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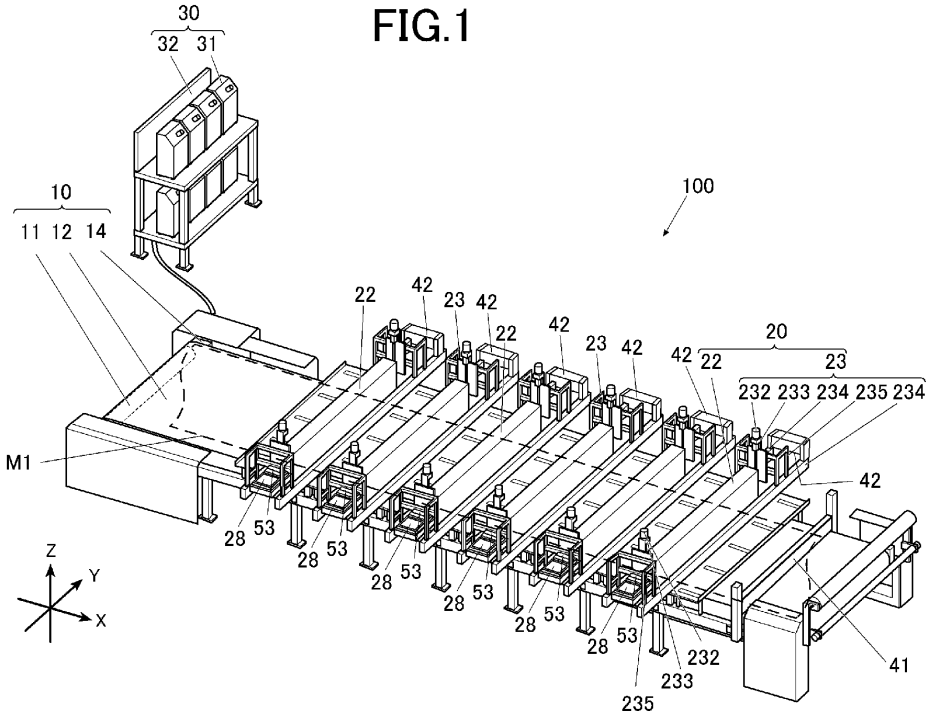
(54) INKJET RECORDING APPARATUS

(57) An inkjet recording apparatus includes, an ink ejector which includes a nozzle and which ejects ink from the nozzle; a first conveyor which conveys a first recording medium in a predetermined first direction facing an ink ejecting surface of the ink ejector; a second conveyor which moves a second recording medium between the ink ejector and a conveying path of the first recording medium along a predetermined second direction; and an imager which is positioned on a moving path along the second direction of the second recording medium and which images a surface of the second recording medium throughout a width in which the ink ejector can record on the second recording medium in a direction intersecting with the second direction.

FIG.1



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Description

BACKGROUND

Technological Field

[0001] The present invention relates to an inkjet recording apparatus.

Description of the Related Art

[0002] Conventionally, there is an inkjet recording apparatus in which ink is ejected from a large number of nozzles and an image is recorded. Problems often occur in nozzles, and it is necessary to adjust the operation among the nozzles. Therefore, a test image is recorded to examine the state of ink ejection from each nozzle. Such test image is analyzed and adjustment is performed as necessary. If recording media originally for image output is used in such adjustment, this increases costs when the recording media is expensive. On the other hand, if a different recording media for inspection is supplied on a normal conveying path, there is a burden that the recording media needs to be switched. JP2019-202522 describes inserting another recording medium in the image recording position from a path different from that used for a recording medium for recording a normal image. The test image can be recorded on such recording medium and it is possible to achieve both of the following, to simplify the burden and to reduce the cost.

SUMMARY

[0003] However, if a separate recording medium is inserted from a direction different from the normal conveying direction, and the recording medium is moved relatively with relation to the nozzles and an imager to perform a recording operation of the test image and an imaging operation, the mechanism of the movable portion regarding the relative motion becomes complicated. This results in the burden of control increasing, and the cost and size increasing in order to obtain sufficient accuracy.

[0004] The present invention is conceived in view of the above problems of the conventional techniques, and the purpose of the present invention is to provide an inkjet recording apparatus in which inspection and adjustment can be performed more simply and with low costs.

[0005] To achieve at least one of the abovementioned objects, according to an aspect of the present invention, an inkjet recording apparatus includes: an ink ejector which includes a nozzle and which ejects ink from the nozzle; a first conveyor which conveys a first recording medium in a predetermined first direction facing an ink ejecting surface of the ink ejector; a second conveyor which moves a second recording medium between the ink ejector and a conveying path of the first recording medium along a predetermined second direction; and an imager which is positioned on a moving path along the second direction of the second recording medium and which images a surface of the second recording medium throughout a width in which the ink ejector can record on the second recording medium in a direction intersecting with the second direction.

[0006] According to aspect 2, the inkjet recording apparatus according to aspect 1 further includes a controller which moves the second recording medium, which controls the ink ejector to record a test image on the second recording medium, and which controls the imager to image the test image.

[0007] According to aspect 3, in the inkjet recording apparatus according to aspect 2, the controller controls the second conveyor to move the second recording medium back and forth along the second direction, and to return the second recording medium to an initial position after recording and imaging the test image.

[0008] According to aspect 4, in the inkjet recording apparatus according to aspect 2 or 3, the controller performs the recording and the imaging of the test image when the second recording medium is moved in either one direction along the second direction.

[0009] According to aspect 5, in the inkjet recording apparatus according to aspect 2, the imager is positioned on an outer side of each end of the ink ejector in the second direction, and the controller moves the second recording medium one way from one of both ends to the other of the both ends each time the recording and the imaging of the test image is performed.

[0010] According to aspect 6, the inkjet recording apparatus according to any one of aspects 2 to 5, further includes, a mover which moves the ink ejector in a direction to change a distance of the first recording medium from the conveying path, wherein, the second conveyor moves the second recording medium in a state in which the mover separates the ink ejector to be separated a predetermined distance or more from the conveying path.

[0011] According to aspect 7, the inkjet recording apparatus according to any one of aspects 2 to 6, further includes a maintenance operator regarding maintenance of the ink ejector, and the second conveyor moves the second recording medium together with the maintenance operator.

[0012] According to aspect 8, in the inkjet recording apparatus according to aspect 7, when the second recording medium moves, while the controller controls the maintenance operator to perform maintenance, the controller allows the nozzle in which maintenance is performed to eject ink, and the controller records a test image on the second recording medium.

[0013] According to aspect 9, in the inkjet recording apparatus according to aspect 7 or 8, the maintenance operator includes an ink receiver which receives ink ejected from the ink ejector, and when the test image is recorded by the ink ejector, the controller allows each nozzle to discharge ink to the ink receiver before recording the test image.

[0014] According to aspect 10, in the inkjet recording

apparatus according to any one of aspects 2 to 9, in the ink ejector, a plurality of nozzles are aligned in a third direction intersecting with the first direction with a predetermined interval, and the third direction is parallel to the second direction.

[0015] According to aspect 11, in the inkjet recording apparatus according to any one of aspects 2 to 9, in the ink ejector, a plurality of nozzles are aligned in a third direction intersecting with the first direction with a predetermined interval, and the first direction and the second direction are parallel.

[0016] According to aspect 12, in the inkjet recording apparatus according to any one of aspects 2 to 11, the ink ejector includes nozzles in a predetermined number of two or more in positions which are the same in a fourth direction orthogonal to the second direction, and in the test image, landing positions from the predetermined number of nozzles are aligned in a row with a landing interval being narrower than an interval of the predetermined number of nozzles in the second direction and equal to or larger than a size of an opening of the nozzle.

[0017] According to aspect 13, in the inkjet recording apparatus according to aspect 12, the ink ejector includes a plurality of recording heads each including a nozzle, the predetermined number of nozzles are provided throughout the plurality of recording heads, and the landing interval is a predetermined first landing interval between the nozzles in the same recording head, and the landing interval is a non-integer multiple of the first landing interval between the nozzles in the different recording heads.

[0018] According to aspect 14, in the inkjet recording apparatus according to any one of aspects 2 to 13, the test image includes a plurality of landing rows in which ink droplets ejected from the plurality of nozzles land with a predetermined landing interval, and the controller specifies the nozzle corresponding to the ink droplet which does not land normally by setting as a reference from among the landing rows a landing row which includes the ink droplets which lands normally in both ends.

[0019] According to aspect 15, in the inkjet recording apparatus according to any one of aspects 2 to 13, the test image includes a plurality of landing rows in which ink droplets ejected from the plurality of nozzles are landed in a predetermined landing interval and the plurality of landing rows each extend in the same direction and are aligned in a two-dimensional matrix shape, and the controller specifies the nozzle corresponding to the ink droplet which does not land normally by setting as a reference a landing row which includes the ink droplet which lands normally in diagonal points in a group of a plurality of landing rows aligned in a direction orthogonal to a direction that the landing rows extend.

[0020] According to aspect 16, in the inkjet recording apparatus according to aspect 14 or 15, the controller does not perform the specifying when there is no landing row that is to be the reference.

[0021] According to aspect 17, in the inkjet recording apparatus according to any one of aspects 1 to 16, the second conveyor includes a relative mover which moves the second recording medium separately from movement along the moving path.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The advantages and features provided by one or more embodiments of the invention will become more fully understood from the detailed description given hereinafter and the appended drawings which are given by way of illustration only, and thus are not intended as a definition of the limits of the present invention, and wherein:

FIG. 1 is a diagram showing an overall perspective view of an inkjet recording apparatus according to a first embodiment;
FIG. 2 is a diagram showing a bottom view of a surface facing a conveying surface in a head unit;
FIG. 3 is a diagram showing a perspective view describing an inspection recorder and a maintenance operator;
FIG. 4 is a block diagram showing a functional configuration of an inkjet recording apparatus;
FIG. 5A to FIG. 5D are diagrams describing an operation procedure when an inspection regarding an abnormality in ejection is performed;
FIG. 6A and FIG. 6B are diagrams describing a test image;
FIG. 7 is a flowchart showing a control procedure of an ejection abnormality detecting process;
FIG. 8A to FIG. 8E are diagrams showing a modification of a detecting operation of an ejection abnormality;
FIG. 9A to FIG. 9E are diagrams showing a modification of a detecting operation of an ejection abnormality;
FIG. 10 is a perspective view schematically showing an outer appearance of an inkjet recording apparatus according to a second embodiment;
FIG. 11A to FIG. 11D are diagrams showing a detecting operation of an ejection abnormality in the inkjet recording apparatus according to the second embodiment; and
FIG. 12 is a diagram showing an example of a test image recorded on a second recording medium.

DETAILED DESCRIPTION OF EMBODIMENTS

[0023] Hereinafter, one or more embodiments of the present invention will be described with reference to the drawings. However, the scope of the invention is not limited to the disclosed embodiments.

[0024] Below, an embodiment of the present invention is described with reference to the drawings.

[First Embodiment]

[0025] FIG. 1 shows an overall perspective view of an inkjet recording apparatus 100 according to a first embodiment of the present invention.

[0026] Such inkjet recording apparatus 100 includes a plurality of line heads, here 6 line heads. The ink is ejected by a single pass method and the color image can be recorded. The inkjet recording apparatus 100 includes a conveyor (first conveyor) 10, a recording operator 20, an ink supplier 30, and a first imager 41.

[0027] The conveyor 10 includes a driving roller 11, a conveying belt 12, and a conveying driver 14. The conveying driver 14 includes a rotating motor which rotates the driving roller 11 at a predetermined speed. An endless conveying belt 12 is wrapped around the driving roller 11 and a following roller which is not shown, and the conveying belt 12 rotates and moves with the rotation of the driving roller. The outside surface of the conveying belt 12 is to be a conveying surface. In the conveyor 10, a first recording medium M1 (first recording medium) is placed in a predetermined area on the conveying surface. The first recording medium M1 is conveyed in a rotating movement direction according to the rotating movement of the conveying belt 12 (movement direction of recording medium during conveying), that is, here, the X-direction (first direction). The type of first recording medium M1 is not limited but here, a continuous fabric is used. In the conveyor 10, for example, a rolled fabric is continuously sent and placed on the conveying surface and with this, the cloth can be conveyed.

[0028] The recording operator 20 includes a head unit 21 (see FIG. 2, ink ejector), a carriage 22, a carriage elevator 23, an inspection recorder 28, a second imager 42 (imager), and a maintenance operator 53.

[0029] The recording operator 20 is provided in a number of sets according to the number of colors of ink (here, 6 sets). Each carriage 22 extends in a direction intersecting with the conveying direction conveyed by the conveyor 10 on a surface parallel to the conveying surface, and here, this is the orthogonal width direction. Each carriage is positioned above (height direction) the conveying surface of the first recording medium M1 conveyed by the conveyor 10. In each carriage 22, a head unit 21 including a plurality of nozzles N (see FIG. 2) which eject ink is fixed. The openings of the nozzles N in the head units 21 are aligned on a surface facing the first recording medium M1 (ink ejecting surface) throughout the entire width (Width in which recording can be performed in the width direction. There may be some margin in both ends or one end) of the conveyed first recording medium M1. The number of nozzles N included in each of the six head units 21 is suitably determined according to a recording resolution or the size of the first recording medium M1 with which recording can be performed in the inkjet recording apparatus 100. The plurality of carriages 22, that is, the recording operators 20 are provided in positions different from each other in the conveying direction. The carriage 22 is provided so that the position in the Z-direction can be changed by the carriage elevator 23, and the distance of the head unit 21 from the conveying surface (space between ink ejecting surface and conveying surface) is changed with the movement of the carriage 22. Each recording element 26 performs a recording operation (ejects ink) and the ink is ejected from the nozzle. With this, an image is recorded on the first recording medium M1.

[0030] The carriage elevator 23 changes the distance of the carriage 22 (head unit 21) from the conveying surface (conveying path of the recording medium). The carriage elevator 23 includes an elevator motor 232, an electromagnetic brake 233, a beam member 234, and a supporter 235.

[0031] Two beam members 234 are provided above (+Z-direction) the conveying belt 12 to be substantially parallel to a direction intersecting with an X-direction (here, orthogonal width direction), that is, a Y-direction. The supporter 235 is fixed in both ends of the beam member 234. The elevator motor 234, the electromagnetic brake 233, and the carriage 22 are attached to the supporter 235. A straight rail which is not illustrated is included in the beam member 234 along the extending direction of the beam member 234 (Y-direction). The inspection recorder 28 and the maintenance operator 53 are able to move along the rail.

[0032] The carriage 22 is raised or lowered according to the operation of the elevating motor 232 and the electromagnetic brake 233 driven based on the control signal from the controller 60 (see Fig. 3), and the position is determined.

[0033] The elevating motor 232 moves the carriage 22 at a predetermined elevating speed. For example, a servo motor or a stepping motor is used as the elevating motor 232.

[0034] The electromagnetic brake 233 maintains the fixed state of the carriage 22. When the fixed state is released in response to the driving signal, the movement of the carriage 22 by the elevating motor 232 becomes temporarily possible. That is, in a normal state including when the electric power supply is cut, the electromagnetic brake 233 fixes the carriage 22. For example, a disc brake is used as the electromagnetic brake 233.

[0035] The ink supplier 30 stores ink of each color used for recording the image and supplies the ink to the head unit 21. Here, an ink storage tank 31 for each color is positioned in a dedicated rack 32, and the ink storage tank 31 is connected to the head unit 21 through pipes such as tubes, and the ink of each color is ejected. The ink of each color is ejected as fine dots from the nozzle of each head unit 21 supplied with ink and landed on the first recording medium M1. A mixed color image is recorded by expression according to the number of fine dots, the density according to the size of the dot (liquid amount) or a combination of the above. The color of the ink stored in the ink storage tank 31 and supplied to the head unit 21 can be exchanged.

[0036] The first imager 41 is provided on a downstream side in a conveying direction with relation to the recording operator 20, and the surface of the first recording medium M1 in which the image is recorded by the recording operator 20 (or passed without recording) is imaged and read. The first image 41 may include a lamp (not shown). The lamp evenly illuminates the imaging surface (surface of the first recording medium M1) imaged by the first imager 41.

[0037] For example, the first imager 41 includes a one-dimensional imaging sensor. Here, in the one-dimensional imaging sensor, a plurality of imaging elements are positioned at least throughout the width of the conveying belt 12 in the width direction. The first recording medium M1 moves in the conveying direction by the operation of the conveyor 10, and the first imager 41 is able to two-dimensionally image the first recording medium M1. A CCD sensor (Charge Coupled Device) or a CMOS sensor (Complementary Metal Oxide Semiconductor) is used as the imaging sensor. Such imaging sensor performs an imaging operation in each imaging element by outputting a charge amount or voltage according to the amount of light input in the light receiving element from the surface of the first recording medium M1 through an optical system (lens). Here, the imaging sensor is able to image at each wavelength band (plurality of wavelength bands) of RGB, and a color read image can be obtained by the first imager 41. Similar to the carriage 22, the distance of the first imager 41 from the conveying surface can be changed.

[0038] When the head unit 21 is separated from the conveying surface, the maintenance operator 53 is able to move between the head unit 21 and the conveying surface in the Y-direction. The maintenance operator 53 performs maintenance of the ink ejecting surface of the head unit 21, specifically, the operation regarding cleaning. Here, the maintenance operator 53 performs the wiping operation of the ink ejecting surface as the operation regarding cleaning.

[0039] The inspection recorder 28 stores a second recording medium M2 (see FIG. 3; second recording medium) inside, and the upper surface side (+Z-direction) is open so as to expose the second recording medium M2. When the recording operation of the predetermined test image is performed by the head unit 21, the inspection recorder 28 moves between the head unit 21 and the conveying surface so as to be able to record the test image on the second recording medium M2. According to the present embodiment, the movement of the inspection recorder 28 is performed together with the movement of the maintenance operator 53. The movement of the inspection recorder 28 is performed by the control of the controller 60 in a state in which the bottom of the carriage 22 (head unit 21) is separated by the operation of the carriage elevator 23 a predetermined distance or more from the conveying surface of the first recording medium M1 so as to be suitable for performing the maintenance operation or recording the test image.

[0040] The second imager 42 is positioned on the moving path of the inspection recorder 28 in the Y-direction along the rail of the beam member 234, and images the surface of the second recording medium M2. One second imager 42 is provided in each recording operator 20 (here, a total of six), and this is to be a line head for each of the second recording medium M2. The configuration of the second imager 42 is to be the same as the first imager 41 with the exception of the imaging being possible along the width in which the head unit 21 is able to record on the second recording medium M2 (read width). When one or all of the ink colors ejected by the head units 21 is fixed, the second imager 42 only needs to include a sensitivity at a wavelength according to the color of the ejected ink, and the imaging operation does not have to be performed for all three colors of RGB.

[0041] FIG. 2 is a bottom diagram showing a surface facing the conveying surface in the head unit 21.

[0042] Here, the head unit 21 of each color is formed in the same shape and has the same configuration. Therefore, the description below is based on any one of the head units 21.

[0043] The head unit 21 includes a plurality of recording heads 211, here, 8 recording heads 211. The openings of a plurality of nozzles N are arranged with a predetermined interval (nozzle pitch) between each other in a Y-direction (third direction, here, the same as the second direction (parallel)) on the bottom of the recording heads 211. The opening positions of the nozzle N may be positioned in different positions in the X-direction as long as the opening positions are arranged with a predetermined interval in the Y-direction. Here, in each recording head 211, the openings of the nozzles N are positioned in a hound's tooth shape. That is, the nozzles N are positioned as nozzle rows extending in the Y-direction (arrangement of a predetermined number of 2 or more nozzles N in the same position in the X-direction) in 4 locations (2 rows in each recording head 211 throughout a unit of 4 (plurality) recording heads 211) in the X-direction (fourth direction orthogonal to the Y-direction).

[0044] The number and size of the openings of the nozzles N shown in each figure in the drawings hereafter are for the purpose of description only. In reality, the number of openings of the nozzle N may be larger, and the size of the openings of the nozzles N may be smaller compared to the width of the positioned range in the width direction of the nozzle N. Both ends of the head unit 21 in the Y-direction are fixed to the carriage 22.

[0045] The 8 recording heads 211 included in one head unit 21 are positioned in a hound's tooth shape in different positions. According to the above, the positioning ranges of the openings of the nozzles N in each recording head 211 in the Y-direction are positioned different from each other. With this, each can record the image in ranges different from each other. The ends of the positioning range in the Y-direction regarding the nozzles N in the adjacent recording heads 211 are slightly overlapped. Therefore, in the head unit 21, by combining the recording

range in the Y-direction for each of the eight recording heads 211, the ink can be ejected from the plurality of nozzles at the above nozzle pitch throughout the entire width of the first recording medium M1 in the width direction (there may be a slight margin in both ends).

[0046] FIG. 3 is a perspective view which describes an inspection recorder 28 and a maintenance operator 53.

[0047] Together with a supporting base 54, the maintenance operator 53 is a portion of a maintenance unit 50. The maintenance operator 53 is positioned on the supporting base 54. The inspection recorder 28 is positioned on the supporting base 54. Here, the inspection recorder 28 is positioned in the -Y-direction than the maintenance operator 53. The supporting base 54 moves along the rail in the Y-direction and the maintenance operator 53 and the inspection recorder 28 move in the Y-direction at the same time.

[0048] The inspection recorder 28 includes a rolling operator 16 (relative mover) of the second recording medium M2. Although not limited, in one inspection, the inspection image is recorded in the exposed surface in a state in which the exposed surface of the second recording medium M2 is fixed. After the inspection ends, the second recording medium M2 is rolled for one inspection by the rolling operator 16 before the next inspection starts. The second recording medium M2 is moved relatively with relation to the inspection recorder 28, and the recording surface which is not used is exposed. When the entire second recording medium M2 is rolled and used, the second recording medium M2 can be exchanged to a new one.

[0049] FIG. 4 is a block diagram showing a functional configuration of the inkjet recording apparatus 100.

[0050] The inkjet recording apparatus 100 includes a conveyor 10, a recording operator 20, a detector 40, a maintenance unit 50, a controller 60, a storage 70, a communicator 81, a display 82, and an operation receiver 83. The conveyor 10 includes the above-described conveying driver 14. The detector 40 includes the above-described first imager 41 and second imager 42.

[0051] In addition to the above-described configuration, the recording operator 20 includes a carriage driver 24 and a head driver 25. The carriage driver 24 outputs a driving signal to the above-described elevating motor 232 and electromagnetic brake 233 and operates or fixes the above. An electromechanical converting element 252 and nozzle N are included in a recording element 26. The mover according to the present embodiment includes a carriage elevator 23 and a carriage driver 24.

[0052] The head driver 25 determines whether to output from a driving signal generator (not shown) a driving waveform signal with a predetermined pattern output periodically synchronized with a clock signal to the recording elements 26 based on the image data of the recording target (when there are a plurality of types of driving waveform signals, determines which one is output), and performs switching. The electromechanical converting element 252 (here, piezoelectric element) operates (deforms) in response to the input driving waveform signal, and causes the pressure of the ink to change in the nozzle N and in the ink flow path in communication with the nozzle N. The predetermined pattern of the driving waveform signal is not limited and examples include a pulse waveform in a trapezoidal wave or a rectangular wave. The ink pressed out from the nozzle N by the deforming operation of the electromechanical converting element 252 by the driving waveform signal (recording operation of the recording element 26) is separated from the ink in the ink flow path in a suitable amount, and ejected as an ink droplet. The amount of ejected ink (droplet amount) can be set in a plurality of stages.

[0053] In addition to the above-described second imager 42, the detector 40 includes an encoder 43. The encoder 43 detects the rotation of the driving motor of the conveying driver 14 or the driving roller 11 and outputs a signal according to the rotating direction for each rotation in a predetermined angle. The detector 40 may be able to separately calculate the moved amount of the supporting base 54 along the rail.

[0054] The maintenance unit 50 includes a supporting base mover 51 and an ink receiver driver 52.

[0055] The supporting base mover 51 includes a motor which moves the supporting base 54 along the rail. The moved amount by the supporting base mover 51 is able to measure with the detector 40 as described above. The inspection recorder 28 and the supporting base mover 51 are included in the second conveyor according to the present embodiment.

[0056] The ink receiver mover 52 moves an ink receiver 55 (see FIG. 9(b)) to a space between the head unit 21 and the conveying surface and evacuates the ink receiver 55 from the space. The ink receiver 55 receives waste ink forcibly discharged or flown out from the nozzle N and guides the ink to a waste tank. The ink receiver 55 not only receives the waste ink but is also used to moisturize the area near the opening of the nozzle N.

[0057] The controller 60 centrally controls the entire operation of the inkjet recording apparatus 100. The controller 60 includes a CPU 61 (Central Processing Unit) and a RAM 62 (Random Access Memory). The controller 60 performs various processes regarding the image recording based on image data and status signals and clock signals of the units. The controller 60 performs processes such as inspection and operation adjustment regarding the ink ejection from the nozzles N.

[0058] The CPU 61 performs various calculating processes and controls the following processes in the inkjet recording apparatus 100 such as conveying, supplying of ink, ejecting of ink, and imaging operation of the recording image regarding the first recording medium M1, movement, imaging operation and analysis of the imaging result regarding the second recording medium M2, and maintenance. The CPU 61 performs calculation and control of the various processes according to the program read from the storage 70.

[0059] The RAM 62 provides a memory space for work

in the CPU 61 and stores temporary data. The storage region of the temporary data can be suitably divided with the DRAM region of the storage 70.

[0060] The storage 70 stores the program 71, various setting data, and the job data 74 regarding the image recording instruction. The job data 74 includes, recording target image data, processed data of such recording target image data, information regarding the operation setting, etc. The program 71 includes, a program to specify the nozzle in which an abnormality is occurring in the ejecting state of the ink (abnormal nozzle), various image processing programs, an abnormal nozzle complementary process program, etc. Setting data includes, predetermined inspection image data 72 for inspection, abnormal nozzle list 73 showing a position of the abnormal nozzle, etc.

[0061] The storage 70 includes a volatile memory such as a DRAM and a nonvolatile memory. The temporary data such as the job data 74 and the processing data can be stored in the volatile memory, processed with high speed, and erased after finishing the image recording operation. The program 71, the setting data, etc. are stored in the nonvolatile memory, continues to be stored even if there is no supply of electric power to the inkjet recording apparatus 100, and the above are readout to the RAM 62, etc. as necessary. Some programs, setting data, etc. such as initial data, core programs, etc. can be stored in a ROM which is not erasable and not rewritable instead of the nonvolatile memory.

[0062] The communicator 81 is a communication interface which controls the operation of communication with the external devices. For example, as the communication interface, one or a plurality of network cards, etc. corresponding to various communication protocols such as a LAN card for example is included. Based on the control by the controller 60, the communicator 81 is able to obtain the job data including the image data of the recording target and the setting regarding the image recording from external devices and is able to transmit the status information to external devices.

[0063] The display 82 performs the display such as the status and the operation menu of the inkjet recording apparatus 100 on the display screen in response to the control signal from the controller 60. An example of the display screen is a liquid crystal display screen. The display 82 may include an LED (Light Emitting Diode) lamp or the like which turns on (or flashes) in response to whether electric power is supplied and/or warning of an error, etc.

[0064] The operation receiver 83 receives the operation from the user and performs an output to the controller 60. For example, the operation receiver 83 includes a touch sensor. The touch sensor is provided overlapped on the display screen of the display 82, and may be used as a touch panel. The operation receiver 83 outputs the information of the position and the type regarding the touch operation detected by the touch sensor to the controller 60. The operation receiver 83 may include a press button switch and/or numeric keys.

[0065] Next, the ejecting inspection from the nozzles N in the inkjet recording apparatus 100 according to the present embodiment is described.

[0066] The inkjet recording apparatus 100 performs inspections regarding whether the operation of ink ejecting from the nozzle N is performed normally. The inspections are performed periodically, before starting each job or each time after the recording operation is performed a predetermined number of times. Such inspection is performed by recording a predetermined test image on a recording medium and imaging and analyzing the test image. When the test image is recorded on a normal first recording medium M1, using expensive recording media is too good for the test image. Therefore, the test image is recorded on the second recording medium M2.

[0067] FIG. 5A to FIG. 5D are diagrams describing the operation procedure when the inspection regarding the abnormality of ejecting ink is performed. Here, the drawing shows one of the carriages 22 (head unit 21) viewed from a downstream side in the conveying direction (+X side). The same operation can be performed in any of the carriages 22 (head unit 21).

[0068] As shown in FIG. 5A, in the normal image recording operation, the carriage 22 is positioned so that the ink ejecting surface of the head unit 21 is positioned near the upper surface (conveying surface) of the conveying belt 12. As shown in FIG. 5B, when the recording operation of the test image is performed, the carriage 22 is moved by the carriage elevator 23 in the +Z direction, and the ink ejecting surface is separated from the conveying surface.

[0069] Then, as shown in FIG. 5C, the supporting base 54 is moved in a +Y-direction in a separated space along the rail from a standby position (initial position) on one side of the head unit 21 in the Y-direction. Here, the maintenance operator 53 positioned in the +Y side comes into contact with the ink ejecting surface first and wipes the ink ejecting surface. Then, the inspection recorder 28 faces the portion of the ink ejecting surface which is wiped. The ink is sequentially ejected from the opening of the nozzle N facing the second recording medium M2 of the inspection recorder 28 and the test image is recorded on the second recording medium M2.

[0070] As shown in FIG. 5D, when the supporting base 54 passes from one end side to the other end side of the head unit 21, the exposed portion of the second recording medium M2 is imaged by the second imager 42 and read. That is, the supporting base 54 and the inspection recorder 28 (second recording medium M2) are to simply move in a straight line, and here, the recording and imaging of the test image are performed continuously during the straight line movement in one direction. When the imaging by the second imager 42 ends, the supporting base 54 is returned to the original standby position by moving back in the opposite direction (-Y-direction). When moved in the opposite direction, the head unit 21 can be evacuated further upward or the maintenance op-

erator 53 can be stored downward so that the maintenance operation is not performed. The speed when moved in the opposite direction can be faster than the speed when moving while performing the maintenance operation and the recording operation of the test image.

[0071] FIG. 6A and FIG. 6B are diagrams which describe a test image.

[0072] As described above, the width of the exposed second recording medium M2 in the Y-direction is shorter than the width of the head unit 21 in the Y-direction. Therefore, the test image is recorded in a more packed row than the actual nozzle pitch P1. FIG. 6A schematically shows a comparison between the bottom of the recording head 211 and the test image on the second recording medium M2.

[0073] In the test image as described above, whether the ink is ejected from the nozzle (whether ejection is normal) is specified. Therefore, the position where the droplets from each nozzle N lands needs to be different. Here, an interval W1 (landing interval) in the Y-direction between the landing positions in the test image is determined to be smaller (narrower) than the nozzle pitch P1 and to be equal to or larger than an opening size P2 of the nozzles N. The arrangement of the nozzles in the recording head 211 is to be a hound's tooth shape as described above. However, in the test image on the second recording medium M2, the landing positions do not have to be shifted from each other in the Y-direction.

[0074] As shown in FIG. 6B, the test image shows two landing rows extending in the same direction for each recording head 211. Each group of landing rows for 8 recording heads 211 are positioned in a two-dimensional matrix shape of 2×4. That is, the landing rows are arranged in a two-dimensional matrix shape of 4×4 (here, only a portion is displayed). In the analysis of the test image, the recording head 211 and the nozzle row are specified by the relation of the positions among the landing rows, and the nozzle N in which the ejection abnormality is occurring is specified according to the distance from the end of each landing row to the position in which the abnormal density is detected. Here, the landing rows (distance between the nozzles in different recording heads 211) regarding the 4 nozzle rows of the 4 recording heads 211 in the same position in the X-direction are aligned with a slight space W3. The space W3 does not have to be large and is to be slightly larger than the interval W1 between nozzles in the same recording head 211 (first landing interval). However, if the space W3 is an integral multiple of the interval W1, it may become difficult to identify the ejection abnormality. Therefore, the space W3 may be a non-integer multiple of the interval W1, specifically, $(k + 0.5)$ times (k is a natural number), for example.

[0075] When the test image is analyzed, and the ejection abnormality occurs in the nozzle N positioned at the end of the landing row, it may not be easy to identify in which end the nozzle in which abnormality occurred is positioned. Here, the droplets are ejected normally in a left end IL and a right end IR of a line L1 but there is a missing portion VR in which there is no ink ejection in a right end of the L2. In this case, when absolute coordinates of the left end are not specified, it is not possible to specify whether the missing portion of ejecting is occurring in the left end or the right end of the line L2.

[0076] In the inkjet recording apparatus 100 according to the present embodiment, the length of the line of the landing rows are measured, and when the measured length is within a normal range, it is specified that normal ink ejection (landing) is performed in both ends of the nozzle row regarding that line. As the reference of the landing row, one end is to be the reference position and the position of the end on the same side in other landing rows are all specified. With this, even if there is a missing portion of ejecting in at least either one end of both ends in each line, the missing portion is determined to be the reference position, and the position in which there is a missing portion of ink ejection is specified among the nozzles including the end of the nozzle row.

[0077] Here, regarding the line L1, the length from the left end IL to the right end IR is determined to be normal. Therefore, one end, for example, the position of the left end IL is specified as the reference position based on the above. From this reference position, based on the distance Y1 to the missing portion VP in which the line shaped density change is occurring and the interval W1, the nozzle N in which the ink ejection is missing is specified. Regarding the line L2, it is specified that the ink ejection from the right end nozzle N is missing according to the distance to the missing portion VR using the left end as the reference.

[0078] Instead of specifying the reference position for each nozzle row (landing row), the reference position can be specified for each recording head 211, that is, in a unit of 2 nozzle rows (a plurality of landing rows) of the recording head 211. In this case, the position of the landing row of the recording head 211 as the reference is specified according to whether the distance between 2 diagonal points (diagonal points) in 2 lines corresponding to the 2 nozzle rows is normal (that is, landing normally in the 2 diagonal points). Here, an upper left point IUL and a lower right point IUR in 2 landing rows at the lower right are positioned in a correct distance according to normal ink ejection. Therefore, the point IUL is to be the reference position, for example. The nozzle N corresponding to the missing portion VQ is specified by the distance X1 in the X-direction from the point IUL and the distance Y2 in the Y-direction. Moreover, the assumed position of each landing row is determined by the relation of the positions with the landing rows by the recording head 211. Therefore, for example, the position of the upper left point IL is determined using the position of the point IUL as the reference and the position of the missing portion VP and the corresponding nozzle N are specified using the position of the point IL as the reference.

[0079] FIG. 7 is a flowchart showing a control procedure by the controller 60 regarding the ejection abnor-

mality detecting process executed in the inkjet recording apparatus 100 according to the present embodiment. Here, the ejection abnormality detecting process starts automatically or based on a predetermined input operation on the operation receiver 83 by the user.

[0080] When the ejection abnormality detecting process starts, the controller 60 operates the carriage driver 24 and evacuates the head unit 21 (carriage 22) upward (Z-direction) (step S101). The controller 60 operates a rolling driver 17 and rolls the second recording medium M2, exposes an unused surface and sets the second recording medium M2 (step S102).

[0081] The controller 60 controls the supporting base mover 51 to start the moving operation of the supporting base 54 (second recording medium M2) in the Y-direction. The controller 60 operates the maintenance operator 53 to perform the wiping operation of the ink ejecting surface and allows the ink to be ejected from the nozzle N after wiping (after maintenance) to record the test image on the second recording medium M2 (step S103). The controller 60 allows the supporting base 54 to continue to move, and controls the second imager 42 to image the test image on the second recording medium M2 (step S104). The controller 60 may reverse the moving direction of the supporting base 54 and return the supporting base 54 to the standby position.

[0082] The controller 60 detects the length of each landing row, extracts those with a normal length, and specifies the above as a reference row (step S105). The controller 60 detects the ejection abnormality based on the density distribution of the landing rows, and specifies the nozzle N in which the ejection abnormality is occurring from the relative position based on the reference coordinates of the reference row in the detected position (step S106). When there are no normal landing rows, and the reference row is not specified, the controller 60 may perform a predetermined abnormality notification operation such as a display on the display 82 notifying the abnormality without specifying the nozzle with the ejection abnormality, and end the process.

[0083] The controller 60 determines whether the detected ejection abnormality can be complemented by a setting of complementing ejection using surrounding nozzles (step S107). When it is determined that the complementing setting is possible ("YES" in step S107), the controller performs the complementing setting (step S108) and ends the ejection abnormality detecting process. When it is determined that the complementing setting is not possible ("NO" in step S107), for example, when the nozzle adjacent to the detected abnormal nozzle is already an abnormal nozzle, the controller 60 performs a predetermined abnormality notification operation, for example, the controller 60 controls the display 82 to display the above (step S109). Then, the controller 60 ends the ejection abnormality detecting process.

[0084] FIG. 8A to FIG. 8E and FIG. 9A to FIG. 9E are diagrams showing a modification of the detecting operation of the ejection abnormality.

[0085] In the modification 1 shown in FIG. 8A to FIG. 8C, the second imager 42 is positioned on the same side as the standby position of the supporting base 54. In FIG. 8A and FIG. 8B, the evacuation of the head unit 21, the maintenance operation, and the recording operation of the test image are similarly performed as in the above-described embodiments. When the maintenance operation and the recording operation of the test image ends, as shown in FIG. 8C, the supporting base 54 moves in the opposite direction to the side of the standby position, and imaging of the test image is performed by the second imager 42 right before the supporting base 54 returns to the standby position.

[0086] According to the modification 2 shown in FIG. 8D and FIG. 8E, the inspection recorder 28 is positioned alone on the supporting base 54 and the maintenance operator 53 is not provided. The maintenance operator 53 may be positioned on a different supporting base which moves independently. Moreover, the two second imagers 42a and 42b are positioned on the outer side of both ends of the head unit 21 (carriage 22) in the Y-direction. The supporting base 54 can standby in both sides of the head unit 21. When the ejection abnormality is detected, the test image is recorded on the second recording medium M2 while moving from one standby position, and the test image is imaged by either the second imager 42a or 42b which is positioned right before the other standby position. In this case, there is no need to move the supporting base 54 in the opposite direction and to return the supporting base 54 to the original standby position after imaging, and the supporting base 54 only needs to move one way. The maintenance operator 53 may perform the maintenance separately as necessary, and does not always have to perform the maintenance before recording of the test image.

[0087] The modification 3 is shown in FIG. 9A to FIG. 9E. Here, the second imager 42 is positioned on the side of one end (left in diagram) of the head unit 21 and this is the same side as the standby position of the supporting base 54. In such modification 3, as shown in FIG. 9A, after the head unit 21 (carriage 22) is evacuated upward, as shown in FIG. 9B, the ink receiver 55 faces or covers the ink ejecting surface at a close distance, the ink is discharged from the nozzles N, and dirty ink is discharged near the opening of the nozzle N before recording the test image.

[0088] As shown in FIG. 9C, only the maintenance operation (wiping operation of ink ejecting surface) by the maintenance operator 53 is performed in response to the movement of the supporting base 54, and the head unit 21 moves to the other end side (right in the diagram). Then, as shown in FIG. 9D, when the supporting base 54 moves in the opposite direction to the one end side, the test image is recorded on the second recording medium M2 of the inspection recorder 28. After arriving to the one end, as shown in FIG. 9E, the test image is imaged by the second imager 42.

[0089] As described above, the inkjet recording appa-

ratus 100 according to the first embodiment includes a head unit 21 which includes a nozzle N and which ejects ink from the nozzle N, a conveyor 10 which conveys a first recording medium M1 in a X-direction facing an ink ejecting surface of the head unit 21, a supporting base mover 51 and an inspection recorder 28 as a second conveyor which moves the second recording medium M2 between the head unit 21 along the Y-direction and the conveying path of the first recording medium M1, and a second imager 42 which is positioned on a moving path along a Y-direction of the second recording medium M2, and which images the surface of the second recording medium M2 throughout a recordable width of the head unit 21 on the second recording medium M2 in a direction intersecting with the Y direction (here, X-direction).

[0090] As described above, the recording of the test image and the imaging of the test image can be performed by the head unit 21 with the one-dimensional movement of the second recording medium M2 in the Y-direction without changing the position of the second imager 42 in the XY plane. Therefore, the second conveyor which tends to need a large amount of space for mechanical reasons and structural reasons in order to move structures with high accuracy can be provided in a compact form. Consequently, the inkjet recording apparatus 100 can perform inspections and adjustments easily and with low costs.

[0091] The inkjet recording apparatus 100 includes a controller 60 which moves the second recording medium M2, which records the test image on the second recording medium M2 using the head unit 21, and which images the test image with the second imager 42.

[0092] The control contents by the controller 60 regarding the inspection and adjustment and the operation contents according to the control by the controller 60 becomes easy as described above. With this, the structure of the inkjet recording apparatus 100 can be made smaller and the costs can be effectively reduced.

[0093] The controller 60 moves the second recording medium M2 back and forth along the Y-direction with the second conveyor, and returns the second recording medium M2 to the initial position after recording and imaging the test image. As described above, the initial position is determined in one end of the one-dimensional operation. Therefore, the control is easy, a large amount of space is not necessary, and a compact inkjet recording apparatus 100 can be obtained.

[0094] The controller 60 performs the recording of the test image and the imaging during the moving in either one direction along the Y-direction. That is, the imaging is performed right after the recording operation. Therefore, the analysis result can be obtained within a short time, and the standby time can be shortened.

[0095] Alternatively, each of the second imagers 42a and 42b is positioned on the outer side of each end of the head unit 21 in the Y-direction, and the controller 60 moves the second recording medium M one way from one to the other of the ends each time the recording and the imaging of the test image are performed.

[0096] The inkjet recording apparatus 100 includes a carriage elevator 23 and a carriage driver 24 as a mover which moves the head unit 21 in a Z-direction which changes the distance from the conveying path of the first recording medium M1. The second conveyor moves the second recording medium M2 in a state in which the head unit 21 and the carriage 22 are separated a predetermined distance or more from the conveying path by the mover.

[0097] That is, when the normal image recording operation is performed on the first recording medium M1, there is no need to insert the second recording medium M2 between the head unit 21 and the first recording medium M1. The head unit 21 is to be positioned to obtain the suitable distance depending on whether the recording operation is performed on either the first recording medium M1 or the second recording medium M2, and the image is to be recorded with the suitable image quality. When the test image is recorded on the second recording medium M2, the image recording can be performed at the distance the same as when the normal image is recorded on the first recording medium M1.

[0098] The inkjet recording apparatus 100 includes a maintenance operator 53 which performs maintenance of the head unit 21. The second conveyor moves the second recording medium M2 together with the maintenance operator 53. By performing the operator together, the components regarding the movement do not need to be increased. Especially in the inkjet recording apparatus 100 which conventionally includes a maintenance operator 53, there is no need to further increase the components for moving the second recording medium M2, and the cost and the burden of assembly can be reduced.

[0099] When the second recording medium M2 moves, the controller 60 controls the maintenance operator 53 to perform maintenance. While the maintenance operator 53 performs maintenance, the controller 60 performs control to eject the ink from the nozzle N in which maintenance is already performed and to record the test image on the second recording medium M2. As described here, the maintenance operation is performed right before the recording operation of the test image is performed. Therefore, the test image is obtained in a state in which the abnormalities that easily recover from performing maintenance is solved. With this, it is possible to handle serious abnormalities quickly without repeated efforts. Moreover, the maintenance, inspection and adjustment can be performed collectively with one movement of the supporting base 54. With this, the efficiency is enhanced.

[0100] The maintenance 53 includes an ink receiver 55 which receives ink ejected from the head unit 21. When the head unit 21 records the test image, the controller 60 allows each of the nozzles N to discharge ink to the ink receiver 55 before recording the test image. As described above, the dirty ink in the nozzle N is replaced with fresh ink before the recording operation of the test image. Therefore, the risk of abnormalities due to ink

occurring can be reduced in advance before performing the inspection regarding the abnormality of ejection of ink. With this, the efficiency of inspection can be enhanced.

[0101] In the head unit 21, a plurality of nozzles N are aligned in a third direction intersecting with the X-direction which is the conveying direction of the first recording medium M1, here the Y-direction, with a predetermined interval W1 (nozzle pitch). This third direction is parallel with the second direction in which the second recording medium M2 is moved. By moving the second recording medium M2 in this direction, the width of the recording medium and the imaging width of the second imager 42 can be made narrower compared to the number of nozzles. With this, a compact structure can be obtained.

[0102] The head unit 21 includes a predetermined number of nozzles, the predetermined number being 2 or more in the same position in the fourth direction orthogonal to the Y-direction which is the moving direction of the second recording medium M2 (that is, X-direction). In the test image, the landing positions from a predetermined number of nozzles are aligned in a row with landing intervals which are narrower than the nozzle pitch P1 of the predetermined number of nozzles N and equal to or larger than the opening size P2 of the nozzle N.

[0103] As described above, the test image is recorded packed than the actual nozzle pitch P1 within a range that the ink ejected from each nozzle N can be discriminated. With this, the length of the second recording M2 in the Y-direction that needs to be used for recording the test image each time can be made shorter and the recording medium is not wasted. Even if the exposed surface of the second recording medium M2 is short, the test image can be recorded at once. Therefore, it is possible to obtain a more compact inkjet recording apparatus 100.

[0104] The head unit 21 includes the plurality of recording heads 211 each including nozzles N. The predetermined number of nozzles N are provided in a plurality of recording heads 211. The landing interval is a predetermined first landing interval (interval W1) among the nozzles N in the same recording head 211. The landing interval is the space W3 between the nozzles N in the different recording heads 211 and the space W3 is the non-integer multiple of the interval W1.

[0105] As described above, between the recording heads 211, the space W3 is set to be the non-integer multiple of the interval W1. Therefore, it is possible to easily discriminate the space due to the ejection abnormality (missing ejection) and the space between the recording heads 211.

[0106] The test image includes a plurality of landing rows in which ink droplets ejected from a plurality of nozzles N land with a predetermined landing interval (interval W1). The landing row in which the ink droplets landed normally in both ends among the landing rows is set to be the reference, and the controller 60 specifies the nozzle N corresponding to the ink droplet which did not land normally. Since it takes time to accurately read the absolute position of each landing position from the image data of the test image imaged by the second imager 42, by specifying the landing position from all of the nozzles N using the relative position with reference to the reference row in which the length between both ends is accurate so that the slight shift in the absolute position has no influence, the process can be performed easily.

[0107] Alternatively, when the plurality of landing rows each extend in the same direction and are arranged in a two dimensional matrix state (here, an arrangement of 4 $\times$ 4), the controller 60 may specify the nozzle corresponding to the ink droplet which does not land normally using the droplet which landed normally in the diagonal points in the group of plurality of landing rows aligned in the direction orthogonal to the extending direction of the landing row. It is possible to determine two points in which the accurate length can be obtained even if it is not always in a unit of each landing row as described above. Therefore, by using such references, it is possible to similarly and easily specify the landing position of each nozzle N.

[0108] When there is no landing row which is to be the reference, the controller 60 does not perform the specifying of the nozzle N including the ejection abnormality. In such case, obviously it is not easy to specify the landing position of each nozzle, and this means that there are many nozzles in which the ejection abnormality is occurring in specific positions. In most cases, it is difficult to output the recording image with high accuracy in such cases. Therefore, it is possible to consult the user or the manager of the inkjet recording apparatus 100 suitably and swiftly including decisions regarding the exchange of the recording head 211 (head unit 21).

[0109] The second conveyor includes a relative mover which moves the second recording medium M separately from moving along the moving path. According to such operation, the portion facing the recording head 211 (head unit 21) of the second recording medium M2 can be adjusted.

[Second Embodiment]

[0110] An inkjet recording apparatus 100a according to the second embodiment is described.

[0111] FIG. 10 is a perspective view showing an outer appearance of an inkjet recording apparatus 100a according to the second embodiment.

[0112] In such inkjet recording apparatus 100a, a carriage 22a is positioned on a conveyor 10a with a narrow width. A storage 29 is positioned in one end of the conveyor 10a. Short head units 21a (see FIG. 11) are aligned extending in the Y-direction in the carriage 22a. The inkjet recording apparatus 100a performs the image recording operation on the recording medium in a belt shape (ribbon shape) with a narrow width in the Y-direction compared to the inkjet recording apparatus 100 according to the first embodiment.

[0113] FIG. 11A to FIG. 11D describe the detection

operation of ejection abnormality in the inkjet recording apparatus 100a. FIG. 11A is a diagram schematically showing the relation of the positions when the carriage 22a is viewed from the lower side, and FIG. 11B to FIG. 11D describe the operation of each unit viewed from the front (+Y side).

[0114] As shown in FIG. 11A, in the carriage 22a, a plurality of (here, six) head units 21a extending in the Y-direction are aligned in positions different from each other in the X-direction. The first recording medium M1a is conveyed along the X-direction and the image is recorded by the ink discharged from each head unit 21a. Although not limited, each head unit 21a includes 2 recording heads 211, for example. A supporting base 54 and an imager 41a are positioned in the storage 29 at one end side of the conveying path of the first recording medium M1a. The maintenance operator 53 and the inspection recorder 28 are positioned on the supporting base 54, and the second recording medium M2 is exposed on the upper surface of the inspection recorder 28.

[0115] Here, the supporting base 54 can move in the X-direction from the storage 29 to the outside passing between the carriage 22a and the conveyor 10a. That is, the conveying direction (first direction) of the first recording medium M1a and the moving direction of the second recording medium M2 (second direction) are parallel.

[0116] As shown in FIG. 11B, when the image recording operation is performed, the head unit 21a (carriage 22a) is positioned near a conveying surface of the conveyor 10a. When the inspection of the ejection abnormality is performed, the carriage is evacuated in the +Z-direction, and the supporting base 54 is able to move between the carriage 22a and the conveying surface. In this case, the maintenance operator 53 performs the wiping operation in a direction orthogonal to the nozzle row. Moreover, the maintenance of the plurality of head units 21a can be performed by the common maintenance operator 53 and the test image can be written on the common second recording medium M2.

[0117] As shown in FIG. 11C, when the maintenance operation on the plurality (six) of head units 21a and the recording operation of the test image on the second recording medium M2 by the plurality of head units 21a finishes, the supporting base 54 moves in the opposite direction. Then, as shown in FIG. 11D, the imaging of the test image by the imager 41a in the storage 29 is performed. In this case, the imager 41a may image both the first recording medium M1a and the second recording medium M2. In order to adjust the focal position of the imager 41a, the imager 41a can be moved in the Z-direction, and the focus can be performed in a wide range.

[0118] FIG. 12 is a diagram showing an example of a test image recorded on the second recording medium M2. In this case, in the Y-direction, the landing positions of the ink droplets ejected from the recording head 211 are aligned with the same width as the nozzle pitch P1 in the recording head 211. In the X-direction, the landing rows can be recorded with the positioning interval of each head unit 21 packed. Here, an interval D1 of the landing rows between the head units 21 adjacent in the X-direction can be set to be sufficiently narrow in a range in which the landing rows can be specified, that is, a range wider than the opening size P2 of the nozzle.

[0119] The ejection abnormality detecting process in the inkjet recording apparatus 100a according to the present embodiment is the same as the ejection abnormality detecting process in the inkjet recording apparatus 100 according to the first embodiment shown in FIG. 7, and the description is omitted.

[0120] As described above, according to the inkjet recording apparatus 100a of the second embodiment, in the head unit 21, the plurality of nozzles N are aligned with a predetermined interval in the Y-direction intersecting with the X-direction which is the conveying direction of the first recording medium M1a. The moving direction of the second recording medium M2 is parallel to the conveying direction of the first recording medium M1a.

[0121] Depending on the width and the interval of the head unit 21, the second recording medium M2 can be moved in the same direction as the conveying direction of the first recording medium Mia as described above. With this, the common structure can be used as the supporting base mover 51 and the imager 41a for a plurality of head units 21.

[0122] The present invention is not limited to the above-described embodiments, and various modifications are possible.

[0123] For example, according to the above embodiments, only the test image is recorded on the second recording medium M2, but the configuration is not limited to the above. The discharge operation from some of the nozzles N (when the amount of liquid is small such as flashing) can be performed on the second recording medium M2 instead of the ink receiver 55.

[0124] According to the above embodiment, the second recording medium M2 is rolled each time the test image is recorded. However, when a plurality of test images can be recorded on one exposed surface, the second recording medium M2 does not have to be rolled each time. In this case, the recording position of the test image on the second recording medium M2 can be changed each time. On the other hand, when the test image does not fit in the exposed surface, the second recording medium M2 can be rolled or conveyed and moved during the recording of the test image. In this case, when the imaging by the second imager 42 is performed, the second recording medium M2 is rolled back and the imaging of the test image is performed.

[0125] According to the present embodiment, both the inspection recorder 28 and the maintenance operator 53 are placed on the supporting base 54 and moved together, but the above may be moved separately. For example, after the maintenance operation is performed, the supporting base 54 is evacuated, the entire area is covered by the ink receiver 55 to perform the ink discharge, and then the supporting base 54 is moved again to perform

the recording operation of the test image. Alternatively, the maintenance operation (including discharge of the ink) does not have to be performed before the inspection recorder 28 is moved and the test image is recorded and imaged.

[0126] After one movement back and forth to perform the recording operation by the inspection recorder 28, another movement back and forth can be performed to perform imaging by the second imager 42.

[0127] If the supporting base 54 (inspection recorder 28) moves one-dimensionally along a rail, the rail (first direction) does not have to be a complete straight line, and may include some curved portions. The movement of the supporting base 54 does not need to use the rail, and can be performed by using other members including another guide member or a belt.

[0128] The second recording medium M2 does not have to be rolled, and may be simply set each time in the inspection recorder 28.

[0129] The landing positions between the recording heads 211 does not have to be a non-integer multiple of the interval W1 between the landing positions within the recording head 211. The head unit 21 does not have to include a plurality of recording heads 211.

[0130] The test image pattern is not limited to the arrangement of the landing row shown in the above-described embodiments. Any test image pattern is possible if the landing positions of the ink droplets from the nozzles N can be specified.

[0131] According to the above-described embodiments, the reference is determined based on the distance between the positions of the diagonal points in 2 landing lines in 2 nozzle rows within the same recording head 211. Alternatively, diagonal points of 2 landing rows in any two nozzle lines can be used. That is, one nozzle row is chosen from each of the different recording heads 211, and the length connecting one end point of one landing row showing one nozzle row and another end point of another landing row showing another nozzle row can be the reference.

[0132] According to the above-described embodiments, the reference is determined based on the distance between the positions of both ends of the landing rows or the positions of the diagonal points of the plurality of landing rows, but the embodiments are not limited to the above, and other methods can be used. For example, an index for specifying the position can be provided by landing from a plurality of nozzles N. The shape of the index is to be a shape according to the shape of the landing position of the plurality of nozzles N, and can be any shape as long as the reference position can be specified even if the ink does not land in some of the positions.

[0133] The number of inspection recorders 28 and imagers 41a does not have to be one in the inkjet recording apparatus 100a according to the second embodiment. For example, the 3 head units 21 on the upstream side than the center and the 4 head units 21 on the downstream side can be examined by different inspection recorders 28 and imagers 41a.

[0134] According to the present embodiment, the rolling operator 16 and the rolling driver 17 rolls the second recording medium M2 in the second direction (Y-direction), but the rolling can be in a different direction. With this, in addition to the test image for detecting the ejection abnormality, various test images can be recorded. Moreover, the movement is not limited to rolling by the rolling operator 16, and the second recording medium M2 may simply be moved parallel with relation to the inspection recorder 28.

[0135] According to the present embodiment, an inkjet recording apparatus including a piezoelectric-type recording head 211 is described, but the embodiments are not limited to the above. For example, the ink can be ejected by other formats such as a thermal type.

[0136] The configuration and the control described in the first embodiment, the modifications 1 to 3 and the second embodiment can be combined with each other as long as there is no inconsistencies.

[0137] The specific configuration, the contents and procedures of the processes and the like described in the embodiments above can be suitably changed without leaving the scope of the present invention. The scope of the present invention includes the scope of the claims and its equivalents.

[0138] Although embodiments of the present invention have been described and illustrated in detail, the disclosed embodiments are made for purposes of illustration and example only and not limitation. The scope of the present invention should be interpreted by terms of the appended claims.

Claims

1. An inkjet recording apparatus comprising:

   an ink ejector which includes a nozzle and which ejects ink from the nozzle;
   a first conveyor which conveys a first recording medium in a predetermined first direction facing an ink ejecting surface of the ink ejector;
   a second conveyor which moves a second recording medium between the ink ejector and a conveying path of the first recording medium along a predetermined second direction; and
   an imager which is positioned on a moving path along the second direction of the second recording medium and which images a surface of the second recording medium throughout a width in which the ink ejector can record on the second recording medium in a direction intersecting with the second direction.

2. The inkjet recording apparatus according to claim 1, further comprising a controller which moves the second recording medium, which controls the ink ejector

to record a test image on the second recording medium, and which controls the imager to image the test image.

3. The inkjet recording apparatus according to claim 2, wherein, the controller controls the second conveyor to move the second recording medium back and forth along the second direction, and to return the second recording medium to an initial position after recording and imaging the test image.

4. The inkjet recording apparatus according to claim 2 or 3, wherein, the controller performs the recording and the imaging of the test image when the second recording medium is moved in either one direction along the second direction.

5. The inkjet recording apparatus according to claim 2, wherein,
the imager is positioned on an outer side of each end of the ink ejector in the second direction, and
the controller moves the second recording medium one way from one of both ends to the other of the both ends each time the recording and the imaging of the test image is performed.

6. The inkjet recording apparatus according to any one of claims 2 to 5, further comprising,
a mover which moves the ink ejector in a direction to change a distance of the first recording medium from the conveying path,
wherein, the second conveyor moves the second recording medium in a state in which the mover separates the ink ejector to be separated a predetermined distance or more from the conveying path.

7. The inkjet recording apparatus according to any one of claims 2 to 6, further comprising,
a maintenance operator regarding maintenance of the ink ejector, and
the second conveyor moves the second recording medium together with the maintenance operator.

8. The inkjet recording apparatus according to claim 7, wherein, when the second recording medium moves, while the controller controls the maintenance operator to perform maintenance, the controller allows the nozzle in which maintenance is performed to eject ink, and the controller records a test image on the second recording medium.

9. The inkjet recording apparatus according to claim 7 or 8, wherein,
the maintenance operator includes an ink receiver which receives ink ejected from the ink ejector, and when the test image is recorded by the ink ejector, the controller allows each nozzle to discharge ink to the ink receiver before recording the test image.

10. The inkjet recording apparatus according to any one of claims 2 to 9, wherein,
in the ink ejector, a plurality of nozzles are aligned in a third direction intersecting with the first direction with a predetermined interval, and
the third direction is parallel to the second direction.

11. The inkjet recording apparatus according to any one of claims 2 to 9, wherein,
in the ink ejector, a plurality of nozzles are aligned in a third direction intersecting with the first direction with a predetermined interval, and
the first direction and the second direction are parallel.

12. The inkjet recording apparatus according to any one of claims 2 to 11, wherein,
the ink ejector includes nozzles in a predetermined number of two or more in positions which are the same in a fourth direction orthogonal to the second direction, and
in the test image, landing positions from the predetermined number of nozzles are aligned in a row with a landing interval being narrower than an interval of the predetermined number of nozzles in the second direction and equal to or larger than a size of an opening of the nozzle.

13. The inkjet recording apparatus according to claim 12, wherein,
the ink ejector includes a plurality of recording heads each including a nozzle,
the predetermined number of nozzles are provided throughout the plurality of recording heads, and
the landing interval is a predetermined first landing interval between the nozzles in the same recording head, and the landing interval is a non-integer multiple of the first landing interval between the nozzles in the different recording heads.

14. The inkjet recording apparatus according to any one of claims 2 to 13, wherein,
the test image includes a plurality of landing rows in which ink droplets ejected from the plurality of nozzles land with a predetermined landing interval, and
the controller specifies the nozzle corresponding to the ink droplet which does not land normally by setting as a reference from among the landing rows a landing row which includes the ink droplets which lands normally in both ends.

15. The inkjet recording apparatus according to any one of claims 2 to 13, wherein,
the test image includes a plurality of landing rows in which ink droplets ejected from the plurality of nozzles are landed in a predetermined landing interval and the plurality of landing rows each extend in the same direction and are aligned in a two-dimensional

matrix shape, and
the controller specifies the nozzle corresponding to the ink droplet which does not land normally by setting as a reference a landing row which includes the ink droplet which lands normally in diagonal points in a group of a plurality of landing rows aligned in a direction orthogonal to a direction that the landing rows extend.

16. The inkjet recording apparatus according to claim 14 or 15, wherein, the controller does not perform the specifying when there is no landing row that is to be the reference.

17. The inkjet recording apparatus according to any one of claims 1 to 16, wherein, the second conveyor includes a relative mover which moves the second recording medium separately from movement along the moving path.

FIG.1

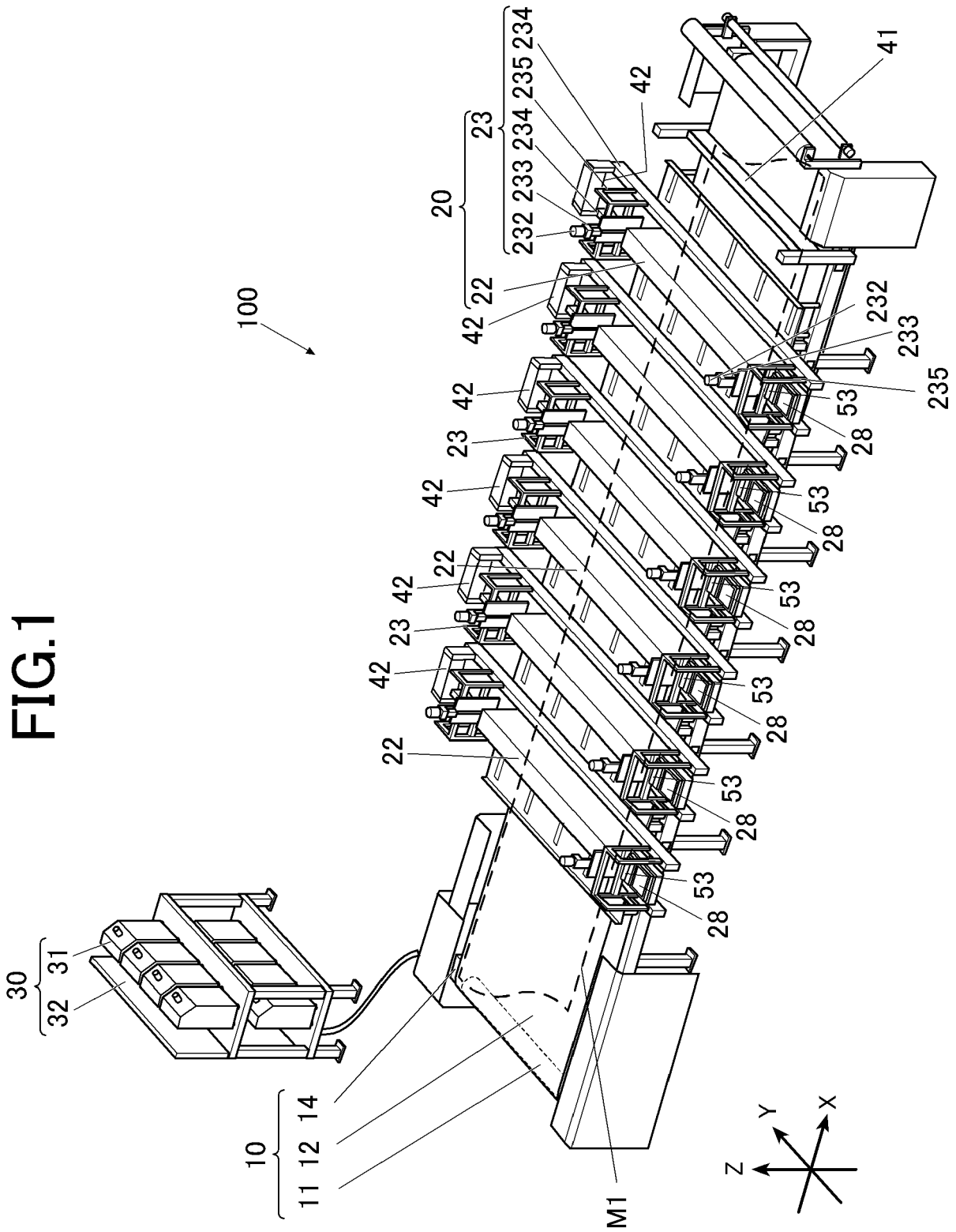


FIG.2

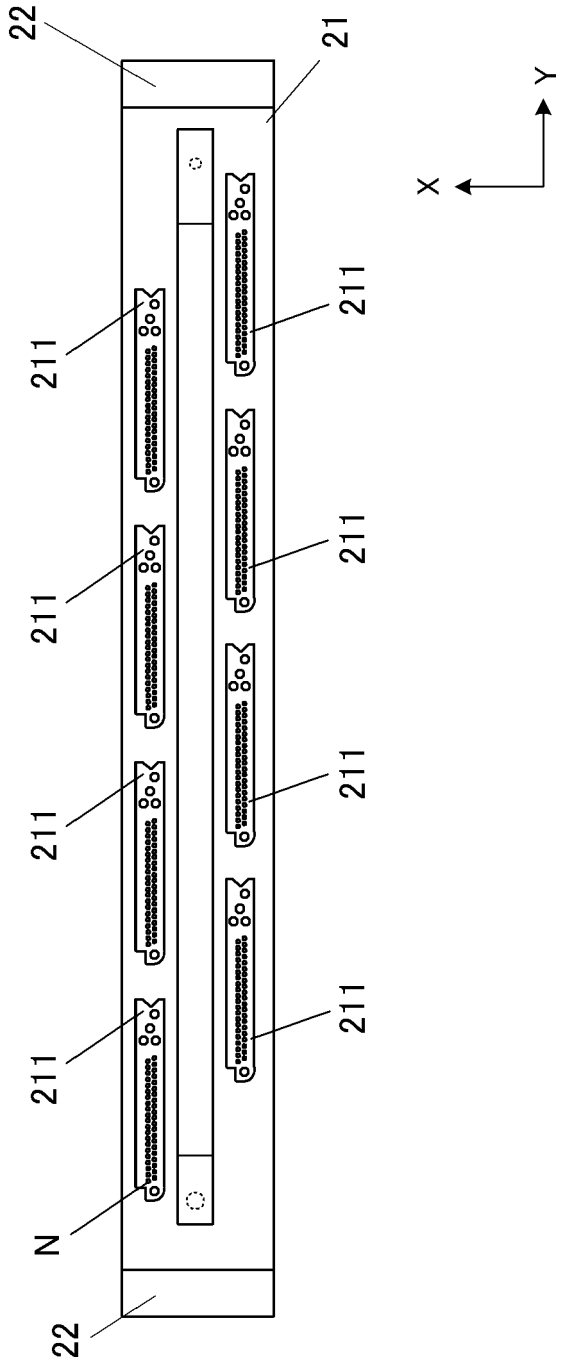


FIG.3

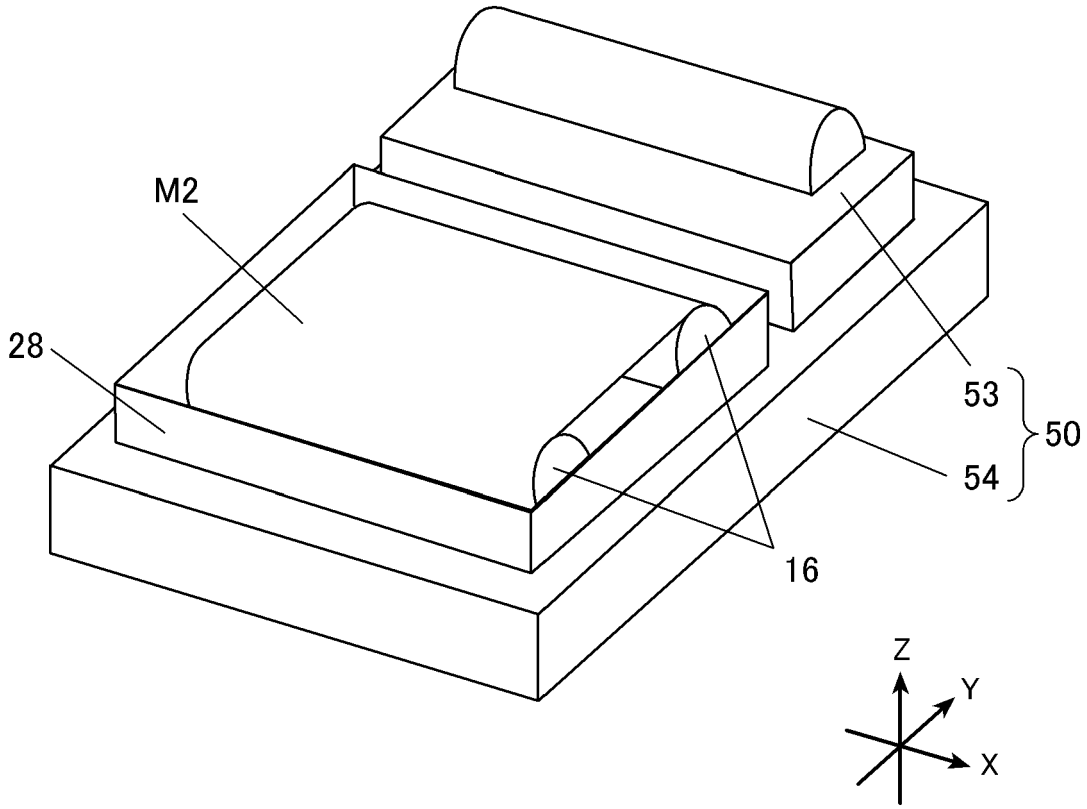


FIG.4

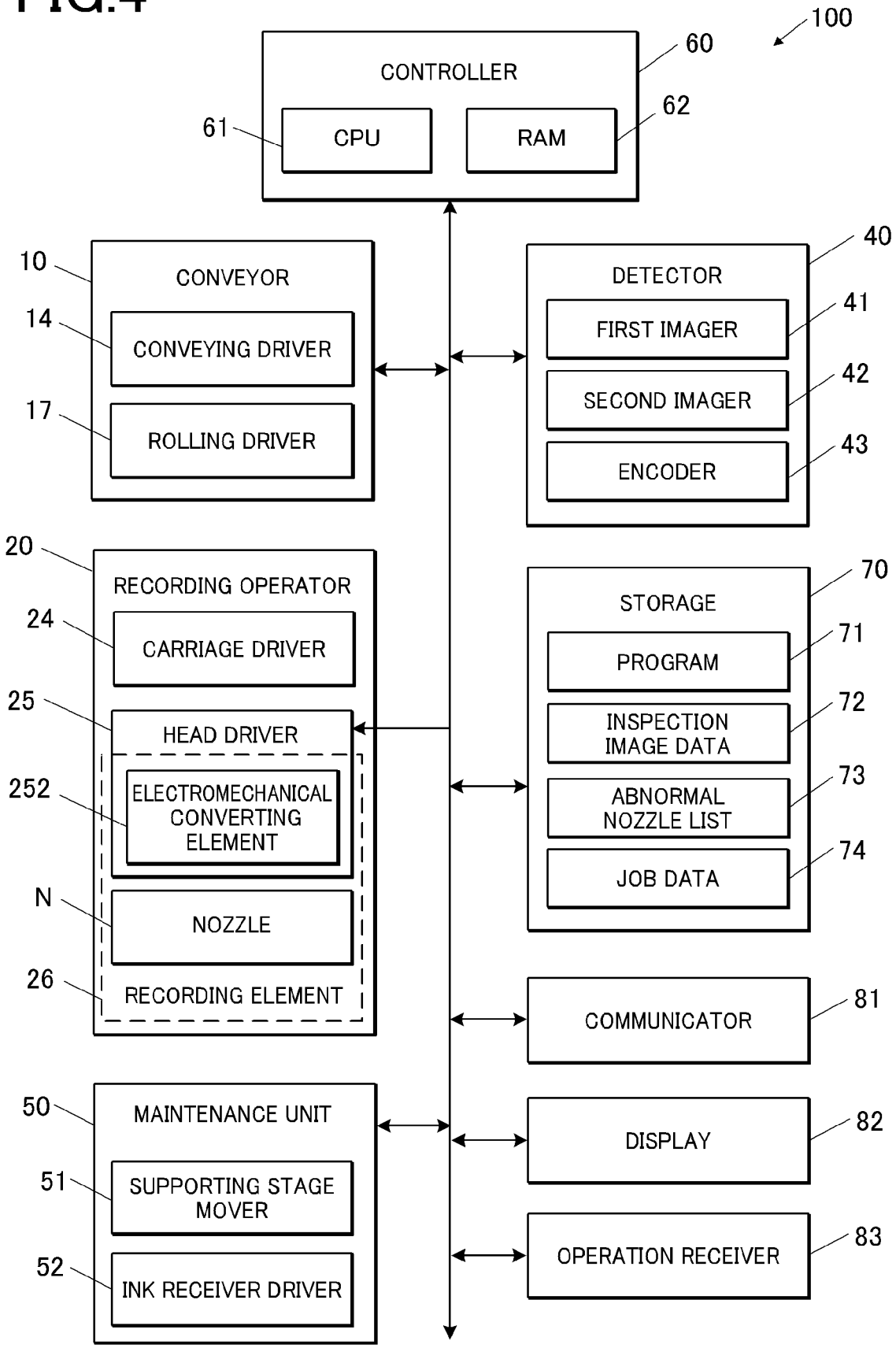

100
CONTROLLER
60
61
CPU
RAM
62
10
CONVEYOR
14
CONVEYING DRIVER
17
ROLLING DRIVER
40
DETECTOR
41
FIRST IMAGER
42
SECOND IMAGER
43
ENCODER
20
RECORDING OPERATOR
24
CARRIAGE DRIVER
25
HEAD DRIVER
252
ELECTROMECHANICAL CONVERTING ELEMENT
N
NOZZLE
26
RECORDING ELEMENT
70
STORAGE
71
PROGRAM
72
INSPECTION IMAGE DATA
73
ABNORMAL NOZZLE LIST
74
JOB DATA
81
COMMUNICATOR
50
MAINTENANCE UNIT
51
SUPPORTING STAGE MOVER
52
INK RECEIVER DRIVER
82
DISPLAY
83
OPERATION RECEIVER

FIG.5A

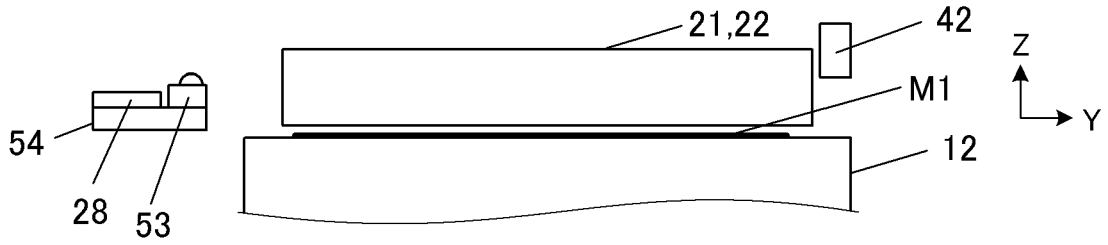


FIG.5B

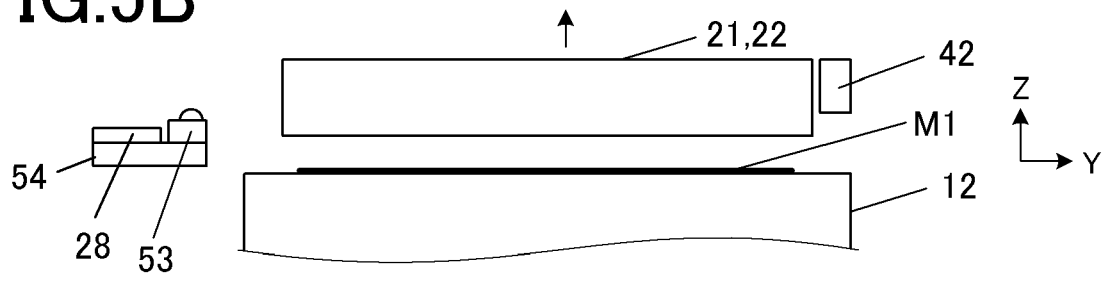


FIG.5C

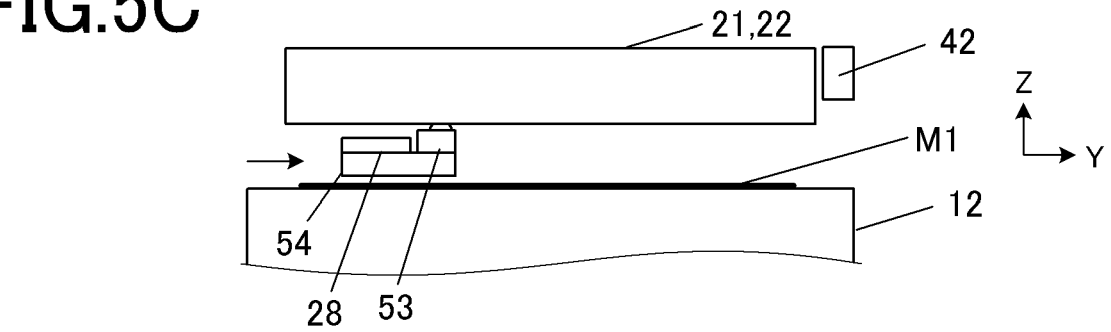


FIG.5D

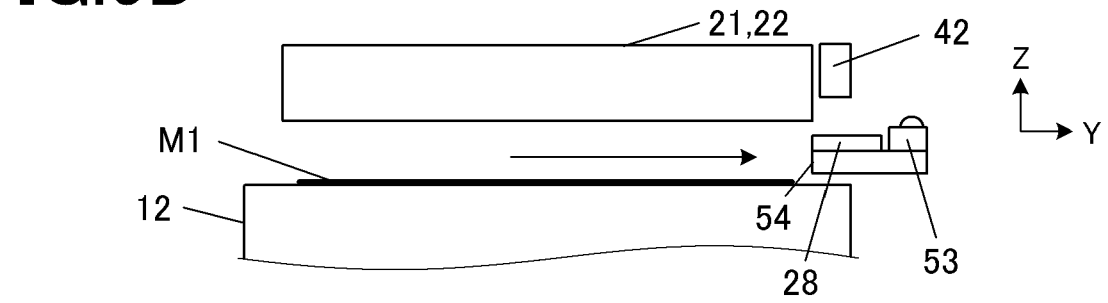


FIG.6A

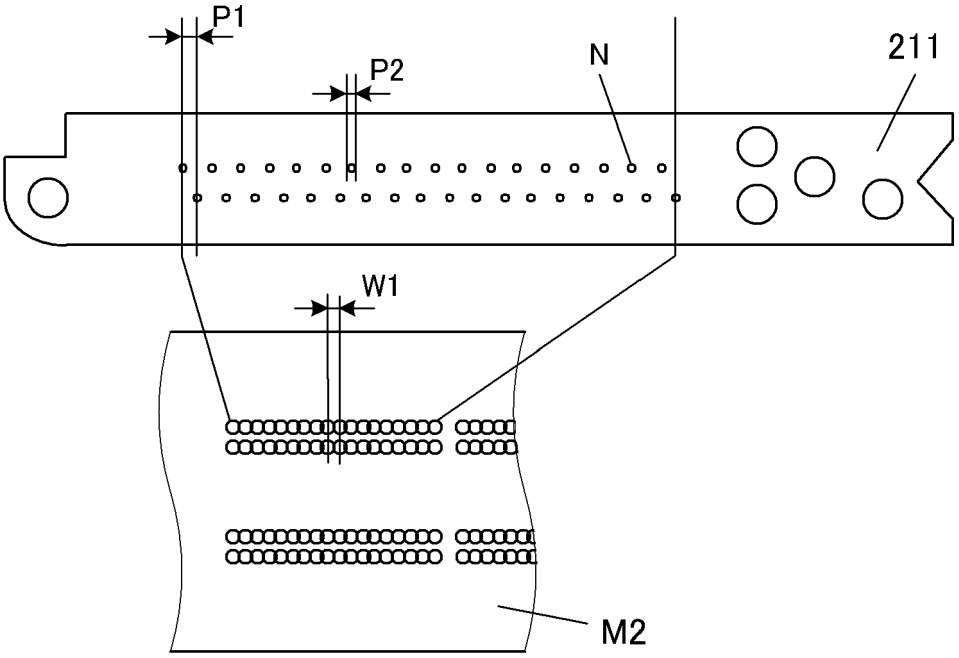


FIG.6B

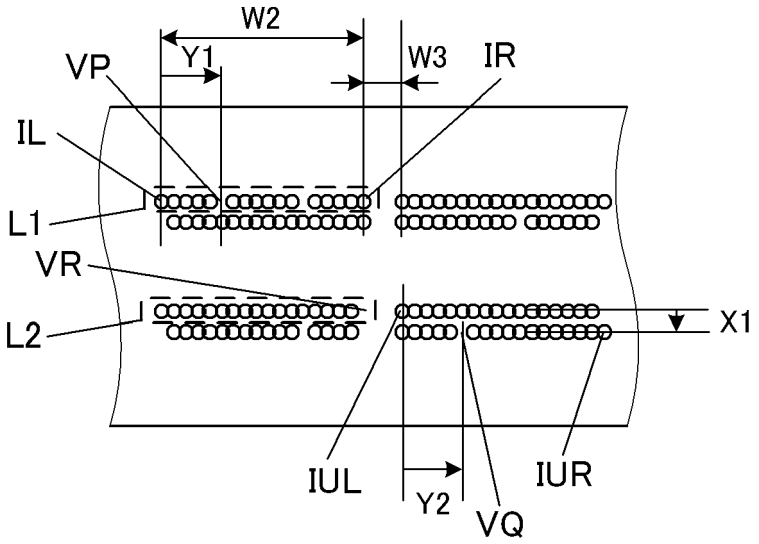


FIG.7

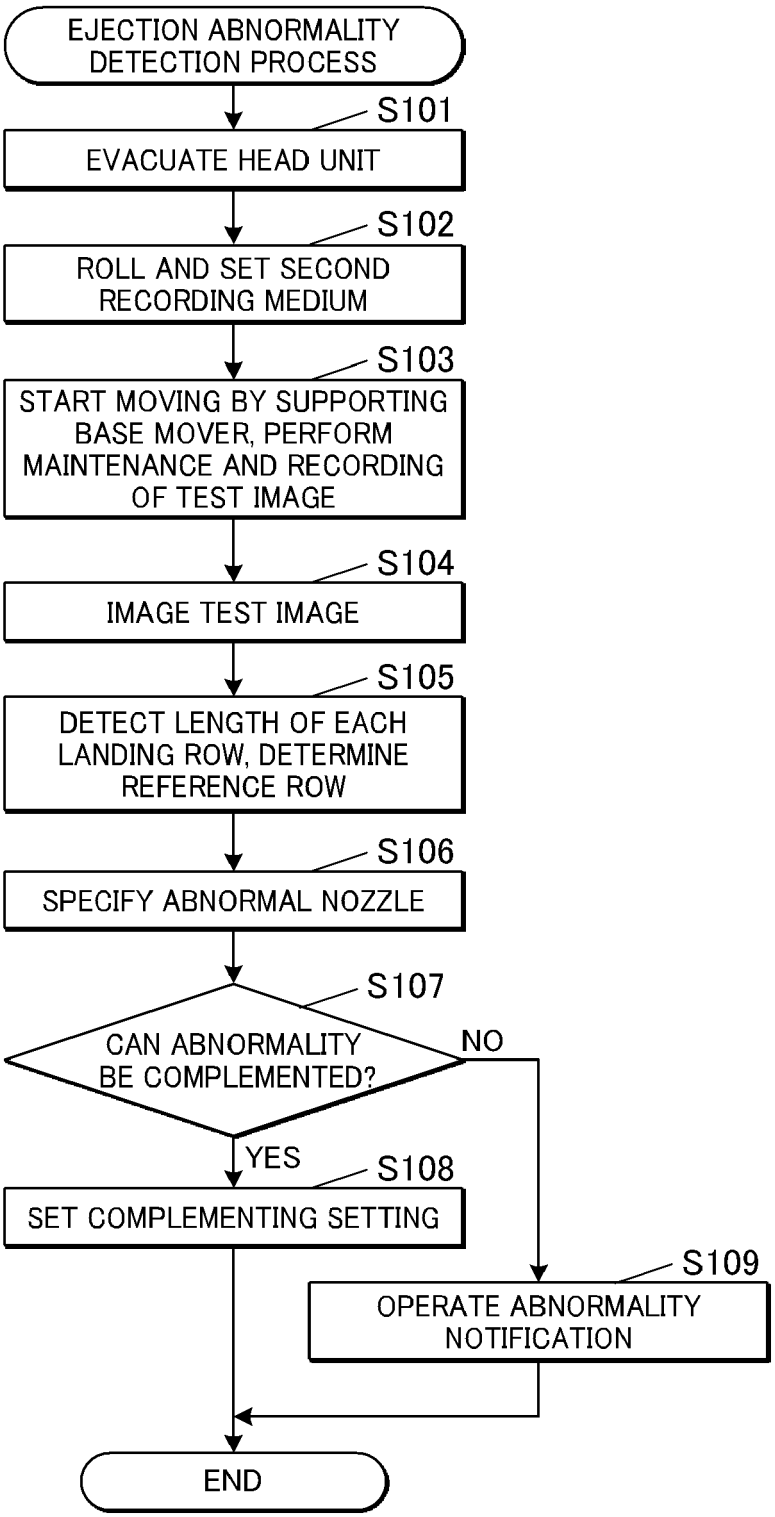

EJECTION ABNORMALITY DETECTION PROCESS
S101
EVACUATE HEAD UNIT
S102
ROLL AND SET SECOND RECORDING MEDIUM
S103
START MOVING BY SUPPORTING BASE MOVER, PERFORM MAINTENANCE AND RECORDING OF TEST IMAGE
S104
IMAGE TEST IMAGE
S105
DETECT LENGTH OF EACH LANDING ROW, DETERMINE REFERENCE ROW
S106
SPECIFY ABNORMAL NOZZLE
S107
CAN ABNORMALITY BE COMPLEMENTED?
NO
YES
S108
SET COMPLEMENTING SETTING
S109
OPERATE ABNORMALITY NOTIFICATION
END

FIG.8A

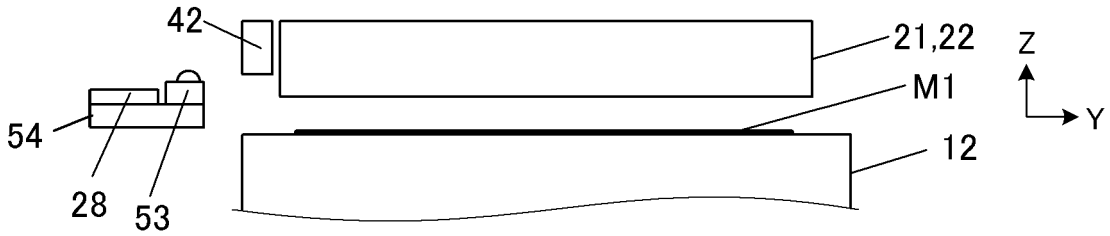


FIG.8B

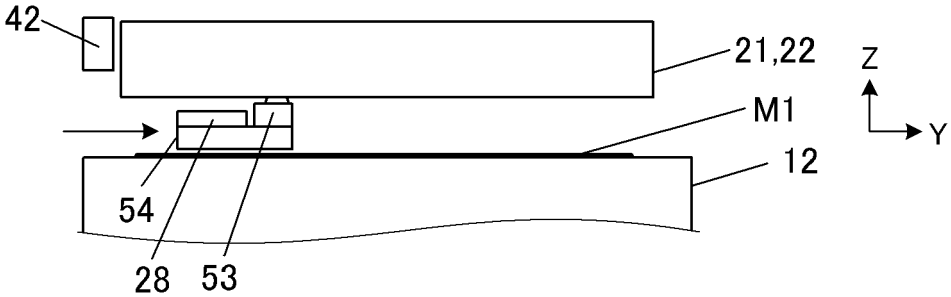


FIG.8C

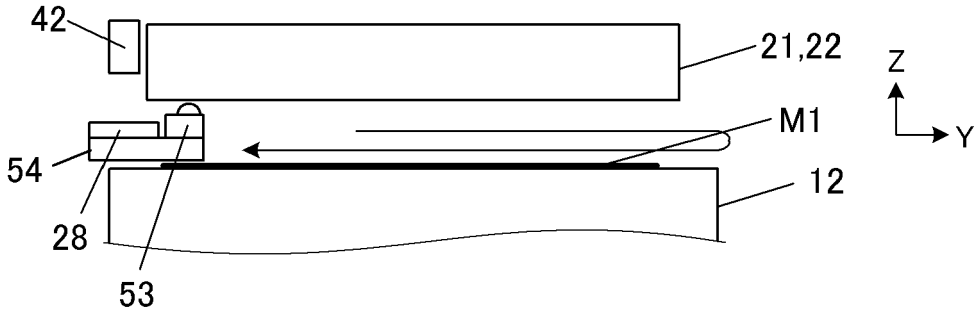


FIG.8D

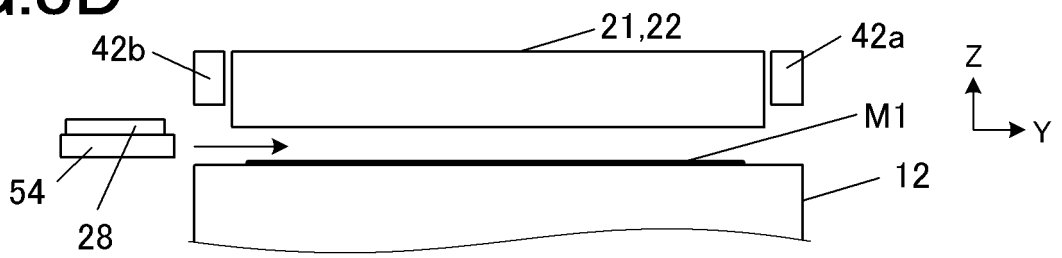


FIG.8E

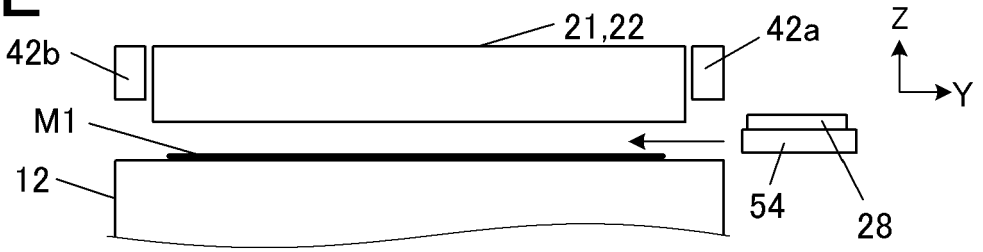


FIG.9A

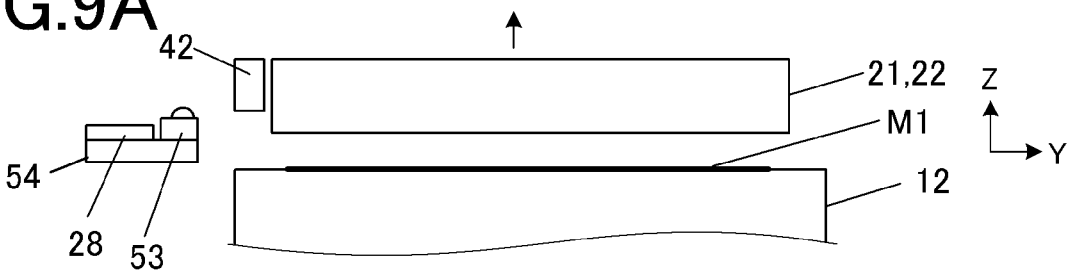


FIG.9B

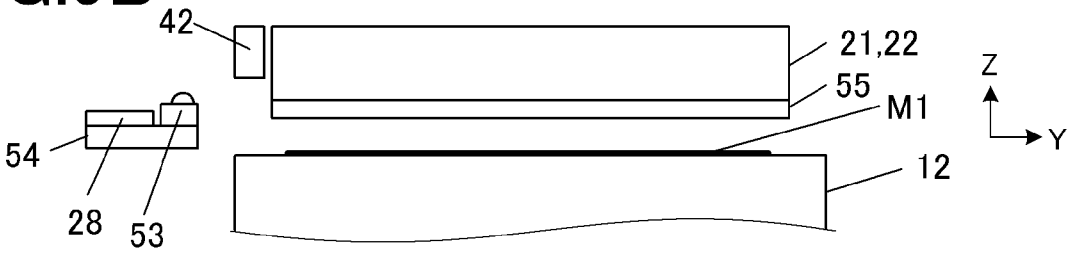


FIG.9C

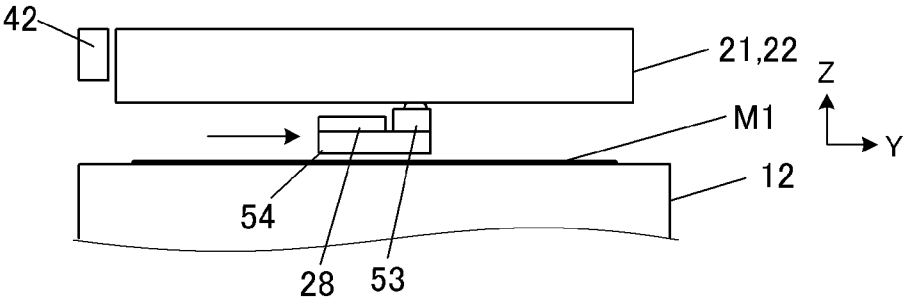


FIG.9D

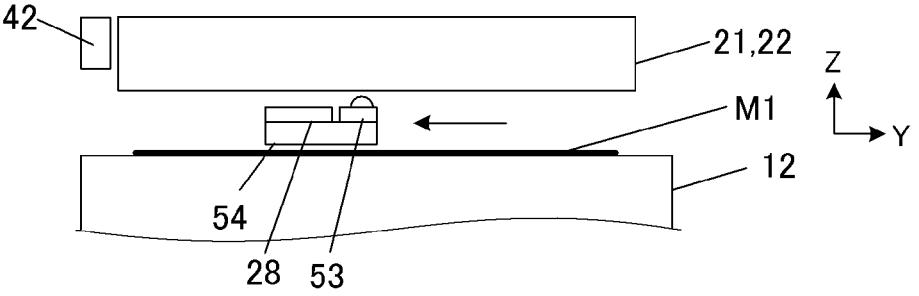


FIG.9E

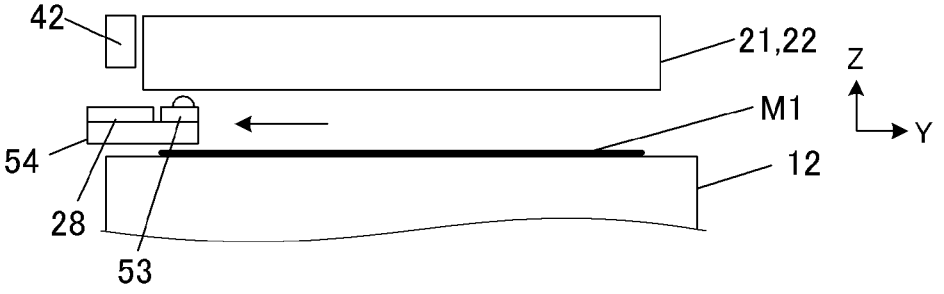


FIG.10

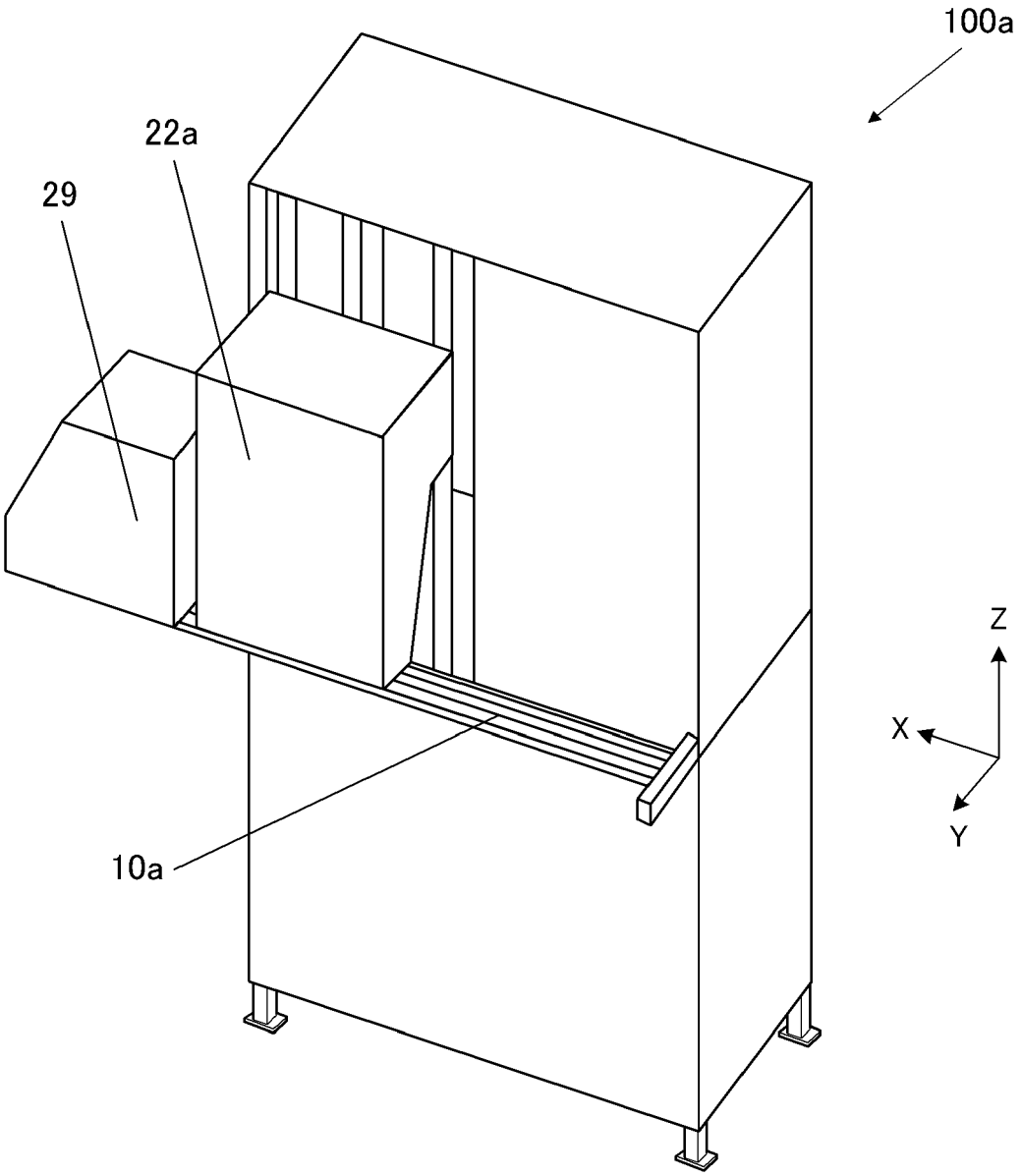


FIG.11A

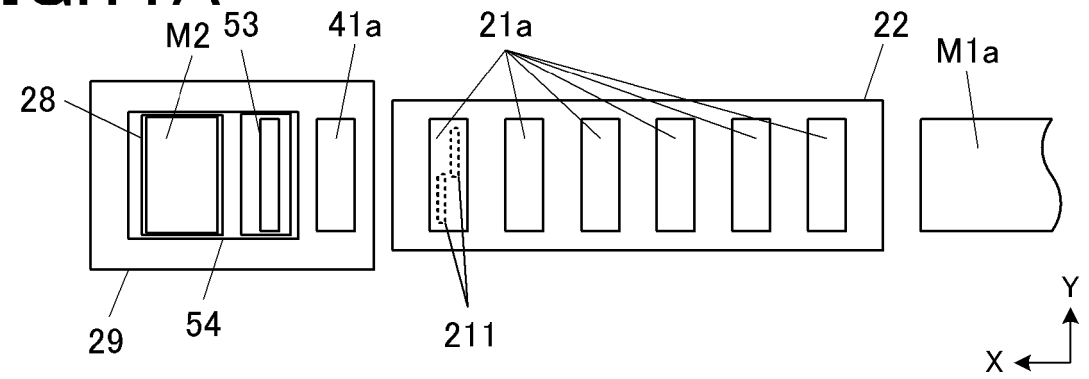


FIG.11B

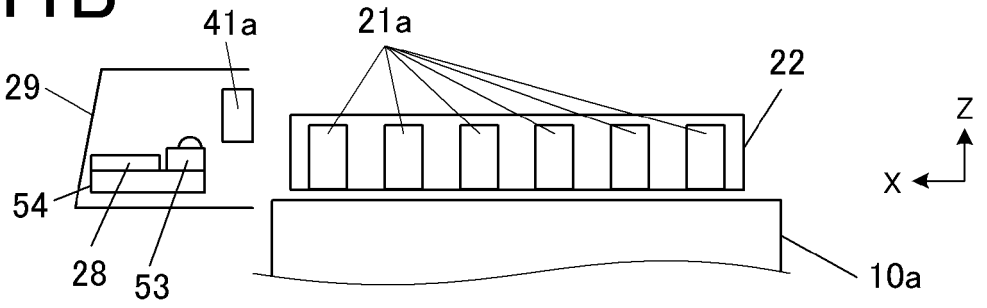


FIG.11C

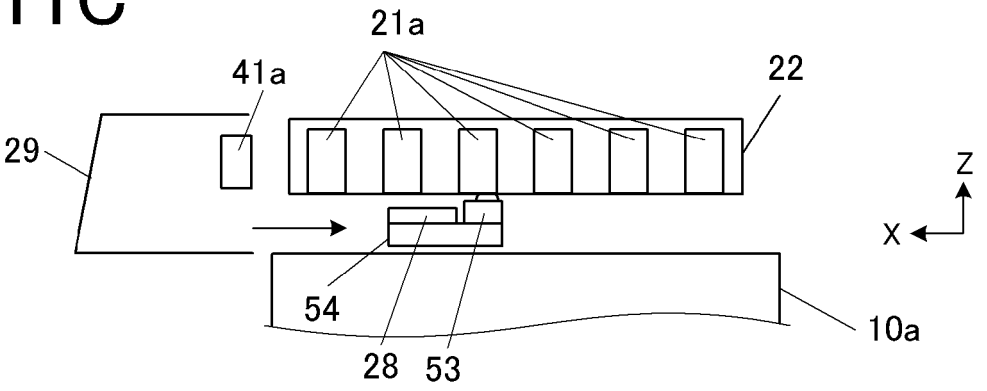


FIG.11D

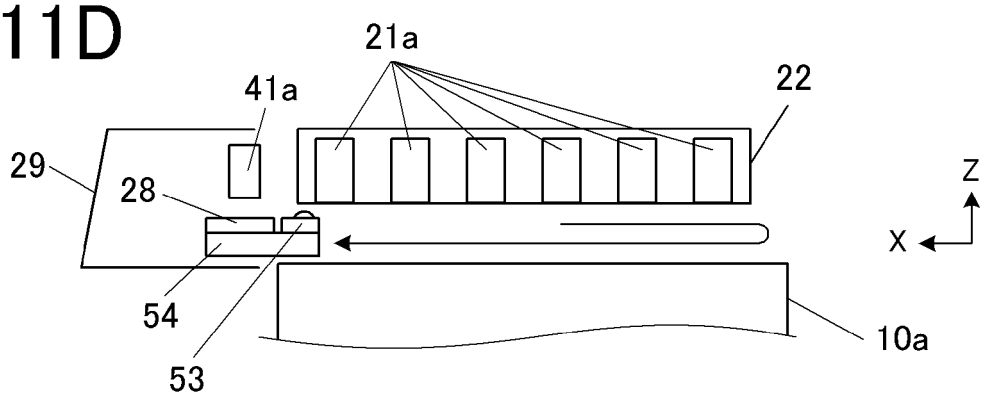
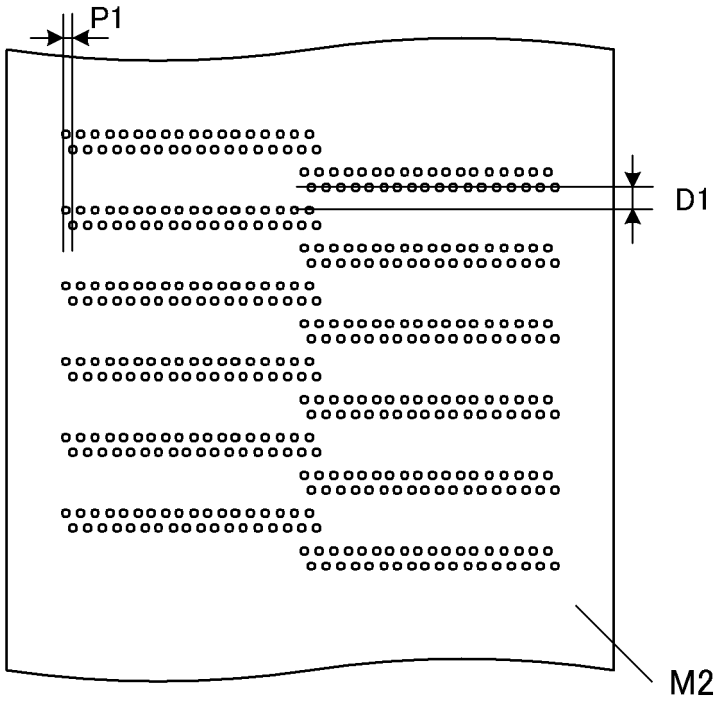


FIG.12



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EUROPEAN SEARCH REPORT

Application Number
EP 21 18 5671

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2015/278649 A1 (YOSHIWAKA HIROFUMI [JP] ET AL) 1 October 2015 (2015-10-01)	1	INV. B41J25/304
A	* figures 1-2 * * paragraph [0028] - paragraph [0036] *	2-17	B41J2/165 B41J15/22
A	US 2007/052786 A1 (NAKAZAWA YUSUKE [JP]) 8 March 2007 (2007-03-08) * figures 1,3 * * paragraph [0062] * * paragraph [0080] - paragraph [0081] *	1-17	
A	US 6 014 159 A (YAMAGUCHI KOSHIRO [JP] ET AL) 11 January 2000 (2000-01-11) * figures 1-3 * * paragraph [0019] - paragraph [0022] * * paragraph [0124] *	1-17	

TECHNICAL FIELDS SEARCHED (IPC)

B41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20 December 2021	João, César

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20-12-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2015278649 A1	01-10-2015	CN 104943368 A	30-09-2015
		EP 2923845 A1	30-09-2015
		JP 6248737 B2	20-12-2017
		JP 2015182335 A	22-10-2015
		US 2015278649 A1	01-10-2015
US 2007052786 A1	08-03-2007	EP 1759855 A2	07-03-2007
		JP 2007062271 A	15-03-2007
		US 2007052786 A1	08-03-2007
US 6014159 A	11-01-2000	DE 69700587 T2	10-02-2000
		EP 0847863 A1	17-06-1998
		JP H10166680 A	23-06-1998
		US 6014159 A	11-01-2000

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Patent documents cited in the description

- JP 2019202522 A **[0002]**