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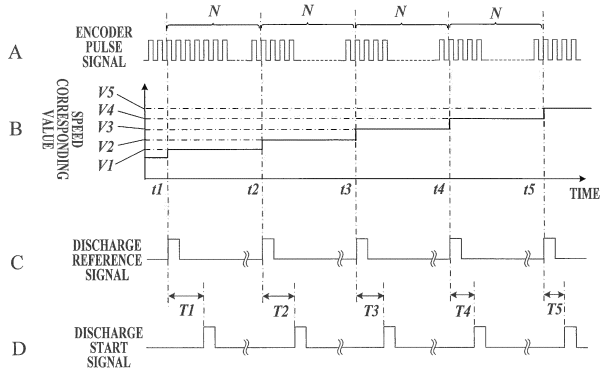
(54) INKJET RECORDING DEVICE AND RECORDING CONTROL METHOD FOR INKJET RECORDING DEVICE

(57) Provided are an inkjet recording device and a recording control method for an inkjet recording device with which it is possible to suppress degradation in the quality of a recorded image more appropriately. This inkjet recording device comprises: a recording means including an ink discharge unit that discharges ink from nozzles; a transportation means that transports a recording medium; a recording control means that causes the ink discharge unit to discharge ink onto the recording medium which has been transported by the transportation means and is in opposition to the nozzles; a transportation control means that changes a transportation speed of the recording medium by the transportation means; and a speed-corresponding information acquisition means that acquires speed-corresponding information related to the transportation speed. At least during a period in which the transportation speed is being changed, the recording control means causes the ink discharge unit to discharge the ink at a timing upon the lapse of a delay time from a discharge reference timing when a discharge target position on the recording medium has moved to a predetermined discharge reference position, said delay time being determined on the basis of the speed-corresponding information related to the transportation speed at said discharge reference timing.

FIG.4



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Description

Technological Field

[0001] The present invention relates to an inkjet recording device and a recording control method for the inkjet recording device.

Background Art

[0002] Conventionally, there have been inkjet recording devices which records images on recording media by discharging ink repeatedly from nozzles by an ink discharger in which nozzles are arranged in the width direction crossing the conveying direction, onto the recording media conveyed in a predetermined conveying direction by a conveyor. In such an inkjet recording device, an appropriate image can be recorded with ink landing at appropriate intervals in the conveying direction by ink discharge at each timing when the target position onto which ink is discharged on a recording medium moves to the reference position onto which ink is to be discharged in the predetermined conveying direction.

[0003] In inkjet recording devices, generally, an image is recorded while a recording medium is conveyed at a constant speed. There is a technique in which deterioration in quality of recorded images is restrained by adjustment of ink discharge timings so that ink is discharged at a timing when the discharge target position on the recording medium moves to the above-described discharge reference position if the conveyance speed of the recording medium changes (for example, Patent Documents 1 and 2).

Prior Art Document

Patent Documents

[0004]

Patent Document 1: Japanese Patent Application Laid Open Publication No. 2007-168226
Patent Document 2: Japanese Patent No. 5303337

Summary of the Invention

Problems to be Solved by the Invention

[0005] However, there is demand for changing the conveyance speed during image recording in inkjet recording devices, so that, for example, an image is recorded while a recording medium is conveyed at a low speed for user's visual check of quality of the image being recorded, and then the image is recorded at a high speed as the conveyance speed increases in the continuous recording after the check.

[0006] When the conveyance speed of the recording medium is changed in such a case, the distance in which the recording medium moves since ink is discharged from the nozzle until the ink lands on the recording medium (moving distance after discharge) changes according to the change in the conveyance speed. Therefore, in the above-described conventional technique, there is a problem that deterioration in quality of recorded images is caused by deviation in the ink landing positions occurring with variation in the moving distance after discharge according to the change in the conveyance speed.

[0007] An object of the present invention is to provide an inkjet recording device which more appropriately restrains deterioration of quality of recorded images, and a method for recording control of the inkjet recording device.

Means for Solving the Problems

[0008] In order to achieve the above object, the invention according to claim 1, the inkjet recording device includes:

a recorder with an ink discharger which discharges ink from a nozzle;
a conveyor which conveys a recording medium in a predetermined conveying direction;
a recording control means which causes the ink discharger to discharge ink from the nozzle onto the recording medium conveyed by the conveyor and facing an ink outlet of the nozzle;
a conveyance control means which changes a conveyance speed of the recording medium on the conveyor; and
a speed corresponding information obtaining means which obtains speed corresponding information concerning the conveyance speed,
wherein the recording control means causes the ink discharger to discharge ink at a timing when a delay time determined based on the speed corresponding information concerning the conveyance speed at a discharge reference timing elapses since the discharge reference timing at least in a period while the conveyance control means is changing the conveyance speed, and
wherein the discharge reference timing is when a discharge target position of ink in the recording medium moves to a predetermined discharge reference position in the conveying direction.

[0009] The invention according to claim 2 is the inkjet recording device according to claim 1,
wherein the ink discharger comprises multiple ink dischargers,
wherein the discharge reference position comprises multiple discharge reference positions,
wherein the discharge reference timing comprises multiple discharge reference timings,
wherein the recorder comprises the multiple ink dischargers disposed at positions different from each other in the

conveying direction, and
wherein the recording control means causes the ink dischargers respectively corresponding to the multiple discharge reference positions to discharge ink at a timing when a delay time determined based on the speed corresponding information concerning the conveyance speed at each of the multiple reference timings elapses since the multiple discharge reference timings when the discharge target position of the recording medium moves to the multiple reference positions respectively corresponding to the multiple ink dischargers.

[0010] The invention according to claim 3 is the inkjet recording device according to any one of claims 1 and 2, wherein the speed corresponding information obtaining means obtains the speed corresponding information concerning the conveyance speed of the recording medium respectively at a position facing each of the multiple ink dischargers in the conveying direction, and
wherein the recording control means causes each of the multiple ink dischargers to discharge ink at a timing when a delay time determined based on the speed corresponding information concerning the conveyance speed of the recording medium at the position facing the ink discharger elapses since the discharge reference timing.

[0011] The invention according to claim 4 is the inkjet recording device according to any one of claims 1 to 3, wherein the delay time is determined based on a distance between the recording medium and an ink discharging outlet of the nozzle in a direction of ink being discharged from the nozzle and the speed corresponding information.

[0012] The invention according to claim 5 is the inkjet recording device according to any one of claims 1 to 4, wherein the conveyor operates in multiple conveyance modes to convey the recording medium at conveyance speeds different from each other, and
wherein the conveyance control means changes the conveyance speed for a predetermined period of time when the conveyance modes of the conveyor switch.

[0013] The invention according to claim 6 is the inkjet recording device according to any one of claims 1 to 5, wherein the conveyor conveys the recording medium by moving a conveyance member with the recording medium being placed on the conveying surface of the conveyance member,
wherein the conveyance control means changes the conveyance speed of the recording medium by changing a moving speed of the conveyance member, and
wherein the speed corresponding information obtaining means has a movement detector which outputs a predetermined detection signal each time the conveyance member moves in a predetermined amount, and obtains the speed corresponding information based on a length of time required to detect a predetermined number of the detection signal or a count of the detection signal detected per predetermined period of time.

[0014] The invention according to claim 7 is the inkjet recording device according to any one of claims 1 to 6, wherein the recording control means detects the discharge reference timing based on the detection signal.

[0015] In order to achieve the above object, the invention according to claim 8, the recording control method for an inkjet recording device including a recorder with an ink discharger which discharges ink from a nozzle and a conveyor which conveys a recording medium in a predetermined conveying direction includes:

a recording step in which the ink discharger discharges ink from the nozzle onto the recording medium conveyed by the conveyor and facing an ink outlet of the nozzle;
a conveyance control step in which a conveyance speed of the recording medium on the conveyor is changed; and
a speed corresponding information obtaining step in which speed corresponding information concerning the conveyance speed is obtained,
wherein, in the recording control step, the ink discharger discharges ink at a timing when a delay time determined based on the speed corresponding information concerning the conveyance speed at a discharge reference timing elapses since the discharge reference timing at least in a period while the conveyance speed is changed in the conveyance control step, and
wherein the discharge reference timing is when a discharge target position of ink in the recording medium moves to a predetermined discharge reference position in the conveying direction.

Effects of the Invention

[0016] The present invention has an advantageous effect of restraining deterioration of quality of recorded images more appropriately.

Brief Description of Drawings

[0017]

Fig. 1 is a schematic configuration of an inkjet recording device.
Fig. 2 is a schematic drawing of a configuration of a head unit.
Fig. 3 is a block diagram of a main functional configuration of the inkjet recording device.
Fig. 4 is a diagram for explaining a method for adjusting ink discharge timings in the inkjet recording device.
Fig. 5 is a flowchart of a control process of an image recording processing.
Fig. 6 is a flowchart of a control process of an ink discharge processing.
Fig. 7 is a schematic configuration of the inkjet recording device according to a modification example.

Embodiments for Carrying Out the Invention

[0018] An embodiment of the inkjet recording device and the recording control method for the inkjet recording device according to the present invention is hereinafter described with reference to the drawings.

[0019] Fig. 1 is a schematic configuration of an inkjet recording device 1 in accordance with the embodiment of the present invention.

[0020] The inkjet recording device 1 includes a conveyor 10 (a conveyance means), a recorder 20 (a recording means), and a controller 30, and such.

[0021] The conveyor 10 includes a driving roller 11, a driven roller 12, a conveyor belt 13, a conveyor motor 14, a rotary encoder 15 (motion detector), a pressing roller 16, a separating roller 17, and such.

[0022] The driving roller 11 rotates, driven by the driving motor 14, centered around the rotation axis which extends in the direction X in Fig. 1. The conveyor belt 13 is a loop belt supported inside by the driving roller 11 and the driven roller 12, and circles according to the rotating motion of the driving roller 11. The driven roller 12 rotates centered around the rotating axis which extends in the direction X with the circling movement of the driving belt 13. For the conveyor belt 13, a material which flexibly bends on the faces contacting the driving roller 11 and the driven roller 12 and reliably supports a recording medium M is used. For example, a belt made of resin such as rubber, a steel belt, or such may be used. The recording medium M may be placed more stably on the conveyor belt 13 which has a material and/or configuration to adhere to the recording medium M. The conveyor 10 conveys the recording medium M in the moving direction of the conveyor belt 13 (conveying direction; Y direction in Fig. 1) as the driving roller 11 rotates and the conveyor belt 13 circles with the recording medium M being placed on the conveying face of the conveyor belt 13.

[0023] The recording medium M is pulled out from a roll of the rolled recording medium M, supplied onto the conveyor belt 13, and rolled on another roll after an image is recorded by the recorder 20. The recording medium M may be a paper sheet which is cut in a fixed size. In such a case, the recording medium M is supplied onto the conveyor belt 13 by a paper supplier and ejected to a paper discharge unit by a paper discharger from the conveyor belt 13 after an image is recorded.

[0024] Various kinds of media on the surface of which discharged ink can be fixed, such as paper, fabric, or sheet resin, may be used as the recording medium M.

[0025] The conveyor 10 in the present embodiment is configured to be able to convey a large recording medium M with approximately 2 meters width in the direction X. A recording medium M with width smaller than 2 meters in the direction X may be conveyed by the conveyor 10. The conveyor 10 may be configured to be able to convey a recording medium M with width larger than 2 meters in the direction X (4 meters, for example). The maximum width of a conveyable recording medium M may be configured to be smaller than 2 meters in the direction X.

[0026] The rotary encoder 15 is mounted on the driving roller 11, and outputs a pulse signal (detecting signal) to the controller 30 and the recording head driving controller 211 (Fig. 3) each time the driving roller 11 rotates at a predetermined angle. The rotary encoder 15 may be, for example, configured to have a code wheel which has multiple slits arranged on a predetermined circumference and rotates with the driving roller 11, a light source which throws light upon the slits of the code wheel, and a light sensor which detects light emitted by the light source and passing through the slits, and to output the pulse signals based on the results of light detection by the light sensor to the controller 30 and the recording head driving controller 211, though not limited. The pulse signals here maybe output at timings of rising and falling of each of two square waves (phase A and phase B) which have a cycle equal to the cycle of receiving the light passing through the slits and whose phases are different from each other at an angle of 90°. In such a configuration, the rotating direction of the driving roller 11 can be detected by the phases A and B.

[0027] The pressing roller 16 presses the recording medium M supplied to the conveying face of the conveyor belt 13 against the conveying face to remove gaps between the recording medium P and the conveying face, which, for example, causes wrinkles.

[0028] The separating roller 17 pulls the recording medium M which is conveyed while being sucked to the conveyor belt 13 by a predetermined force to separate the recording medium M from the conveying face, and sends the separated recording medium M to the finishing unit not shown in the drawings.

[0029] The recorder 20 includes four head units 21 (ink discharging units). Each of the head units 21 discharges ink from the nozzles onto the recording medium M conveyed by the conveyor 10 to record an image based on image data. In the inkjet recording device 1 in the present embodiment, four head units 21 respectively corresponding to inks colored yellow (Y), magenta (M), cyan (C), and black (K) are arranged at predetermined intervals in an order of Y, M, C, and K from the upstream in the conveying direction of the recording medium M.

[0030] Fig. 2 is a schematic drawing of the configuration of the head unit 21. The drawing shows a plane figure of the head unit 21 viewed from the side facing the conveying face of the conveyor belt 13.

[0031] The head unit 21 has eight recording heads 212 with multiple recording elements which discharge ink arranged in the direction crossing the conveying direction of the recording medium M (the direction intersecting the conveying direction at a right angle in the present embodiment, that is, the X direction). Fig. 2 shows the position of the ink discharging outlet of the nozzle 213 which is a constituent of the recording element. The eight recording heads 212 are arranged in a staggered pattern such that the position ranges in the X direction partially overlap each other, in the positional relationship such

that the ink dischargeable range of the nozzle 213 is successive in the X direction.

[0032] The position range of the nozzles 213 included in the head units 21 in the direction X covers the width in the X direction of the range in which the image can be recorded on the recording medium M conveyed by the conveyor belt 13. That is, the inkjet recording device 1 is a single pass type using head units 21 with line heads.

[0033] Each of the recording elements of the recording heads 212 has a pressure room to store ink, piezoelectric elements attached on the wall surface of the pressure room, and a nozzle 213. In the recording element, when a driving signal to deform the piezoelectric elements is input, the deformation of the piezoelectric elements deforms the pressure room and changes the pressure in the pressure room, and ink is discharged from the nozzle communicating with the pressure room.

[0034] Fig. 3 is a block diagram of the main functional configuration of the inkjet recording device 1.

[0035] The inkjet recording device 1 has a conveyance driver 101 and a rotary encoder 15 disposed in the conveyor 10, a recording head driving controller 211 and a recording head 212 disposed in the head unit 21, a controller 30, an operation display 41, an input/output interface 42, a bus 43, and such. The controller 30 among those has a CPU 31 (central processing unit) (conveyance control means), a RAM 32 (random access memory), a ROM 33 (read only memory) and a memory 34. In the present embodiment, a recording control means is configured with the CPU 31 and the recording head driving controller 211.

[0036] The conveyance driver 101 supplies a driving signal to the conveyor motor 14 based on the control signal supplied by the CPU 31 and causes the driving roller 11 to rotate at a predetermined rotating speed to cause the conveyor belt 13 to move at a predetermined moving speed. The conveyance driver 101 changes the rotating speed of the driving roller 11, namely the moving speed of the conveyor belt 13, based on the control signal supplied by the CPU 31.

[0037] The recording head driving controller 211 supplies a driving signal to deform the piezoelectric elements according to the image data at an appropriate timing to the recording elements of the recording heads 212 to cause ink to be discharged from the nozzles 213 of the recording heads 212 in an amount according to the pixel value of the image data. The recording head driving controller 211 calculates the moving speed of the conveyor belt 13, namely the conveyance speed of the recording medium M, based on the pulse signal output from the rotary encoder 15. The recording head driving controller 211 calculates the delay time of the ink discharge timing based on the calculated conveyance speed.

[0038] In the present embodiment, the recording head driving controller 211 is disposed in each two neighboring recording heads 212 of the eight recording heads, summing up to four, in each head unit 21. The recording head driving controller 211 may be configured to have a circuit board connected to two recording heads 212 and a semiconductor integrated circuit such as an FPGA (field programmable gate array) or an ASIC (application specific integrated circuits) mounted on the circuit board, for example. The four recording head driving controllers 211 calculate the conveyance speed and the delay time independently from each other, adjusts ink discharge timings of the recording heads 212, and supplies the driving signal to the recording heads 212. A method for adjusting ink discharge timings of the recording head driving controller 211 is described later. In the present embodiment, a means for obtaining speed corresponding information is configured with the rotary encoder 15 and the recording head driving controller 211.

[0039] The number of the recording heads 212 corresponding to one recording head driving controller 211 is not limited to two. For example, a recording head driving controller 211 may be disposed in each recording head 212, or one recording head driving controller 211 may be disposed in the recording heads 212 in all in the head unit 21.

[0040] The CPU 31 reads out various programs for controls and setting data stored in the ROM 33 and stores them in the RAM 32 to perform various calculating processings by executing the programs. The CPU 31 generally controls the whole operation of the inkjet recording device 1. For example, the CPU 31 causes constituents of the conveyor 10 and the recorder 20 to operate to record an image on the recording medium M based on the image data stored in the memory 34. The CPU 31 causes the conveyor 10 to operate in multiple conveyance modes to convey the recording medium M at conveyance speeds different from each other.

[0041] The RAM 32 provides working memory space to the CPU 31 and stores temporary data. The RAM 32 may include a non-volatile memory.

[0042] The ROM 33 stores various programs for controls and setting data executed by the CPU 31. A rewritable non-volatile memory such as an EEPROM (electrically erasable programmable read only memory) or a flash memory may be used instead of the ROM 33.

[0043] The memory 34 stores print jobs (image recording commands) input from the external device 2 via the input/output interface 42 and the image data for the print jobs. An HDD (hard disk drive) may be used as the memory 34, and a DRAM (dynamic random access memory) may be used in combination.

[0044] The input/output interface 42 mediates sending/receiving of data between the external device 2 and the controller 30. The input/output interface 42 is configured with various serial interfaces, various parallel interfaces or a combination thereof.

[0045] The bus 43 is a path for sending and receiving signals between the controller 30 and other constituents.

[0046] The external device 2 is a personal computer, for example, and provides print jobs, image data, and such to the controller 30 via the input/output interface 42.

[0047] Next, the method for adjusting the ink discharge

timings in the inkjet recording device 1 according to the present embodiment is explained.

[0048] In the inkjet recording device 1 according to the present embodiment, the conveyance speed of the recording medium M may be changed while an image is recorded on the recording medium M. For example, an image is recorded while the recording medium M is being conveyed in the first conveyance mode in which the conveyance speed of the recording medium M is the first conveyance speed at which the quality of the image being recorded can be checked visually, and after a user has checked that the image being recorded contains no error in the image quality, the image can be thereafter recorded at a high speed while the recording medium M is being conveyed in the second conveyance mode in which the conveyance speed of the recording medium M is larger than the first conveyance speed. The image is continuously recorded even while the conveyance mode is switching from the first conveyance mode to the second conveyance mode and the conveyance speed is gradually changing between the first conveyance speed and the second conveyance speed for a predetermined period of time. Such an operation can suppress the amount of recording media M to be used and lost for check of the quality of recorded images.

[0049] In the inkjet recording device 1 according to the present embodiment, the conveyance speed of the recording medium M is calculated in view of image recording of appropriate quality while the conveyance speed of the recording medium M is being changed. The ink discharge timings are adjusted according to the calculated conveyance speed and the distance between the nozzles 213 and the recording medium M in the direction of discharging ink (direction Z) (hereinafter also referred to as the discharge distance). Hereinafter the method for adjusting the ink discharge timings is explained.

[0050] Fig. 4 is a diagram for explaining the method for adjusting the ink discharge timings in the inkjet recording device 1.

[0051] The pulse signals output from the rotary encoder 15 are shown in A of Fig. 4.

[0052] The speed corresponding values which correspond to the conveyance speed of the recording medium M calculated in the recording head driving controller 211 are shown in B of Fig. 4.

[0053] Shown in C of Fig. 4 are the discharge reference signals output to the recording head driving controller 211 from the CPU 31 at each timing (discharge reference timing) when the target position onto which ink is discharged in a recording medium M moves in the conveying direction to the predetermined reference position onto which ink is to be discharged.

[0054] Shown in D of Fig. 4 are the starting discharge signals which indicate the timings for starting ink discharge.

[0055] Hereinafter described is the outline of the method for adjusting the ink discharge timings according to the present embodiment. First, the conveyance speed of the recording medium M (the speed corresponding value which corresponds to the conveyance speed (speed corresponding information) (B of Fig. 4) here) is calculated based on a pulse signal of the rotary encoder 15 (A of Fig. 4). Then a discharge reference signal (C of Fig. 4) is output at a discharge reference timing when the target position onto which ink is discharged in the recording medium M moves to the predetermined reference position onto which ink is to be discharged, and a starting discharge signal (D of Fig. 4) is generated at a timing when the delay time calculated based on the conveyance speed and the discharge distance elapses since the timing of output of the discharge reference signal. A driving signal starts to be supplied to the recording heads 212 at a timing of generation of the starting discharge signal, and ink is discharged from the nozzles 213.

[0056] The discharge reference position is determined according to each of the four head units 21, and each of the head units 21 discharges ink at a timing when the delay time elapses since the discharge reference timing when the target position onto which ink is discharged in the recording medium M moves to the predetermined reference position onto which ink is to be discharged corresponding to the head unit 21.

[0057] Hereinafter the method for calculating the conveyance speed of recording medium M and the method for setting the delay time of ink discharge timings are explained.

[0058] First, the method for calculating the conveyance speed of the recording medium M is explained.

[0059] The conveyance speed of the recording medium M is calculated based on the length of time required to detect N pulse signals from the rotary encoder 15, with the number N corresponding to the ink discharge intervals in the conveying direction (N=70 in the present embodiment). In detail, the inverse of the length of time required to detect N pulse signals is calculated as the speed corresponding value which corresponds to the conveyance speed of the recording medium M (speed corresponding information). The speed corresponding value is in proportion to the moving speed of the conveyor belt 13 in the period when N pulse signals are detected (hereinafter also referred to as the pulse detection period), namely the conveyance speed of the recording medium M. In the present embodiment, the speed corresponding value obtained by averaging and smoothing the speed corresponding value in the latest period of detecting a predetermined number n of pulses (n=64 in the present embodiment).

[0060] Instead of the above-mentioned speed corresponding value, the conveyance speed calculated by dividing the moving distance of the conveyor belt 13 corresponding to N pulse signals by the time required to detect N pulse signals may be used for the speed corresponding information.

[0061] Table data in which the duration of the pulse detection period and the speed corresponding value (or conveyance speed) correspond to each other may be

prepared to be referred to from the duration of the detected pulse detection period for obtaining the speed corresponding information (or conveyance speed).

[0062] The above-mentioned number N may be suitably changed according to the configuration of the rotary encoder 15. The above-mentioned number N may be suitably changed according to the extent of variation of the calculation results of the conveyance speed for each pulse detection period or the variance of the conveyance speed per predetermined time.

[0063] In that way, the speed corresponding value which corresponds to the conveyance speed of the recording medium M is calculated in each pulse detection period in the inkjet recording device 1. B of Fig. 4 describes an example where the speed corresponding values V1, V2 (>V1), V3 (>V2), V4 (>V3), and V5 (>V4) are each calculated at the times t1 to t5 for each pulse detection period respectively, in the period while the conveyance speed of the recording medium M is increasing.

[0064] The speed corresponding values are each calculated by the four recording head driving controllers 211 in the head units 21. The calculation results of the conveyance speed are equal as long as the calculation process contains no error, for the same pulse signals are distributed and input from the rotary encoder 15 in each of the recording head driving controllers 211.

[0065] Next, the method for setting the delay time of ink discharge timings is explained.

[0066] The discharge reference signals shown in C of Fig. 4 are output from the CPU 31 to the recording head driving controllers 211 each time N pulse signals are detected from the rotary encoder 15. In other words, the target position onto which ink is discharged in a recording medium M in the conveying direction is located at the reference position onto which ink is to be discharged each time the conveyor belt 13 moves (that is, the recording medium M is conveyed) for a distance corresponding to N pulse signals in the inkjet recording device 1. The timings of output of discharge reference signals may be different from the above-described timings of calculation of the speed corresponding values.

[0067] When the conveyance speed of the recording medium M is constant, appropriate images can be recorded, for ink lands at equal intervals even if ink is discharged at the discharge reference timing of output of the discharge reference signal.

[0068] However, when the conveyance speed of the recording medium M changes, the distance of movement of the recording medium M from when ink is discharged from the nozzle 213 to when ink lands on the recording medium M (moving distance after discharge) varies according to the conveyance speed. This causes difference in the distance between the position on the recording medium M where facing the ink outlet of the nozzle 213 at the discharge reference timing and the position where ink discharged from the nozzle 213 lands depending on the conveyance speed at the discharge reference timing, when ink is discharged at the discharge reference timing. For example, the extent of deviation from the appropriate landing position is larger in ink discharged by a head unit 21 in the lower stream which performs discharge at a timing when the conveyance speed is comparatively high, as for ink discharged to the same discharge target position of the recording medium M by the head units 21 of Y, M, C, and K when the conveyance speed of the recording medium M is in increase. As a result, a deviation occurs in the position where ink discharged by the four-color head units 21 lands, causing defects in image quality such as color mixture or color unevenness.

[0069] Especially, above-mentioned defects tend to be prominent in the inkjet recording device 1 which records on the large recording medium M as in the present embodiment, for the space between the head units 21 in the conveying direction is larger, and differences in the conveyance speed increase depending on the position of each head unit 21. The above-mentioned defects also tend to be prominent when the discharge distance is larger, for the moving distance after discharge in the head unit 21 gets larger.

[0070] In the present embodiment, an appropriate delay time (number of cycles of clock signals) is calculated based on the conveyance speed (speed corresponding value) of the recording medium M and the discharge distance, and the starting discharge signal which triggers the start of ink discharge is generated at a timing when the delay time elapses since the timing when the discharge reference signal is output (D of Fig. 4). The starting discharge signals are generated with a shorter delay time being set for a larger conveyance corresponding value and discharge distance so that the distance between the position on the recording medium M where facing the ink outlet of the nozzle 213 at the timing of output of the discharge reference signal and the position where ink lands is constant irrespective of the conveyance speed. The delay time is calculated based on the function using the speed corresponding value and the discharge distance as the variable in each of the recording head driving controllers 211. In D of Fig. 4, the starting discharge signal is generated at the timing when the delay time T1 elapses since the discharge reference signal if the speed corresponding value is V1. The starting discharge signal is generated at the timing when the delay time T2 (<T1) elapses since the discharge reference signal if the speed corresponding value is V2. The starting discharge signal is generated at the timing if the delay time T3 (<T2) elapses since the discharge reference signal if the speed corresponding value is V3. The starting discharge signal is generated at the timing when the delay time T4 (<T3) elapses since the discharge reference signal if the speed corresponding value is V4. The starting discharge signal is generated at the timing when the delay time T5 (<T4) elapses since the discharge reference signal if the speed corresponding value is V5.

[0071] When the starting discharge signal is generated, the recording head driving controller 211 starts to supply driving signals from the driving circuit to the re-

cording heads 212 at the timing of the starting discharge signal and causes ink to be discharged from the nozzles 213 of the recording heads 212.

[0072] Next, the control process of the image recording processing by the CPU 31 and the control process of the ink discharge processing by the recording head driving controller 211, performed by the inkjet recording device 1 is explained.

[0073] Fig. 5 is a flowchart of the control process of the image recording processing by the CPU 31.

[0074] The image recording processing is performed when print jobs and image data are input from the external device 2 via the input/output interface 42 to the controller 30.

[0075] Before the start of the image recording processing, the CPU 31 causes the conveyance driver 101 to output the driving signal to the conveyor motor 14 and starts the circling movement operation of the conveyor belt 13. The CPU 31 outputs the control signal to the rotary encoder 15 and starts the output of pulse signals to the controller 30 and the recording head driving controller 211. The CPU 31 outputs the control signal to the recording head driving controller 211 and starts the processing of calculating the speed corresponding value of the recording medium M for each pulse detection period.

[0076] The CPU 31 obtains the discharge distance information indicating the discharge distance in the print job to be executed after the start of the image recording processing (Step S101). The CPU 31 displays a prompt for input of the discharge distance information from the user on the operation display 41, and obtains the discharge distance information input to the operation display 41 by the input operation by the user. The discharge distance information obtained may be included in the print job data, for example.

[0077] The CPU 31 determines whether an input operation to change the conveyance speed of the recording medium M is made to the operation display 41 (Step S102). If it is determined that the input operation is not made ("NO" at Step S102), the CPU 31 proceeds to S 104 of the processing.

[0078] If it is determined that an input operation to change the conveyance speed of the recording medium M is made ("YES" at Step S102), the CPU 31 outputs the control signal to the conveyance driver 101 to change the rotating speed of the driving roller 11 into the speed corresponding to the input conveyance speed (Step S103: conveyance control step). The conveyance driver 101 gradually increases or decreases the rotating speed of the driving roller 11 for a predetermined period of time so that the rotating speed of the driving roller 11 is the predetermined speed.

[0079] The CPU 31 determines whether the discharge target position of the recording medium M is at the predetermined discharge reference position (that is, at the discharge reference timing) (Step S104). The CPU 31 determines whether N pulse signals are output from the rotary encoder 15 after detecting that the recording medium M has just been conveyed to the discharge reference position. If ink is discharged for the first time in the current print job, the CPU 31 determines that the discharge target position of the recording medium M is at the discharge reference position when a predetermined number of pulse signals are output from the rotary encoder 15 after the edge of recording medium M is detected or the previous print job is completed.

[0080] If it is determined that the discharge target position of the recording medium M is not at the discharge reference position ("NO" at Step S104), the CPU 31 proceeds to Step 102 of the processing.

[0081] If it is determined that the discharge target position of the recording medium M is at the discharge reference position ("YES" at Step S104), the CPU 31 outputs the discharge reference signal to the recording head driving controller 211 and causes the recording head driving controller 211 to execute the ink discharge processing (Step S 105).

[0082] The CPU 31 determines whether the target image recording is completed (Step S106). If it is determined that the image recording is not completed ("NO" at Step S106), the CPU 31 proceeds to Step S102 of the processing.

[0083] If it is determined that the image recording is completed ("YES" at Step S106), the CPU 31 determines whether a command to execute a new print job is given (obtained) (Step S107). If it is determined that such a command is obtained ("YES" at Step S107), the CPU 31 proceeds to Step S101 of the processing.

[0084] If it is determined that a command to execute a new print job is not obtained ("NO" at Step S107), the CPU 31 ends the image recording processing.

[0085] Fig. 6 is a flowchart of the control process of the ink discharge processing by the recording head driving controller 211.

[0086] When the ink discharge processing starts, the recording head driving controller 211 calculates the conveyance speed (speed corresponding value) of the recording medium M in the above-mentioned method (Step S201: speed corresponding value obtaining step).

[0087] The recording head driving controller 211 calculates the delay time of ink discharge timing based on the calculated speed corresponding value and the discharge distance obtained at Step S101 of the image recording processing (Step S202).

[0088] The recording head driving controller 211 generates the starting discharge signal at the timing when the above-mentioned delay time elapses since the timing of input of the discharge reference signal, starts supplying the driving signal according to the image data from the driving circuit to the recording head 212 at the timing of the starting discharge signal, and causes ink to be discharged from the nozzle 213 of the recording head 212 (Step S203: recording step).

[0089] When Step S203 of the processing is completed, the recording head driving controller 211 ends the

ink discharge processing.

[0090] As described above, the inkjet recording device 1 according to the present embodiment includes a recorder 20 with head units 21 which discharge ink from nozzles 213, a conveyor 10 conveying a recording medium M in a predetermined conveying direction, a rotary encoder 15, a CPU 31, and a recording head driving controller 211. The CPU 31 and the recording head driving controller 211 cause the head unit 21 to discharge ink from the nozzles 213 onto the recording medium M conveyed by the conveyor 10 and facing the ink outlets of the nozzles 213 (recording control means). The CPU 31 changes the conveyance speed of the recording medium M on the conveyor 10 (conveyance control means). The rotary encoder 15 and the recording head driving controller 211 obtain the speed corresponding value concerning the conveyance speed of the recording medium M (speed corresponding information obtaining means). The CPU 31 and the recording head driving controller 211 cause the head units 21 to discharge ink at the timing when the delay time determined based on the speed corresponding value concerning the conveyance speed at the discharge reference timing elapses since the discharge reference timing when the ink discharge target position of the recording medium M moves to the predetermined discharge reference position in the conveying direction in the period while the CPU 31 as the conveyance control means is changing the conveyance speed at least. This can prevent a defect of variation in the distance between the position on the recording medium M where facing the ink outlet of the nozzle 213 at the discharge reference timing and the position where ink discharged from the nozzle 213 lands depending on the conveyance speed of the recording medium M. Therefore, images can be appropriately recorded in the period while the conveyance speed of the recording medium M is changing.

[0091] The recorder 20 has multiple head units 21 disposed at the positions different from each other in the conveying direction. The CPU 31 and the recording head driving controller 211 cause the head units 21 respectively corresponding to the multiple discharge reference positions to discharge ink at the timing when the delay time determined based on the speed corresponding value concerning the conveyance speed at each of the multiple discharge reference timings elapses since the multiple discharge reference timings when the discharge target positions of the recording medium M respectively moves to the multiple discharge reference positions corresponding to the multiple head units 21 (recording control means). Such a configuration allows ink from each of the multiple head units 21 to land at the positions appropriate about the discharge reference positions respectively corresponding to the head units 21. This can prevent variation in the positions where ink discharged from the multiple head units 21 lands concerning the same discharge target positions of the recording medium M, and prevent defects in image quality of images recorded by the multiple head units 21 in the period while the conveyance speed is changing.

[0092] The above-described delay time is determined based on the discharge distance between the recording medium M and the ink outlet of the nozzle 213 in the direction Z and the conveyance speed. Such a configuration allows ink to land at appropriate landing positions irrespective of the conveyance speed of the recording medium M when the discharge distance has been changed. In the inkjet recording device 1 in which the discharge distance may change, images can be appropriately recorded in the period while the conveyance speed of the recording medium M is being changed.

[0093] The conveyor 10 operates in multiple conveyance modes for conveying the recording medium M at the conveyance speeds different from each other, and the CPU 31 changes the conveyance speed for a predetermined period of time when switching the conveyance mode of the conveyor 10 (conveyance control means). This enables appropriate image recording continuously before and after the conveyance modes switch.

[0094] The conveyor 10 conveys the recording medium M by moving the conveyor belt 13 with the recording medium M placed on the conveying face of the conveyance belt 13, and the CPU 31 changes the conveyance speed of the recording medium M by changing the moving speed of the conveyor belt 13 (conveyance control means). The rotary encoder 15 outputs a predetermined detection signal each time the conveyor belt 13 moves in a predetermined amount, and the rotary encoder 15 and the recording head driving controller 211 obtain the speed corresponding value based on the time required to detect detection signal for predetermined times (speed corresponding value obtaining means). With such a configuration, without measuring the speed of the recording medium M directly, the speed corresponding value can be obtained with a simple configuration and processing.

[0095] The CPU 31 and the recording head driving controller 211 detect the discharge reference timings based on the detection signals of the rotary encoder 15 (recording control means). With such a configuration, the discharge reference timings can be detected correctly with a simple configuration and processing.

[0096] The recording control method in the inkjet recording device 1 according to the present embodiment includes a recording step at which ink is discharged from the nozzles 213 by the head units 21 onto the recording medium M which is conveyed by the conveyor 10 and facing the ink outlets of the nozzles 213, a conveyance control step at which the conveyance speed of the recording medium M on the conveyor 10 is changed, and a speed corresponding information obtaining step at which the speed corresponding value concerning the conveyance speed is obtained. In the recording step, ink is discharged by the head unit 21 at the timing when the delay time determined based on the speed corresponding information concerning the conveyance speed at the discharge reference timing elapses since the discharge

reference timing when the target position onto which ink is discharged in the recording medium M moves to the predetermined reference position onto which ink is to be discharged in the period while the conveyance speed of the recording medium M is being changed at least. This enables appropriate image recording during the period while the conveyance speed of the recording medium M is changing.

[Modification Example]

[0097] Next, a modification example of the above-described embodiment is explained. The present modification example differs from the above-described embodiment in that the conveyance speed of the recording medium M is calculated at each position of four head units 21 and that the delay time of the ink discharge timing is calculated based on the respective calculation results of the conveyance speed for each head unit 21. Hereinafter the points that differ from the above-described embodiment are explained.

[0098] Though the conveyor belt 13 ideally neither expands nor shrinks in the circling operation, the conveyor belt 13 inevitably expands and shrinks to some extent for the conveyor belt 13 is difficult to be configured with material which can be regarded as rigid. Especially, in the inkjet recording device 1 which performs recording on a large recording medium M, the conveyor belt 13 expands and shrinks to an unignorable extent considering the resolution of image to be recorded.

[0099] The extent of expansion and shrinkage of the conveyor belt 13 generally varies according to the position in the conveying direction, and the moving speed of the conveyor belt 13 at each of the four head units 21, namely the conveyance speed of the recording medium M, may vary resulting from the extent of expansion and shrinkage that varies. This may result in insufficient restraint of deviation of ink discharge positions in each head unit 21 if the discharge timing is adjusted using the conveyance speed calculated based on the detection signal from a single rotary encoder 15 as in the embodiment described above.

[0100] In the inkjet recording device 1 in the present modification example, the conveyance speed of the recording medium M is independently calculated at the positions facing each of the four head units 21 in the conveying direction.

[0101] Fig. 7 is a schematic configuration of the inkjet recording device 1 according to the present modification example.

[0102] The inkjet recording device 1 according to the present modification example has a belt encoder 18 instead of a rotary encoder 15. The belt encoder 18 is a linear magnetic encoder which has a magnetic scale 182 arranged on the conveyor belt 13 with the N pole and S pole appearing by turns along the conveying direction at predetermined intervals, and four magnetic pickups 181 to read the magnetic pole face of the magnetic scale 182. The four magnetic pickups 181 are respectively arranged at the positions of the four head units 21 in the conveying direction. Each of the magnetic pickups 181, independent from one another, detects changes of the magnetic pole of the magnetic scale 182 at the positions of the magnetic pickups 181 according to the circling movement of the conveyor belt 13 and output pulse signals according to the detection results to the controller 30 and the recording head driving controller 211.

[0103] The recording head driving controller 211 of each head unit 21 calculates the conveyance speed of the recording medium M based on the pulse signal output from the magnetic pickup 181 corresponding to each head unit 21. In the inkjet recording device 1 in the present modification example, the conveyance speed of the recording medium M at the positions facing each head unit 21 in the conveying direction is calculated respectively, and the delay time of ink discharge timings is calculated for each head unit 21 independently based on the calculation result. Then ink is discharged.

[0104] A rotary encoder may be used instead of the belt encoder 18 described above. In that case, driven rollers which each rotate with the movement of the conveyor belt 13 at the positions of four head units 21 in the conveying direction are disposed, and a rotary encoder is mounted on each of the four driven rollers, for example.

[0105] In such a way, in the inkjet recording device 1 according to the present modification example, the rotary encoder 15 and the recording head driving controller 211 obtain the speed corresponding information concerning the conveyance speed of the recording medium M at the positions respectively facing the multiple head units 21 in the conveying direction (speed corresponding information obtaining means). The CPU 31 and the recording head driving controller 211 cause each of head units 21 to discharge ink at the timings when the delay time determined based on the speed corresponding information concerning the conveyance speed of the recording medium M at the positions facing the head units 21 elapses since the discharge reference timing (recording control means). With such a configuration, ink may be discharged at appropriate timings according to the conveyance speed at the positions of each head unit 21 if the conveyance speed of the recording medium M varies at each of multiple head units 21 resulting from the extent of expansion and shrinkage of the conveyor belt 13 that varies. Therefore, images can be recorded more appropriately in the period while the conveyance speed of the recording medium M is being changed.

[0106] The present invention is not limited to the embodiment and modification example described above and various changes can be made thereto.

[0107] For example, in the embodiment and modification example described above, the delay time is calculated by the recording head driving controller 211 each time ink is discharged, though not limitative in any way. The delay time may be, for example, obtained with reference to the table data in which a possible combination

of the conveyance speed of the recording medium M and the discharge distance is respectively associated with the delay time and which is stored in the ROM 33 or the memory 34.

[0108] In the embodiment and modification example described above, the conveyance speed (speed corresponding information) and the delay time are calculated by the recording head driving controller 211. However, the CPU 31 may calculate or obtain either or both of the conveyance speed and the delay time instead.

[0109] In the embodiment and modification example described above, the delay time is calculated based on the conveyance speed of the recording medium M and the discharge distance, though not limitative in any way. For example, the delay time may be calculated based on the conveyance speed of the recording medium M only, if the discharge distance is constant or if the discharge distance is adjusted to a predetermined value by a mechanism which moves the head unit 21 in the Z direction.

[0110] In the embodiment and modification example described above, the discharge timing is adjusted by calculation of the delay time based on the calculated value of the conveyance speed even in the period when the conveyance speed is not changing, though not limitative any way. For example, in the period when the conveyor 10 operates in a predetermined conveyance mode and the conveyance speed of the recording medium M is constant, the discharge timing may be adjusted based on the predetermined delay time which is determined beforehand corresponding to the conveyance mode according to the conveyance speed in the conveyance mode.

[0111] In the embodiment and modification example described above, the speed corresponding information is obtained from the time to detect a predetermined number of detection signals from the rotary encoder 15 (belt encoder 18). However, the speed corresponding information may be obtained from the count of detection signals output per predetermined period of time instead.

[0112] In the embodiment and modification example described above, the rotation amount of the driving roller 11 is detected by the rotary encoder 15. However, the rotation amount of the driven roller 12 or the conveyor motor 14 may be detected by the rotary encoder 15 instead.

[0113] In the embodiment and modification example described above, the conveyance speed of the recording medium M is calculated based on the pulse signal output from the rotary encoder 15 (belt encoder 18). However, the conveyance speed may be detected by a device which directly measures the speed of the recording medium M or the conveyor belt 13, such as a laser Doppler velocimeter instead.

[0114] In the embodiment and modification example described above, the discharge reference signal is generated by the CPU 31 and output to the recording head driving controller 211. However, the discharge reference signal may be generated by the recording head driving controller 211 based on the pulse signal from the rotary encoder 15.

[0115] In the embodiment and modification example described above, the delay time is calculated based on the discharge distance information input from the exterior. However, the discharge distance measured by a distance measuring means which measures the distance between the ink outlet of the nozzle 213 and the recording medium M may be used instead.

[0116] In the embodiment and modification example described above, the conveyance speed of the recording medium M is changed according to the input operation to the operation display 41 by the user. However, the change of conveyance speed may be controlled by the CPU 31 according to the sequence programmed beforehand instead.

[0117] In the embodiment and modification example described above, the recording medium M is conveyed by the conveyor 10 with the conveyor belt 13, though not limitative in any way. The conveyor 10 may convey the recording medium M by holding it on the peripheral surface of the rotating conveyor drum, for example. Otherwise, a paper roll abutting and sliding on the face of a member whose relative position to the head unit is fixed may be conveyed, for example.

[0118] Though several embodiments of the present invention have been described above, the scope of the present invention is not limited to the above embodiments, and includes the scope of inventions, which is described in the scope of claims, and the scope equivalent thereof.

Industrial Applicability

[0119] The present invention is applicable to an inkjet recording device and a recording control method for an inkjet recording device.

Description of Reference Numerals

[0120]

1	Inkjet recording device
2	External device
10	Conveyor
101	Conveyance driver
11	Driving roller
12	Driven roller
13	Conveyor belt
14	Conveyor motor
15	Rotary encoder
16	Pressing roller
17	Separating roller
18	Belt encoder
181	Magnetic pickup
182	Magnetic scale
20	Recorder
21	Head unit

211 Recording head driving controller
212 Recording head
213 Nozzle
30 Controller
31 CPU
32 RAM
33 ROM
34 Memory
41 Operation display
42 Input/output interface
43 Bus
M Recording medium

Claims

1. An inkjet recording device comprising:

a recorder with an ink discharger which discharges ink from a nozzle;
a conveyor which conveys a recording medium in a predetermined conveying direction;
a recording control means which causes the ink discharger to discharge ink from the nozzle onto the recording medium conveyed by the conveyor and facing an ink outlet of the nozzle;
a conveyance control means which changes a conveyance speed of the recording medium on the conveyor; and
a speed corresponding information obtaining means which obtains speed corresponding information concerning the conveyance speed,
wherein the recording control means causes the ink discharger to discharge ink at a timing when a delay time determined based on the speed corresponding information concerning the conveyance speed at a discharge reference timing elapses since the discharge reference timing at least in a period while the conveyance control means is changing the conveyance speed, and
wherein the discharge reference timing is when a discharge target position of ink in the recording medium moves to a predetermined discharge reference position in the conveying direction.

2. The inkjet recording device according to claim 1,
wherein the ink discharger comprises multiple ink dischargers,
wherein the discharge reference position comprises multiple discharge reference positions,
wherein the discharge reference timing comprises multiple discharge reference timings,
wherein the recorder comprises the multiple ink dischargers disposed at positions different from each other in the conveying direction, and
wherein the recording control means causes the ink dischargers respectively corresponding to the multiple discharge reference positions to discharge ink at a timing when a delay time determined based on the speed corresponding information concerning the conveyance speed at each of the multiple reference timings elapses since the multiple discharge reference timings when the discharge target position of the recording medium moves to the multiple reference positions respectively corresponding to the multiple ink dischargers.

3. The inkjet recording device according to claim 2,
wherein the speed corresponding information obtaining means obtains the speed corresponding information concerning the conveyance speed of the recording medium respectively at a position facing each of the multiple ink dischargers in the conveying direction, and
wherein the recording control means causes each of the multiple ink dischargers to discharge ink at a timing when a delay time determined based on the speed corresponding information concerning the conveyance speed of the recording medium at the position facing the ink discharger elapses since the discharge reference timing.

4. The inkjet recording device according to any one of claims 1 to 3, wherein the delay time is determined based on a distance between the recording medium and an ink discharging outlet of the nozzle in a direction of ink being discharged from the nozzle and the speed corresponding information.

5. The inkjet recording device according to any one of claims 1 to 4,
wherein the conveyor operates in multiple conveyance modes to convey the recording medium at conveyance speeds different from each other, and
wherein the conveyance control means changes the conveyance speed for a predetermined period of time when the conveyance modes of the conveyor switch.

6. The inkjet recording device according to any one of claims 1 to 5,
wherein the conveyor conveys the recording medium by moving a conveyance member with the recording medium being placed on the conveying surface of the conveyance member,
wherein the conveyance control means changes the conveyance speed of the recording medium by changing a moving speed of the conveyance member, and
wherein the speed corresponding information obtaining means has a movement detector which outputs a predetermined detection signal each time the conveyance member moves in a predetermined amount, and obtains the speed corresponding information based on a length of time required to detect a predetermined number of the detection signal or a

count of the detection signal detected per predetermined period of time.

7. The inkjet recording device according to claim 6, wherein the recording control means detects the discharge reference timing based on the detection signal.

8. A recording control method for an inkjet recording device comprising a recorder with an ink discharger which discharges ink from a nozzle and a conveyor which conveys a recording medium in a predetermined conveying direction, the method comprising:

a recording step in which the ink discharger discharges ink from the nozzle onto the recording medium conveyed by the conveyor and facing an ink outlet of the nozzle;
a conveyance control step in which a conveyance speed of the recording medium on the conveyor is changed; and
a speed corresponding information obtaining step in which speed corresponding information concerning the conveyance speed is obtained,
wherein, in the recording control step, the ink discharger discharges ink at a timing when a delay time determined based on the speed corresponding information concerning the conveyance speed at a discharge reference timing elapses since the discharge reference timing at least in a period while the conveyance speed is changed in the conveyance control step, and
wherein the discharge reference timing is when a discharge target position of ink in the recording medium moves to a predetermined discharge reference position in the conveying direction.

FIG.1

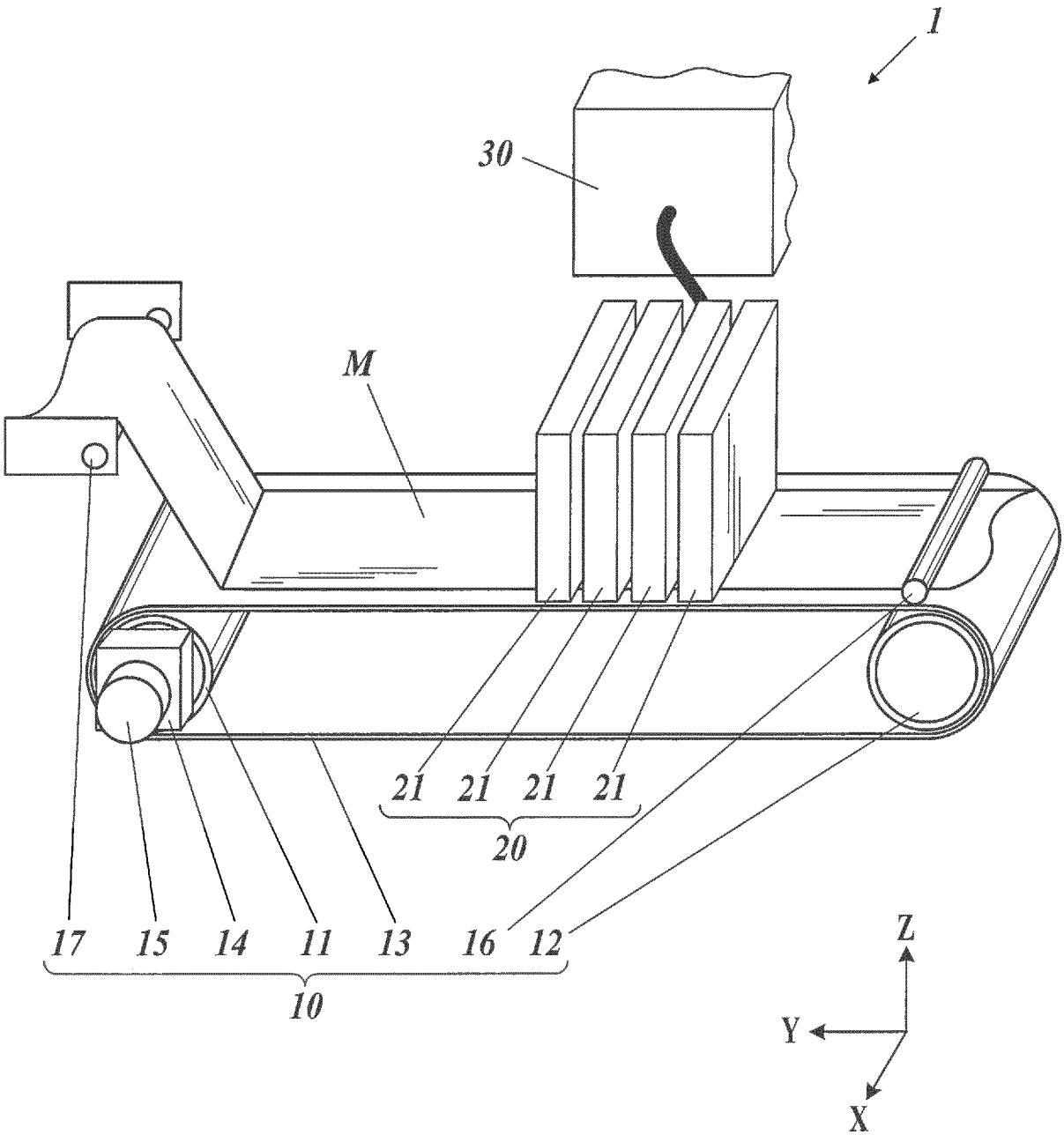


FIG.2

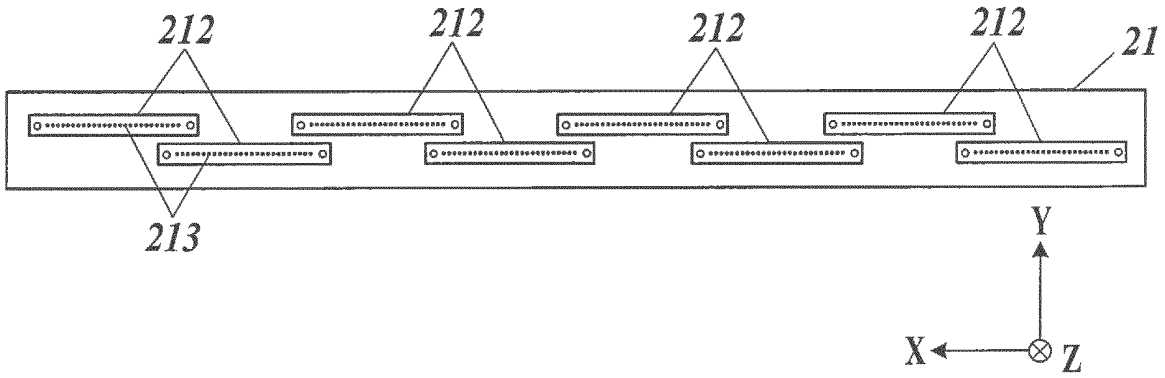

212
212
212
212
21
213
Y
X
Z

FIG.3

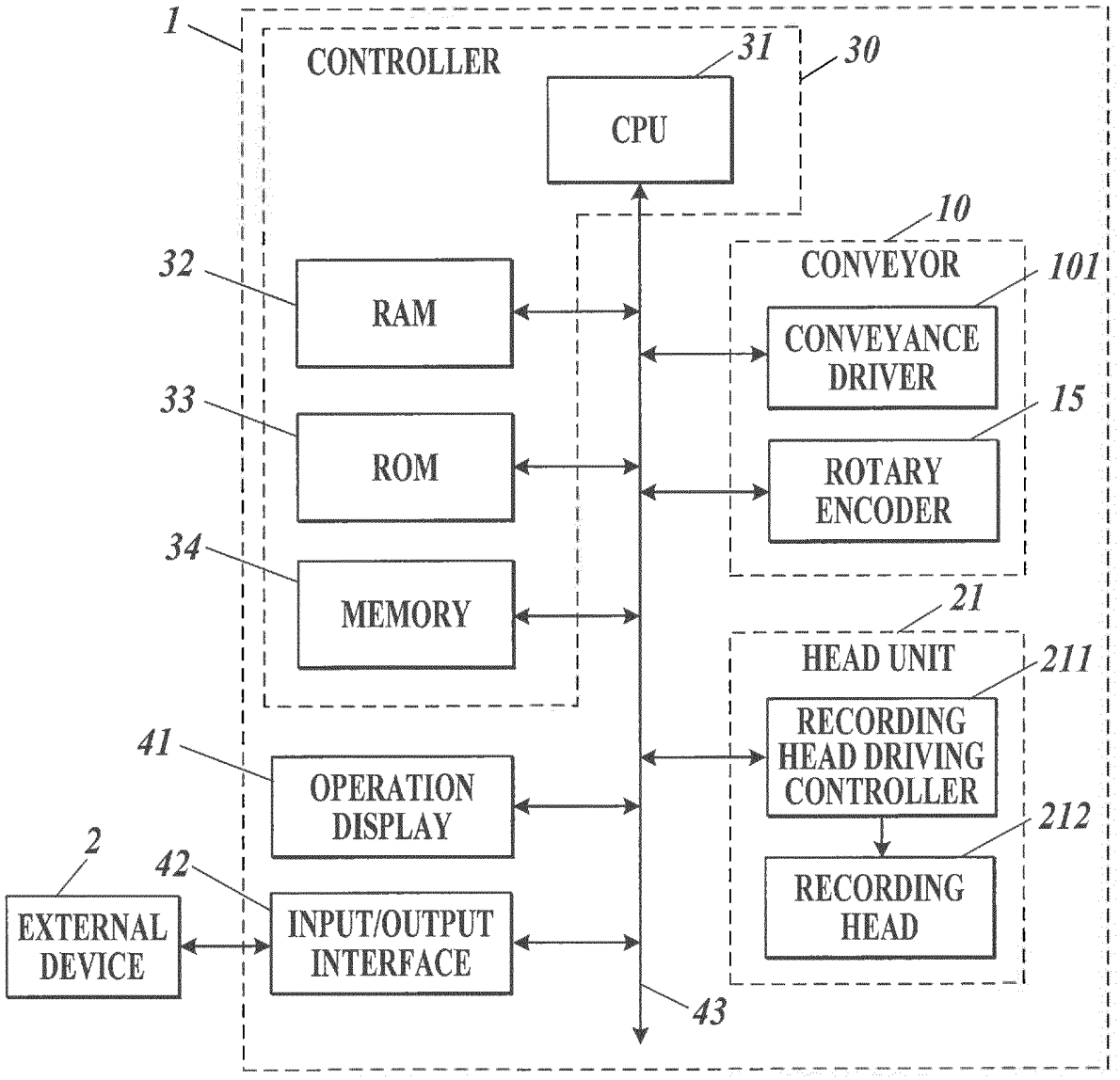

1
CONTROLLER
31
30
CPU
10
CONVEYOR
101
32
RAM
CONVEYANCE DRIVER
33
ROM
15
ROTARY ENCODER
34
MEMORY
21
HEAD UNIT
211
41
OPERATION DISPLAY
RECORDING HEAD DRIVING CONTROLLER
212
2
42
EXTERNAL DEVICE
INPUT/OUTPUT INTERFACE
RECORDING HEAD
43

FIG.4

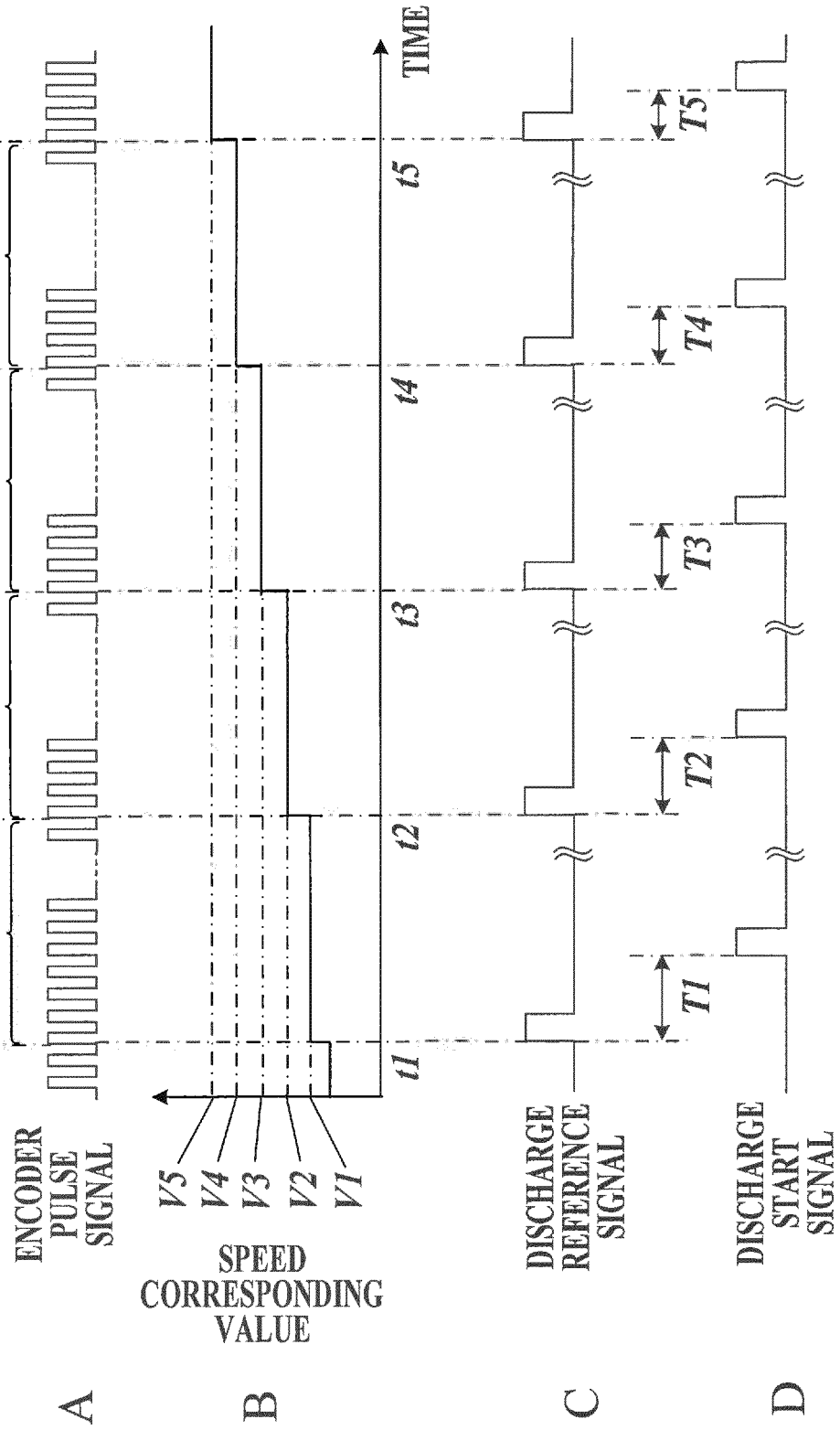

A
B
C
D
ENCODER PULSE SIGNAL
SPEED CORRESPONDING VALUE
DISCHARGE REFERENCE SIGNAL
DISCHARGE START SIGNAL
TIME
N
N
N
N
V5
V4
V3
V2
V1
t1
t2
t3
t4
t5
T1
T2
T3
T4
T5

FIG. 5

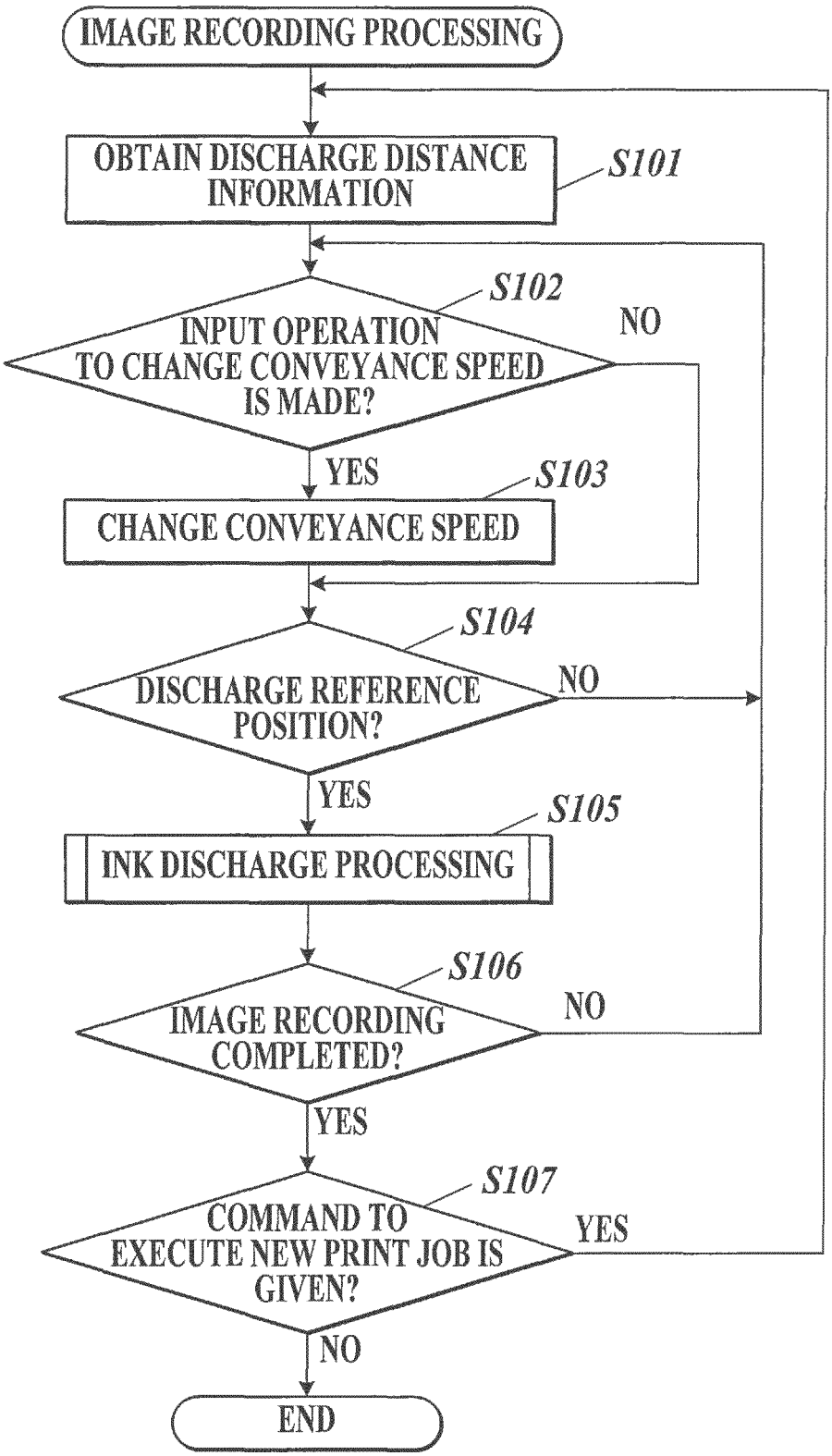


IMAGE RECORDING PROCESSING
OBTAIN DISCHARGE DISTANCE INFORMATION
S101
S102
INPUT OPERATION TO CHANGE CONVEYANCE SPEED IS MADE?
NO
YES
S103
CHANGE CONVEYANCE SPEED
S104
DISCHARGE REFERENCE POSITION?
NO
YES
S105
INK DISCHARGE PROCESSING
S106
IMAGE RECORDING COMPLETED?
NO
YES
S107
COMMAND TO EXECUTE NEW PRINT JOB IS GIVEN?
YES
NO
END

FIG. 6

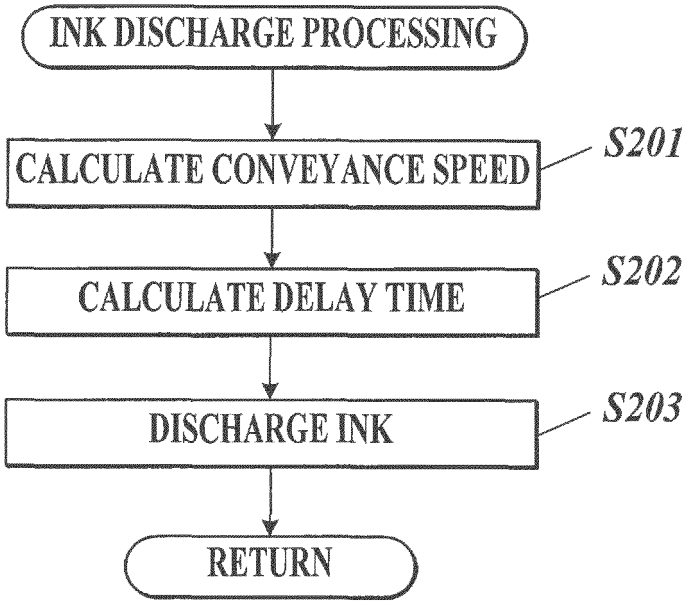
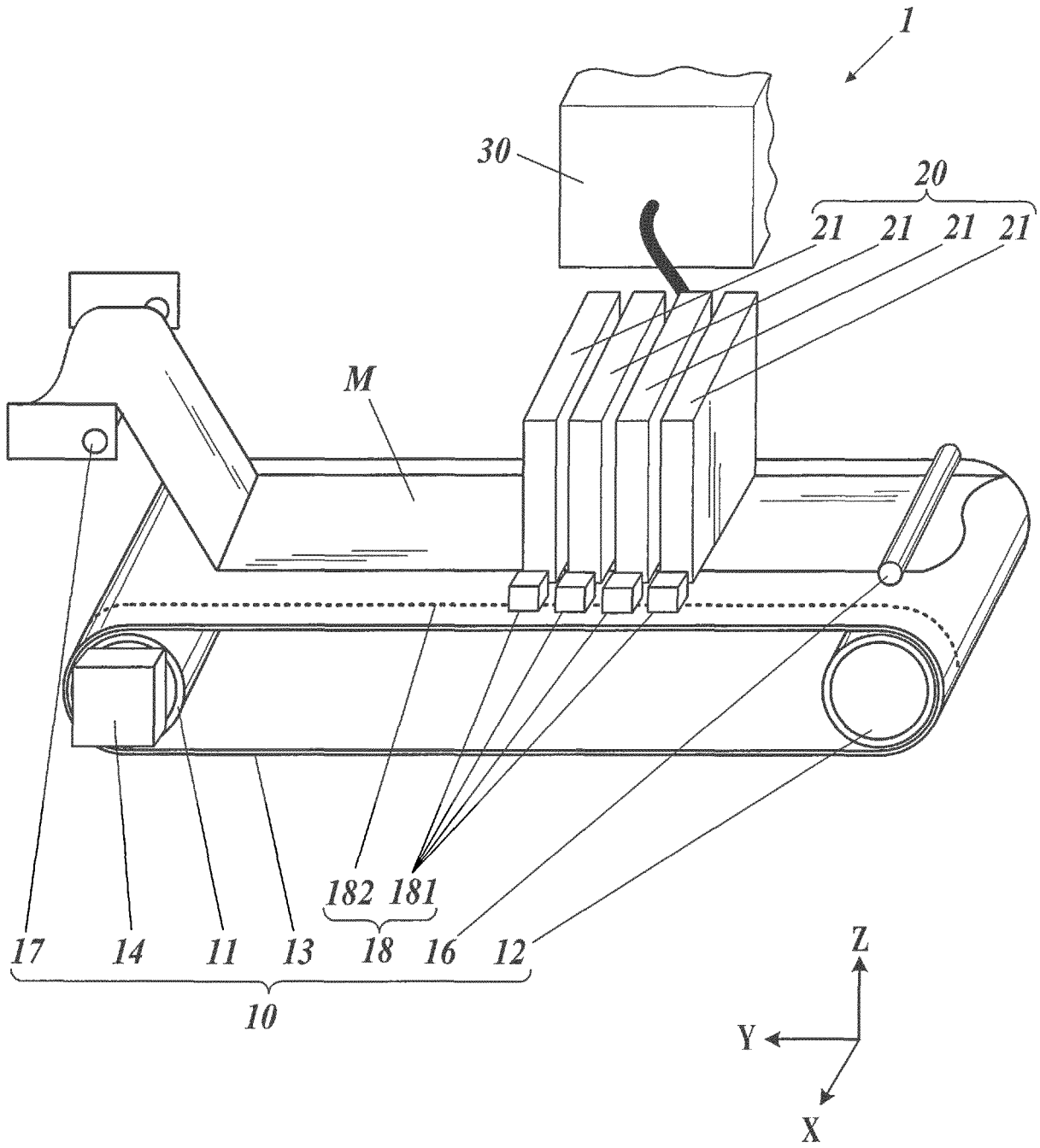

INK DISCHARGE PROCESSING
CALCULATE CONVEYANCE SPEED
S201
CALCULATE DELAY TIME
S202
DISCHARGE INK
S203
RETURN

FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/005612

A. CLASSIFICATION OF SUBJECT MATTER
B41J2/155(2006.01)i, *B41J2/01*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B41J2/155, B41J2/01

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2017
Kokai Jitsuyo Shinan Koho	1971-2017	Toroku Jitsuyo Shinan Koho	1994-2017

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2-80269 A (Canon Inc.), 20 March 1990 (20.03.1990), page 3, upper right column to page 5, upper right column; fig. 1, 4 to 6 & US 5828387 A column 5 to column 7, line 11; fig. 1, 4 to 6	1-3,5-6,8 4,7
Y A	JP 2010-167629 A (Canon Finetech Inc.), 05 August 2010 (05.08.2010), claim 1; paragraphs [0006], [0009]; fig. 8(b) (Family: none)	1-3,5-6,8 4,7
A	JP 2016-20064 A (Kyocera Document Solutions Inc.), 04 February 2016 (04.02.2016), entire text; all drawings (Family: none)	1-8

☒ Further documents are listed in the continuation of Box C. ═ See patent family annex.

* Special categories of cited documents:
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- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 March 2017 (16.03.17)	28 March 2017 (28.03.17)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/005612

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2007-237402 A (Fuji Xerox Co., Ltd.), 20 September 2007 (20.09.2007), entire text; all drawings & US 2007/0206040 A1 entire text; all drawings	1-8
A	JP 2015-139915 A (Seiko Epson Corp.), 03 August 2015 (03.08.2015), entire text; all drawings & US 2015/0210073 A1 entire text; all drawings	1-8
A	JP 2008-23943 A (Seiko Epson Corp.), 07 February 2008 (07.02.2008), entire text; all drawings (Family: none)	1-8
A	JP 2014-34205 A (Ricoh Co., Ltd.), 24 February 2014 (24.02.2014), entire text; all drawings (Family: none)	1-8

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2007168226 A **[0004]**
- JP 5303337 B **[0004]**