light source **30** and the platen gap PG is reflected at the end, as described above.

[0039] In this manner, with the end portion of the printing region being the base point, returning is performed at a position at which the overlapping amount OW of one LED is subtracted from the movement distance obtained by adding the width of the light source **30** to the position where the nozzle row H of the head **22** is disposed.

[0040] In addition, the overlapping amount OW changes depending on the fixing situation, and it is possible to perform adjustment in a unit of the number of LEDs. That is, it is possible to adjust the turning position concerning a unit of the number of LEDs. By increasing the overlap OW, it is possible to reduce the movement range of the carriage **41**, which makes it possible to improve the throughput.

[0041] In this manner, when the light source **30** includes light elements of a plurality of columns in the scanning direction, the control unit **80** adjusts the turning position in a unit the width of the

light elements.
[0042] In step S**150**, the control unit **80** causes printing to be performed while moving the carriage **41** so as to achieve the movement distance described above.
[0043] With reference to the drawing, the rightmost end of the movable range of the carriage **41** illustrated in FIG. **4** is first moved to the starting position, and is started from this position. During the operation, predetermined photocurable ink is ejected from the heads **21** and **22** of the recording head **20** while the carriage **41** is being moved on the basis of the control data regarding the current printing pass based on the print data as illustrated in FIG. **5**. Then, the light source **30** emits, to the ink, ultraviolet light for fixing. FIG. **6** illustrates a state where the carriage **41** moves by the necessary amount of movement calculated in step S**140**, and at this position, the carriage **41** is turned from the outward operation to the returning operation.
[0044] The position of turning is a position at which, by setting the overlapping amount OW as described above, the area irradiated with light by the light source **30** does not deviate from the region of the medium B where the photocurable ink is ejected. After the outward operation is performed to this position, the operation is turn to the returning operation.
[0045] When this turning position is specified, the control unit **80** makes change on the basis of the platen gap PG that is the distance between the light source **30** and the medium B, as described above. This is because the emitted light from the light source **30** spreads out, and the irradiated area changes depending on the distance to the medium B.
[0046] This eliminates the need of always moving the carriage **41** such that the light source **30** overpasses the end of the medium B as in the related art. This makes it possible to achieve both curing the photocurable ink and improvement in the throughput.
[0047] FIG. **9** is a diagram illustrating a table for reference concerning the movement range of the carriage on the basis of the distance from the light source of the carriage to the medium.
[0048] In order to obtain the amount LP of movement of the adjustment amount on the basis of the platen gap PG, it may be possible to make calculation every time. However, it may be possible to obtain it by looking up the table illustrated in FIG. **9**. As for this table, by looking up the table on the basis of two parameters of the platen gap PG and the number of LEDS so as to perform adjustment using the number of LEDs in accordance with the fixing situation at the same time, it is possible to look at the amount LP of movement of the adjustment amount. In this manner, the control unit **80** uses the distance between the light source **30** and the medium B as a parameter to look up a predetermined table, thereby determining the turning position described above.
[0049] Note that, as for a method of controlling a carriage of the recording device **10**, step S**120** corresponds to a step of acquiring a region of the medium B where photocurable ink is ejected; step S**130** and step S**140** correspond to a step of determining the turning position from the outward operation to the returning operation at a position at which the area irradiated with light by the light source **30** does not deviate from the region where the photocurable ink is ejected; and step S**150** corresponds to a step of controlling movement of the carriage **41** at the turning position.
[0050] FIG. **10** is a flowchart concerning a program according to a modification example of controlling of an operation of the carriage.
[0051] In the embodiment described above, the movement range of the carriage **41** is obtained with the reference being the end of the printing region where the photocurable ink is actually ejected. However, it is possible to use the end of the printing medium B as the reference similarly to the printing region. Even in this case, by determining the overlapping amount OW and returning the operation at this position, it is possible to make the turning position earlier than the related art, which contributes to an improvement in the throughput.
[0052] Differences from the flowchart shown in FIG. **3** lie in that the control unit **80** performs a process of acquiring the width of the medium in step S**220** in place of step S**120**, and the control unit **80** uses this width of the medium as a reference in place of the printing region to acquire the amount of movement in step S**240** in placed of step S**140**. Note that, as indicated by the dashed line

in FIG. **1**, a medium sensor **61** is provided, and the output from the medium sensor **61** is obtained to acquire the width of the medium in step S**220**.
[0053] Furthermore, as in the previous embodiment, turning is performed in a range from the position that does not deviate from the printing region to the position that does not deviate from the printing medium as in this modification example. This makes it possible to improve the throughput as compared with the related art.
[0054] In addition, the recording device **10** may include an adjustment mechanism configured to adjust the platen gap PG. For example, the adjustment mechanism includes a moving unit configured to move the recording head **20** to adjust the gap to the medium B, or a moving unit configured to move the position of a support portion configured to support the medium B, or the like.
[0055] Note that it is needless to say that the present disclosure is not limited to the embodiment described above. It is obvious for those skilled in the art that: [0056] mutually replaceable members, configurations, and the like disclosed in the embodiment described above can be applied by appropriately changing their combinations; [0057] although not disclosed in the embodiment, known members, known configurations, and the like that are mutually replaceable with the members, configurations, and the like disclosed in the embodiment are appropriately replaced, and also combinations thereof are changed and applied; and [0058] although not disclosed in the embodiment, the members, the configurations, and the like disclosed in the embodiment described above are appropriately replaced, as a replacement, with members, configurations, and the like that those skilled in the art could conceive on the basis of know techniques or the like, and also combinations thereof are changed and applied. These should be disclosed as embodiments of the present disclosure.

Claims

1. A recording device comprising: a carriage in which a recording head and a light source are mounted, the carriage being configured to reciprocate in a main scanning direction, the recording head being configured to eject photocurable ink to a medium, the light source being configured to emit light that causes the photocurable ink ejected in an outward operation to be cured; and a control unit configured to control an operation of the carriage, wherein the control unit controls movement of the carriage so as to turn from the outward operation to a returning operation at a position at which an area irradiated with light by the light source does not deviate from a region of the medium where the photocurable ink is ejected.
2. The recording device according to claim 1, wherein the control unit changes a turning position on a basis of a distance between the light source and the medium.
3. The recording device according to claim 2, wherein the control unit calculates the turning position using, as a parameter, a distance between the light source and the medium.
4. The recording device according to claim 2, wherein the control unit looks up a predetermined table using a distance between the light source and the medium as a parameter to determine the turning position.
5. The recording device according to claim 1, wherein the control unit is configured to adjust a turning position.
6. The recording device according to claim 5, wherein the light source includes a light element of a plurality of columns in a scanning direction, and the control unit adjusts the turning position in a unit of a width of the light element.
7. A method of controlling a carriage of a recording device configured to control an operation of a carriage configured to reciprocate in a main scanning direction, the carriage being a carriage in which a recording head and a light source are mounted, the recording head being configured to eject photocurable ink to a medium, the light source being configured to emit light that causes the

photocurable ink ejected in an outward operation to be cured, the method including: acquiring a region of the medium where the photocurable ink is ejected; determining a turning position from the outward operation to a returning operation at a position at which an area irradiated with light by the light source does not deviate from a region where the photocurable ink is ejected; and controlling movement of the carriage at the turning position.