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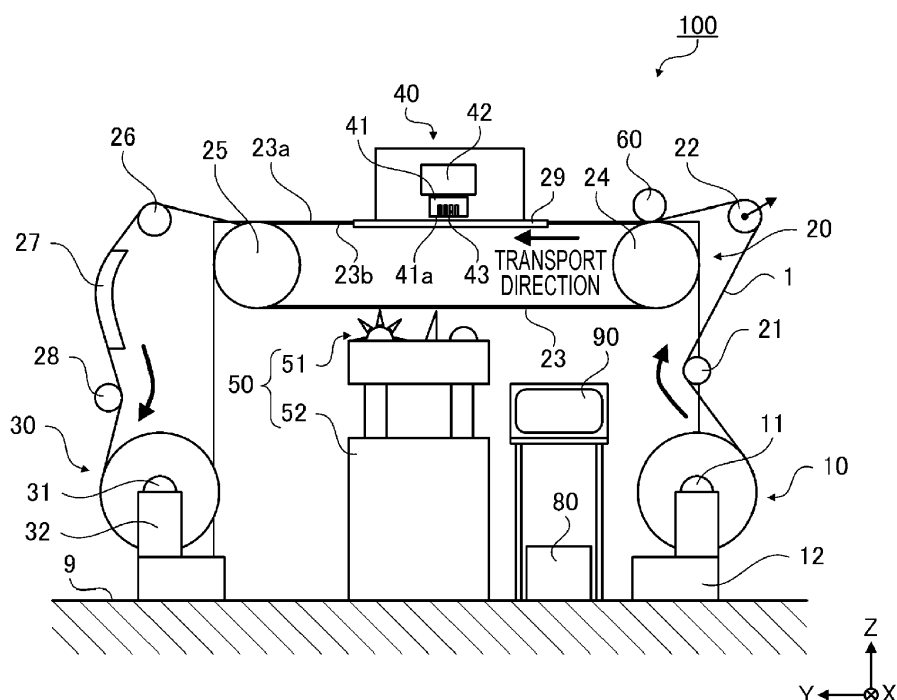
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(54) **PRINTING APPARATUS AND ADJUSTMENT METHOD FOR PRINTING APPARATUS**

(57) A fabric printing apparatus (100) includes a transport belt (23) configured to transport fabric (1) in a transport direction, a printing section (40) configured to perform printing by imparting ink droplets onto the fabric (1) having been transported, and a control section (80) configured to control positions for imparting the ink droplets, and based on displacement characteristic data in-

dicating displacement amounts of the transport belt (23) that arise in a direction intersecting with the transport direction along with movements of the transport belt (23) in the transport direction, the control section (80) corrects the positions for imparting the ink droplets, in the direction intersecting with the transport direction.

FIG. 1



Description

BACKGROUND

1. Technical Field

[0001] The present invention relates to a printing apparatus that performs printing on a printing medium transported by a belt, and to an adjustment method for the printing apparatus.

2. Related Art

[0002] Heretofore, as a printing apparatus, an ink jet printer that, just like, for example, a fabric printing apparatus that performs printing on long-sized fabric, performs printing on a printing medium having been transported by a transport belt has been well known. In such a printing apparatus, techniques for reducing the degradation of printing quality due to transport accuracy (error) in the transport of the printing medium by the transport belt have been considered. For example, in JP-A-2014-69322, there is disclosed a printing apparatus (image formation apparatus) including a transport belt configured to transport a printing medium (printing paper) in a transport direction (sub-scanning direction), a line head including nozzles extending along a main-scanning direction orthogonal to the transport direction, and a correction means configured to correct timing points of the discharge of ink droplets from the line head so as to allow the timing points to be associated with ink-droplet landing-position discrepancies that occur along with the revolving of the transport belt. Further, for example, in JP-A-2015-187035, there is disclosed a printing apparatus including a meandering detection means configured to detect meandering of a printing medium (recording medium) in a state of being transported, and a control means configured to perform meandering elimination processing for eliminating the detected meandering.

[0003] In the printing apparatus disclosed in JP-A-2014-69322, however, there is a problem in that ink-droplet landing-position discrepancies in the transport direction (the sub-scanning direction) can be corrected, but ink-droplet landing-position discrepancies in the main-scanning direction orthogonal to the transport direction are difficult to correct.

[0004] Further, in the printing apparatus disclosed in JP-A-2015-187035, the occurrence of rucks can be reduced by detecting and eliminating the meandering of the printing medium, but there is a room for improvement in the correction of ink-droplet landing-position discrepancies in the main-scanning direction orthogonal to the transport direction (the sub-scanning direction) because of situations, such as a situation where it is difficult to achieve sufficient correction in the sizes of ink droplets and the accuracy in the pitch between ink droplets.

SUMMARY

[0005] An advantage of some aspects of the invention is that a printing apparatus and an adjustment method for the printing apparatus are provided that enable a correction relative to displacements of a transport belt that occur in a direction intersecting with a transport direction of the transport belt to be made with higher accuracy. The invention can be achieved as the following application examples and an embodiment described later.

Application Example 1

[0006] A printing apparatus according to this application example includes a transport belt configured to transport a printing medium in a transport direction, a printing section configured to perform printing by imparting ink droplets onto the printing medium having been transported, and a control section configured to control positions for imparting the ink droplets, and based on displacement characteristic data indicating displacement amounts of the transport belt that arise in a direction intersecting with the transport direction along with movements of the transport belt in the transport direction, the control section corrects the positions for imparting the ink droplets, in the direction intersecting with the transport direction.

[0007] According to this application example, the control section corrects positions for imparting ink droplets, in the direction intersecting with the transport direction, on the basis of the displacement characteristic data indicating the displacement amounts of the transport belt that arise in the direction intersecting with the transport direction along with the movements of the transport belt in the transport direction. That is, the positions of the ink droplets imparted onto the printing medium which is transported by the transport belt and whose position is displaced along with the displacements of the transport belt are corrected on the basis of the displacement characteristic data, indicating the displacement amounts of the transport belt that arise in the direction intersecting with the transport direction along with the movements of the transport belt in the transport direction. As a result, a correction relative to the displacements of the transport belt that occur in the direction intersecting with the transport direction is made with higher accuracy, and the degradation of printing quality that occurs along with the displacements is further effectively minimized.

Application Example 2

[0008] In the printing apparatus according to the above application example, the control section determines a reference position for the printing in the direction intersecting with the transport direction based on the displacement characteristic data.

[0009] According to this application example, the control section determines a reference position for the printing in the direction intersecting with the transport direction

on the basis of the displacement characteristic data indicating the displacement amounts of the transport belt that arise in the direction intersecting with the transport direction along with the movements of the transport belt in the transport direction. As a result, printing on the printing medium which is transported by the transport belt and whose position is displaced along with the displacements of the transport belt is performed at further appropriate positions.

Application Example 3

[0010] In the printing apparatus according to the above application example, the displacement characteristic data includes at least one cycle of data in which the displacement values vary, and, based on at least one displacement amount which is among the displacement amounts and each of which is associated with and obtained at a corresponding one of at least one circumferential position of the transport belt within the one cycle, the control section corrects positions for imparting the ink droplets, in the direction intersecting with the transport direction at each said at least one circumferential position.

[0011] According to this application example, the displacement characteristic data indicating the displacement amounts of the transport belt that arise in the direction intersecting with the transport direction along with the movements of the transport belt in the transport direction includes at least one cycle of data in which the displacement amounts vary. Further, based on at least one displacement amount which is among the displacement amounts and each of which is associated with and obtained at at least one corresponding circumferential position of the transport belt within the one cycle, the control section corrects positions for imparting the ink droplets, in the direction intersecting with the transport direction at each said at least one circumferential position. That is, the positions of the ink droplets imparted onto the printing medium which is transported by the transport belt and whose position is displaced along with the displacements of the transport belt are corrected on the basis of the displacement characteristic data, that is, data indicating displacement values each associated with a corresponding one of movement positions of the transport belt in the transport direction. As a result, the correction with the displacements of the transport belt in the direction intersecting with the transport direction is made with higher accuracy, and the degradation of printing quality is minimized.

Application Example 4

[0012] In the printing apparatus according to the above application example, in order to measure the displacement values, an image processing section configured to obtain the displacement characteristic data by recognizing an image of a predetermined pattern having been

printed by the printing section, and performing image processing on the recognized image of the predetermined pattern is further included.

[0013] According to this application example, the printing apparatus is configured to, in order to measure the displacement values that arise in the direction intersecting with the transport direction along with the movements of the transport belt in the transport direction, include an image processing section configured to obtain the displacement characteristic data by recognizing an image of a predetermined pattern having been printed by the printing section, and performing image processing on the recognized image of the predetermined pattern. Thus, for example, a user of the printing apparatus is able to update the displacement characteristic data so as to allow the displacement characteristic data to reflect the latest condition of the printing apparatus. As a result, the correction with the displacements of the transport belt in the direction intersecting with the transport direction is made with higher accuracy, and the degradation of printing quality is minimized.

Application Example 5

[0014] An adjustment method for a printing apparatus, according to this application example, is an adjustment method for a printing apparatus including a transport belt configured to transport a printing medium in a transport direction, and a printing section configured to perform printing by imparting ink droplets onto the printing medium having been transported, and includes a step of obtaining displacement characteristic data indicating displacement amounts of the transport belt that arise in a direction intersecting with the transport direction along with movements of the transport belt in the transport direction, and a step of determining, based on the displacement characteristic data, at least one circumferential position of the transport belt at which an adjustment of the printing apparatus is performed. Further, an adjustment of positions for imparting the ink droplets, in the direction intersecting with the transport direction, is performed at each of the at least one circumferential position having been determined.

[0015] The adjustment method for the printing apparatus, according to this application example, includes a step of obtaining displacement characteristic data indicating displacement values of the transport belt that arise in the direction intersecting with the transport direction along with movements of the transport belt in the transport direction, and a step of determining, based on the displacement characteristic data, at least one circumferential position of the transport belt at which the adjustment of the printing apparatus is performed. Further, at each said at least one circumferential position having been determined, the adjustment of ink-droplet imparting positions in the direction intersecting with the transport direction is performed. That is, the adjustment of the ink-droplet imparting positions in the direction intersecting

with the transport direction is performed at each said at least one circumferential position having been determined on the basis of the displacement characteristic data indicating the displacement values of the transport belt that arise along with the movements of the transport belt in the transport direction. This configuration, therefore, enables the adjustment of the ink-droplet imparting positions to be performed at positions where the displacements of the transport belt in the direction intersecting with the transport direction are further stable, and as a result, this configuration enables the adjustment to be performed further appropriately.

Application Example 6

[0016] In the adjustment method for the printing apparatus, according to the above application example, based on the displacement characteristic data, a central value of a width within which the transport belt is displaced in the direction intersecting with the transport direction is obtained, and at least one circumferential position of the transport belt at each of which the transport belt is located at the central value is determined as at least one circumferential position of the transport belt at each of which the adjustment of the printing apparatus is performed.

[0017] According to this application example, the adjustment of the ink-droplet imparting positions in the direction intersecting with the transport direction can be performed at the at least one circumferential position of the transport belt at which the transport belt is located at the central value of the width within which the transport belt is displaced in the direction intersecting with the transport direction. This configuration, therefore, enables the adjustment of the ink-droplet imparting positions to be performed at positions where the displacements of the transport belt in the direction intersecting with the transport direction are further stable, and as a result, this configuration enables the adjustment to be performed further appropriately.

Application Example 7

[0018] In the adjustment method for the printing apparatus, according to the above application example, based on the displacement characteristic data, a most frequent position at which the transport belt is most frequently located in the direction intersecting with the transport direction is obtained, and a circumferential position of the transport belt at which the transport belt is located at the most frequent position is determined as a circumferential position of the transport belt at which the adjustment of the printing apparatus is performed.

[0019] According to this application example, the adjustment of an ink-droplet imparting position in the direction intersecting with the transport direction can be performed at the most frequent position at which the transport belt is most frequently located in the direction intersecting with the transport direction, and thus, an effective

adjustment that allows the ratio of a contribution of a period of time during which the adjustment result is reflected to be higher is achieved.

5 BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings, wherein like numbers reference like elements.

Fig. 1 is a schematic diagram illustrating a fabric printing apparatus taken as an example of a "printing apparatus" according to an embodiment of the invention.

Fig. 2 is a block diagram illustrating the functions of an apparatus controller and an image processing device.

Fig. 3 is a diagram illustrating the fundamental functions of a printer driver.

Fig. 4 is a schematic diagram illustrating an example of the arrangement of nozzles that is seen from the bottom face side of a head.

Fig. 5 is a diagram illustrating an example of a predetermined pattern used for obtaining displacement amounts.

Fig. 6 is a graph illustrating an example of plotted pieces of displacement characteristic data in relation to a transport belt.

Fig. 7 is a graph illustrating an example of two cycles of plotted pieces of displacement characteristic data having been obtained through a measurement.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0021] Hereinafter, an embodiment obtained by embodying the invention will be described with reference to the drawings. Description below is just an embodiment of the invention, and does not limit the invention. Note that individual figures referred to below may be drawn in scales different from actual scales for easy understanding of the description below. Further, in a coordinate system appended in each of figures referred to below, a Z-axis direction indicates an upper-lower direction; a +Z-axis direction indicates an upper direction; an X-axis direction indicates a front-back direction; a -X-axis direction indicates a front direction; a Y-axis direction indicates a left-right direction; a +Y-axis direction indicates a left direction; and an X-Y plane is a horizontal plane.

Embodiment

Fundamental Configuration of Printing Apparatus (Fabric Printing Apparatus)

[0022] Fig. 1 is a schematic diagram illustrating a fabric printing apparatus 100, that is, a fabric printing apparatus taken as an example of a printing apparatus according

to this embodiment, and illustrates a front view of the fabric printing apparatus 100 installed on a floor surface 9.

[0023] The fabric printing apparatus 100 is an ink jet printing apparatus that performs printing on fabric 1, that is, fabric taken as an example of a "printing medium", by discharging (imparting) ink droplets onto the fabric 1 to form an image thereon. Examples of fabric used as the fabric 1 include, but are not limited to, cotton, silk, wool, synthetic fabric, and blended fabric.

[0024] The fabric printing apparatus 100 includes a fabric supplying section 10, a fabric transporting section 20, a fabric collecting section 30, a printing section 40, a maintenance section 50, a fabric pressing and adhering section 60, an apparatus controller 80, an image processing device 90, and any other component.

[0025] The fabric supplying section 10 contains the fabric 1 before subjected to the imparting of inks, that is, in a state not subjected to formation of a desired image. The fabric supplying section 10 includes a shaft portion 11 and a shaft receiving portion 12.

[0026] The shaft portion 11 supports the band-shaped fabric 1 in a state of being wound in a roll shape so as to allow the fabric 1 to be rotatable in a circumferential direction. The shaft portion 11 is attached to the shaft receiving portion 12 so as to be attachable/detachable to/from the shaft receiving portion 12.

[0027] The shaft receiving portion 12 includes a rotation driving portion (omitted from illustration) for driving the rotation of the shaft portion 11, and supports the shaft portion 11 so as to allow the shaft portion 11 to be rotatable. The rotation driving portion is controlled by the apparatus controller 80 so as to rotate the shaft portion 11 in a direction in which the fabric 1 is fed out in the case where the fabric 1 is stretch fabric. Further, in the case where the fabric 1 is fabric to which tension is required to be applied, control that allows a load to be applied so as not to rotate the shaft portion 11 is performed.

[0028] The fabric transporting section 20 transports the fabric 1 using a transport path from the fabric supplying section 10 to the fabric collecting section 30 via the printing section 40. The fabric transport section 20 includes transport rollers 21, 26, and 28, a tension roller 22, a transport belt 23, a belt rotation roller 24, a belt driving roller 25, a drying unit 27, a belt guide 29, and any other constituent element.

[0029] The transporting belt 23 is formed in an endless shape, and is hung on the belt roller 24 and the belt driving roller 25 so as to allow the portion hung therebetween to be kept parallel to the floor surface 9. The transport belt 23 includes an adherence layer (omitted from illustration) provided on the surface thereof (i.e., on a support face 23a thereof) and causing the fabric 1 to adhere to the support face 23a. The transport belt 23 supports the fabric 1 using the support face 23a, on which the adherence

layer is provided.

[0030] The belt rotation roller 24 and the belt driving roller 25 support an inner circumference face 23b of the transport belt 23. Here, a configuration that allows a support portion for supporting the transport belt 23 from the inner circumference face 23b to be provided between the belt rotation roller 24 and the belt driving roller 25 may be employed.

[0031] In the transport path, the belt driving roller 25 is disposed at the downstream side of the belt rotation roller 24. The belt driving roller 25 allows its rotation to be controlled by the apparatus controller 80. The rotation of the belt driving roller 25 causes the transport belt 23 to rotate, and with the rotation of the transport belt 23, the belt rotation roller 24 rotates. The rotation of the transport belt 23 transports the fabric 1, which is supported by the transport belt 23 (using the support face 23a), in a transport direction. That is, a direction from the belt rotation roller 24 toward the belt driving roller 25 corresponds to the transport direction.

[0032] The tension roller 22 is provided between the fabric supplying section 10 and the transport belt 23 in the transport path, and generates and applies predetermined tension to the fabric 1 between the transport belt 23 (the support face 23a adhered to the fabric 1) and the tension roller 22 itself.

[0033] The transport roller 21 relays the fabric 1 between the fabric supplying section 10 and the tension roller 22.

[0034] The transport roller 26 relays the fabric 1 having been transported by the transport belt 23.

[0035] The drying unit 27 is provided between the transport roller 26 and the transport roller 28 to guide and dry the fabric 1 after being subjected to the imparting of inks. The transport roller 28 relays the fabric 1 having been guided by the drying unit 27 to the fabric collecting section 30.

[0036] The belt guide 29 is a pair of flat-plate shaped guides that is provided so as to pinch the transport belt 23 from the both width-direction edge sides of the transport belt 23 in a region (a printing region) existing on the transport belt 23 and facing the printing section 40, and restrains the displacement of the transport belt 23 in a direction intersecting with the transport direction.

[0037] The fabric collecting section 30 contains the fabric 1 having been subjected to the imparting and the drying of inks (that is, having been subjected to formation (printing) of a desired image). The fabric collecting section 30 includes a shaft portion 31 and a shaft receiving portion 32.

[0038] The shaft portion 31 is provided so as to be rotatable in a circumferential direction to wind the fabric 1 in a roll shape and contain it. The shaft portion 31 is attached so as to be attachable/detachable to/from the shaft receiving portion 32.

[0039] The shaft receiving portion 32 includes a rotation driving portion (omitted from illustration) for driving the rotation of the shaft portion 31, and supports the shaft

portion 31 so as to allow the shaft portion 31 to be rotatable. The rotation driving portion is controlled by the apparatus controller 80 to rotate the shaft portion 31 in a direction in which the fabric 1 is wound.

[0040] The printing section 40 is controlled by the apparatus controller 80, and discharges ink droplets to the fabric 1. The printing section 40 includes a head 41, a head moving section 42, and an ink supplying section (omitted from illustration). The head 41 includes a discharge face 41a, and from this discharge face 41a, inks supplied from the ink supplying section are discharged as ink droplets. A plurality of nozzles 43 are formed on the discharge face 41a, and the ink droplets are discharged through these nozzles 43. In the printing region, the discharge face 41a is provided so as to face the fabric 1 in a state of being transported by the transport belt 23.

[0041] The head moving section 42 includes a carriage mounting the head 41 therein, a guide shaft provided in a direction intersecting with the transport direction of the fabric 1, a driving mechanism for moving the carriage along the guide shaft, and any other component (these components being omitted from illustration), and moves the head 41 in a width direction of the fabric 1 (the X-axis direction), that is, in a direction intersecting with the transport direction.

[0042] Fig. 4 is a schematic diagram illustrating an example of the arrangement of the nozzles 43 that is seen from the bottom face side of the head 41.

[0043] The head 41 allows the plurality of nozzles 43 arranged along the transport direction (the Y-axis direction) of the fabric 1 to form, for example, four nozzle rows, and is configured to discharge, for each of the nozzle rows, a corresponding one of mutually different colors (for example, cyan: C, magenta: M, yellow: Y, and black: K). In the example shown in Fig. 4, each of the nozzle rows is constituted by 400 nozzles 43, that is, #1 to #400 nozzles 43.

[0044] The maintenance section 50 (see Fig. 1) is controlled by the apparatus controller 80, and performs the maintenance of the transport belt 23. The maintenance section 50 includes a processing portion 51, a base portion 52, and any other component. The processing portion 51 includes mechanisms for performing various processes on the transport belt 23, such as a removal portion for removing foreign matters, such as dust and lint, adhered to the transport belt 23, an adherence layer repairing portion for repairing the adherence layer of the transport belt 23 when the adherence layer has been degraded (these mechanisms being omitted from illustration). The base portion 52 supports the processing portion 51 so as to enable the processing portion 51 to move up and down.

[0045] The fabric pressing and adhering section 60 is disposed above the transport belt 23 at the upstream side of the printing section 40 in the transport path. The fabric pressing and adhering section 60 presses and adheres the fabric 1 onto the support face 23a, including the adherence layer, to prevent the fabric 1 from sepa-

rating (floating) from the transport belt 23.

[0046] Fig. 2 is a block diagram illustrating the functions of the apparatus controller 80 and the image processing device 90.

[0047] The image processing device 90 includes an image control section 91, an input section 92, a display section 93, a storage section 94, and any other component, and performs processes, such as transmitting/receiving of data to/from external electronic devices connected to the image processing device 90 itself via networks or the like, job control of the printing performed by the fabric printing apparatus 100, and an image process in relation to the printing. The image processing device 90 is constituted using a personal computer as a suitable example.

[0048] Software in accordance with which the image processing device 90 operates includes commonly-used image processing application software (hereinafter referred to as application) for dealing with image data on the basis of which printing is performed, and printer driver software (hereinafter referred to as a printer driver) for generating printing data needed for the execution of the printing by the fabric printing apparatus 100 based on the image data.

[0049] The image control section 91 includes a CPU (Central Processing Unit) 95, an ASIC (Application Specific Integrated Circuit) 96, a DSP (Digital Signal Processor) 97, a memory 98, an interface 99, and any other component.

[0050] The input section 92 is an information inputting means serving as a human interface. Specifically, the input means 92 corresponds to components, such as a key board and ports to which information input devices are connected.

[0051] The display section 93 is an information display means (a display) serving as a human interface, and allows information input from the input section 92, an image to be printed, information in relation to the printing job, and any other information to be displayed on the display section 93 itself on the basis of the control of the image control section 91.

[0052] The storage section 94 is a rewritable storage medium, such as a hard disk drive (HDD) or a memory card, and allows software in accordance with which the image processing device 90 operates (i.e., programs operated in the image processing section 91), an image to be printed, information in relation to the printing job, and any other information to be stored in the storage section 94 itself.

[0053] The memory 98 is a storage medium for securing an area for storing therein programs in accordance with which the CPU 95 operates, a work area for use in the operation of the CPU 95, and any other area, and is constituted by storage elements, such as RAM and EEPROM.

[0054] The device control section 80 includes an interface 81, a CPU 82, a memory 83, a driving control section 84, and any other component, and performs overall con-

trol of individual driving portions of the fabric printing apparatus 100. Specifically, the device control section 80 performs control of the printing section 40 (ink discharge control on the head 41 and head movement control on the head moving section 42), transport drive control on the fabric transporting section 20, and any other control.

[0055] At the time of the execution of printing, the device control section 80 performs control so as to allow two successive operations to be repeated: one being an operation of discharging ink droplets from the head 41 onto the fabric 1 having been supplied to the printing region by the fabric transporting section 20 in accordance with the printing data having been sent from the image processing device 90 while moving the carriage supporting the head 41 in a main-scanning direction (the X-axis direction) along the guide shaft; the other being an operation of causing the fabric transporting section 20 (the transport belt 23) to move the fabric 1 in the transport direction (the Y-axis direction) intersecting with the main-scanning direction. With the repetition of these two successive operations, a desired image is formed (printed) on the fabric 1.

[0056] The interface 81 is connected to the image processing device 90 (the interface 99), and transmits/receives data to/from the image processing device 90.

[0057] The CPU 82 is an arithmetic processing device for performing driving control of the whole of the fabric printing device 100.

[0058] The memory 83 is a storage medium for ensuring an area for storing therein programs in accordance with which the CPU 82 operates, a work area for use in the operation of the CPU 82, and any other area, and is constituted by storage elements, such as RAM and EEPROM.

[0059] The CPU 82 controls the fabric supplying section 10, the fabric transporting section 20, the fabric collecting section 30, the printing section 40, the maintenance section 50, and the fabric pressing and adhering section 60 via the driving control section 84 in accordance with the programs stored in the memory 83 and the printing data having been received from the image processing device 90.

Fundamental Functions of Printer Driver

[0060] Fig. 3 is a diagram illustrating the fundamental functions of the printer driver.

[0061] The printing on the fabric 1 is started at the time when the printer driver transmits printing data from the image processing device 90 to the apparatus controller 80. The printing data is generated by the printer driver.

[0062] Hereinafter, processing for generating the printing data will be described referring to Fig. 3.

[0063] Upon receipt of image data from application, the printer driver converts the image data into printing data having a format interpretable by the apparatus controller 80, and outputs the printing data to the apparatus controller 80. When converting the image data from the

application into the printing data, the printer driver performs resolution conversion processing, color conversion processing, halftone processing, rasterization processing, command addition processing, and any other processing.

[0064] The resolution conversion processing is processing for converting the resolution of the image data having been output from the application into a resolution (printing resolution) for printing on the fabric 1. For example, when the printing resolution is designated to be 720 x 720 dpi, the image data of a vector format having been received from the application is converted into image data of a bitmap format and a resolution of 720 x 720 dpi. Each piece of pixel data constituting the image data after the resolution conversion processing is constituted by pixels arranged in a matrix shape. Each of the pixels has a grayscale value among, for example, 256 grayscale values in an RGB color space. That is, each piece of pixel data after the resolution conversion processing indicates the grayscale values of a corresponding pixel.

[0065] Pieces of pixel data corresponding to a row of pixels arranged in a predetermined direction among the pixels arranged in the matrix shape are called raster data. Note that the predetermined direction in which the pixels corresponding to the raster data are arranged corresponds to the movement direction of the head 41 (i.e., the main-scanning direction) at the time of the execution of printing of an image.

[0066] The color conversion processing is processing for converting RGB data into data in a CMYK color system space. The CMYK color corresponds to cyan (C), magenta (M), yellow (Y), and black (K), and the image data in the CMYK color system space is data corresponding to the colors of the inks provided in the fabric printing apparatus 100. Thus, in the case where the fabric printing apparatus 100 uses ten kinds of inks in the CMYK color system, the printer driver generates image data corresponding to ten dimensional spaces in the CMYK color system on the basis of the RGB data.

[0067] The color conversion processing is performed on the basis of a table in which grayscale values of RGB data are associated with grayscale values of CMYK color system data (i.e., a color conversion lookup table LUT). Here, pixel data after having been subjected to the color conversion processing is CMYK color system data represented by the CMYK color system spaces and corresponding to, for example, 256 grayscale levels.

[0068] The halftone processing is processing for converting data having high grayscale levels (256 grayscale levels) into data having grayscale levels formable by the fabric printing apparatus 100. Through this halftone processing, each piece of data representing one of 256 grayscale levels is converted into, for example, a piece of one-bit data representing one of two grayscale levels (i.e., a dot presence and a dot absence), or a piece of two-bit data representing one of four grayscale levels (i.e., a dot absence, a small size dot, a middle size dot, and a large size dot). Specifically, based on a dot gen-

eration table in which each of grayscale values (0 to 255) is associated with one of dot generation ratios), dot generation ratios (for example, dot generation ratios each associated with a corresponding one of the dot absence, small size dot, middle size dot, and large size dot in the case of the four grayscale levels) are obtained, and using the obtained generation ratios, image data is generated so as to allow dots to be formed in a distributed state by means of a dither method, an error diffusion method, or the like.

[0069] The rasterization processing is processing for rearranging pixel data arranged in a matrix shape (for example, the one-bit data or the two-bit data, such as described above) in accordance with order in which dots are formed at the time of the execution of printing. The rasterization processing includes allocation processing for allocating image data constituted by the pixel data having been subjected to the halftone processing to individual pass operations through which ink droplets are discharged from the head 41 (the nozzle rows) being allowed to move and scan. Upon completion of the allocation processing, the pixel data arranged in a matrix shape is allocated to actual nozzles forming individual raster lines constituting an image to be printed.

[0070] The command addition processing is processing for adding command data in accordance with a printing method to the data having been subjected to the rasterize processing. Examples of the command data include, but are not limited to, transport data in relation to a transport specification (for example, a movement amount, a speed, and the like in the transport direction) with respect to a printing medium (the fabric 1).

[0071] These kinds of processing by the printer driver are performed by the ASIC 96 and the DSP 97 (see Fig. 2) under the control of the CPU 95, and the generated printing data is transmitted to the apparatus controller 80 via the interface 99 by printing data transmission processing.

[0072] In the fabric printing apparatus 100 having the aforementioned fundamental configuration, a situation where, in the printing region, when the transport belt 23 is displaced by a slight distance in the width direction of the fabric 1 (the X-axis direction) intersecting with the transport direction (the Y-axis direction), the position of the fabric 1 in the X-axis direction is displaced along with the displacement of the transport belt 23, and the displacement of the position of the fabric 1 in the X-axis direction causes the discrepancies of the landing positions of the ink droplets discharged onto the fabric 1 (i.e., the positions of dots formed by the ink droplets), thereby causing the degradation of the quality of printing (the quality of an image) constituted by the plurality of dots has sometimes occurred.

[0073] Since the belt guides 29 guide the transport belt 23 so as to come into contact with the width-direction edge portions of the transport belt 23, the displacements of the transport belt 23 in the width direction of the fabric 1 (the X-axis direction), intersecting with the transport

direction (the Y-axis direction), are prevented from causing large meandering. In the case where, however, for example, there is a variation in (the length of) the width of the transport belt 23 and/or in the case where there are concavo-convex portions that occur in the width-direction edge portions in accordance with the degree of treatment processing on the transport belt 23, the transport belt 23 may be slightly displaced along with the revolving of the transport belt 23 due to the stress from the belt guides 29 with which the transport belt 23 is in sliding contact. Further, in addition to the above factors, due to factors such as the eccentricity of each of the transport rollers 21, 26, and 28, the tension roller 22, the transport belt 23, the belt rotation roller 24, the belt driving roller 25, and the like, and the variation in assembling accuracy, the transport belt 23 may be slightly displaced.

[0074] Thus, the fabric printing apparatus 100 according to the present embodiment is configured to preliminarily obtain and evaluate displacement characteristic data in relation to the fabric printing apparatus 100, that is, data indicating the amounts of displacements of the transport belt 23 that occur in the direction intersecting with the transport direction of the transport belt 23 along with the movements of the transport belt 23 in the transport direction, and the apparatus controller 80 is configured to be capable of correcting ink-droplet imparting positions in the direction intersecting with the transport direction on the basis of the displacement characteristic data.

[0075] Hereinafter, this configuration will be specifically described.

Displacement Characteristic Data

[0076] First, the displacement characteristic data and a method of obtaining it will be described. An adjustment method for the fabric printing apparatus 100, according to the present embodiment of the invention, includes a step of obtaining the displacement characteristic data.

[0077] The displacement amounts, that is, the amounts of displacements of the transport belt 23 in the direction intersecting with the transport direction, are obtained by printing a predetermined pattern on a printing medium (the fabric 1 or printing paper mounted (supported) on the transport belt 23 and having been transported to the printing region, and analyzing the predetermined pattern having been printed thereon.

[0078] Fig. 5 is a diagram illustrating an example of the predetermined pattern used for obtaining the displacement amounts.

[0079] The predetermined pattern is constituted by a landing pattern (a dot row K shown in Fig. 5) formed by ink droplets discharged through a specific nozzle row provided in the head 41. The specific nozzle row corresponds to any nozzle row among the nozzle rows constituted by the plurality of nozzles 43, which are arranged along the transport direction (see Fig. 4), and corresponds to, for example, a nozzle row through which the

black ink (K) is discharged. Here, the dot row K formed as the specific pattern and shown in Fig. 5 is illustrated as a ruled line composed of dot rows.

[0080] First, the transport belt 23 is caused to stop at the position of a starting point in a transport system, and then, the head 41 is caused to stop at a predetermined position in the main-scanning direction (the X-axis direction) (this predetermined position being located at, for example, an approximately central position of the width of the transport belt 23) to allow a one-shot ink droplet to be discharged through each of the nozzles 43 in the nozzle row K so as to allow a dot row K1 to be formed. Next, the printing medium moved in the transport direction (the +Y direction) by a length D, that is, a length equal to that of the nozzle row, to allow one-shot ink droplets to be discharged again through all the nozzles in the nozzle row so as to allow a dot row K2 to be formed. Subsequently, the movement of the printing medium and the discharge of ink droplets are repeated in a similar manner, and as a result, the dot row K formed as the specific pattern and composed of dot rows K1 to Kn is printed.

[0081] Here, the position of the starting point in the transport system is a predetermined given position from which circumferential positions of the transport belt 23 constituting the fabric transporting section 20, and rotation positions of the individual transport rollers are specified, and any repeatable position may be employed as the position of the starting point. Information in relation to the circumferential positions of the transport belt 23 and the rotation positions of the individual transport rollers are obtained through components, such as encoders, provided at individual portions.

[0082] Next, the printing medium on which the predetermined pattern (the dot row K) has been printed is removed from the fabric printing apparatus 100, and displacement amounts of the respective dot rows K1 to Kn in the main-scanning direction (the X-axis direction) are measured. A method of measuring the displacement amounts is not particularly limited, but, for example, the image of the predetermined pattern (the dot row K) is read in as image data using a CCD (Charge Coupled Device) image sensor or the like, and image processing is performed on the image data to obtain the displacement amounts. In the present embodiment, the predetermined pattern (the dot row K) is read into the image processing device 90 as image data, and the displacement amounts can be obtained by allowing the image control section 91 to perform image processing on the image data. That is, the image processing device 90 includes the function as an "image processing section" configured to obtain the displacement characteristic data by recognizing the image of the predetermined pattern having been printed by the printing section 40 for the purpose of the measurement of the displacement amounts, and performing image processing on the recognized image of the predetermined pattern.

[0083] Herein, in order to make it possible to measure the displacement amounts without removing the printing

medium, on which the predetermined pattern (the dot row K) has been printed, from the fabric printing apparatus 100, the fabric printing apparatus 100 may be configured to include an image obtaining section, such as a CCD image sensor. In this case, the image obtaining section is disposed at a position at which the image of the printed predetermined pattern (the dot row K) can be obtained, that is, at the downstream side of the head 41 in the transport path for the fabric 1. Further, the image data having been obtained by the image obtaining section is preferably configured so as to be transmitted to the image processing device 90. In this case, the image processing device 90 exerts the function as the "image processing section" including the image obtaining section.

[0084] In this configuration, in order not to be affected by the displacements of the transport belt 23 in the direction intersecting with the transport direction when the image of the predetermined pattern (the dot row K) is obtained, for example, a straight line serving as a reference line (i.e., a reference line extending in the transport direction) on a printing medium on which the predetermined pattern (the dot row K) is to be printed is preferably provided in advance. In this manner, the displacement amounts can be obtained as relative values relative to the reference line in the X-axis direction.

[0085] Examples of a method of obtaining the displacement amounts from the image data corresponding to the predetermined pattern (the dot row K) using image processing include a method of obtaining the positions of gravity points P (in other words, the centre) of the respective dot rows K1 to Kn (in Fig. 5, the gravity point of the dot row K3 being shown as P), and then obtaining the displacement amounts thereof in the X-axis direction. The displacement characteristic data is obtained as the values of the differences of the positions of the gravity points P (X values) of the respective dot rows Kn relative to a reference position, that is, the position of the gravity point P of the dot row K1 (an X value).

[0086] Fig. 6 is a graph illustrating an example of plotted pieces of displacement characteristic data related to the transport belt 23 and having been obtained from image data corresponding to the predetermined pattern (the dot row K) shown in Fig. 5. In Fig. 5, for example, the printed position of the dot row K2 is out of alignment in the +X-axis direction relative to a reference position, that is, the position of the dot row K1, and this means that the printing medium (the transport belt 23) is displaced in the -X-axis direction, and thus, the X-axis polarity represented by each of the plots of the graph shown in Fig. 6 is reverse to the polarity of the X-axis direction discrepancy of a corresponding one of the dot rows shown in Fig. 5.

[0087] Note that the predetermined pattern is not limited to the aforementioned pattern. Any pattern that enables the displacement amounts of the transport belt 23 in the direction intersecting with the transport direction to be obtained as the displacement characteristic data using positions in the transport system (the fabric trans-

porting section 20) (for example, the positions being circumferential positions of the transport belt 23) may be employed. For example, a pattern obtained by forming a row of consecutive dots in a way that allows an ink droplet to be sequentially discharged at a constant interval through a specific nozzle 43 having been moved at an approximately central position of the width of the transport belt 23 while allowing the transport belt 23 to revolve at a constant speed from the position of the starting point in the transport system may be employed.

[0088] In the case where displacements of the transport belt 23 that occur in the direction intersecting with the transport direction along with the movement of the transport belt 23 in the transport direction are due to concavo-convex portions in the width-direction edge portions of the transport belt 23, the cycle of the displacement characteristic data corresponds to the cycle of the revolving of the transport belt 23, but in the case where any other factor is involved, the cycle of the displacement characteristic data may be longer.

[0089] Fig. 7 is a graph illustrating an example of two cycles of plotted pieces of displacement characteristic data having been obtained through a measurement. In the case where a plurality of main factors exist in the displacements of the transport belt 23 in the direction intersecting with the transport direction, a cycle T of the displacement characteristic data becomes longer than the cycle of the revolving of the transport belt 23.

[0090] In the case where displacement characteristic data is obtained as characteristics having periodicity, regardless of the factors of the displacements, the degradation of printing quality is minimized by correcting ink-droplet imparting positions in the direction intersecting with the transport direction in accordance with transport amounts from the position of the starting point in the transport system on the basis of the displacement characteristic data. Further, the degradation of the printing quality is minimized by adjusting the fabric printing apparatus 100 on the basis of the size of the displacements of the transport belt 23 in the direction intersecting with the transport direction (width direction) and the distribution of displacement positions.

[0091] Hereinafter, the adjustment method and the correction method will be specifically described.

Determination of Adjustment Position of Printing apparatus (Fabric Printing Apparatus)

[0092] One of the contents of the adjustment of the fabric printing apparatus 100 is the adjustment of ink-droplet landing positions in the main-scanning direction (the X-axis direction). This adjustment involves the correction of ink-droplet landing-position discrepancies that occur along with the scanning movement of the head 41. In this adjustment, first, ink-droplet landing positions in an outward path of the scanning movement are determined as target points, and next, ink-droplet landing positions in a return path of the scanning movement are

adjusted so as to correspond to the respective ink-droplet landing positions in the outward path (that is, the correction of position discrepancies is made).

[0093] The target points are points for determining the position of a printing region in the main-scanning direction (the X-axis direction), and with this determination of the target points, with respect to the aforementioned pieces of image data corresponding to a printed image and arranged in a matrix shape, their X-axis positions relative to the fabric 1 are determined. That is, in the case where, in order to correct the discrepancies between the ink-droplet landing positions in an outward path of the scanning movement and the ink-droplet landing positions in a return path of the scanning movement, the ink-droplet landing positions in the return path are caused to move in the X-axis direction, as a result, the position of a corresponding printing region is also shifted by the amount of the movement in the X-axis direction.

[0094] The adjustment method for the fabric printing apparatus 100, according to the present embodiment, includes a step of determining circumferential positions of the transport belt 23 at which the adjustment of the fabric printing apparatus 100 is performed. Specifically, circumferential positions of the transport belt 23 at each of which the aforementioned target points are determined is determined on the basis of the displacement characteristic data. More specifically, the central value of the width within which the transport belt 23 is displaced in the direction intersecting with the transport direction is obtained on the basis of the displacement characteristic data, and circumferential positions of the transport belt 23 at each of which the transport belt 23 is located at the central value are determined as the circumferential positions of the transport belt 23 at each of which the target points are determined. For example, in an example shown in Fig. 7, as circumferential positions of the transport belt 23 within the cycle T, positions y1, y2, and y3 are circumferential positions of the transport belt 23 at which the transport belt 23 is located at a central value (x3) of a width (x1 to x2) within which the transport belt 23 is displaced in the direction intersecting with the transport direction, and thus, at any one of these points, the adjustment of the fabric printing apparatus 100 (i.e., the determination of the target points and the correction of the ink-droplet landing position discrepancies) is performed. In other words, the center of the image in the width direction is aligned with the center of the belt at these circumferential positions. In addition to adjusting the fabric printing apparatus 100 in this way when the transport belt 23 is located at the central value, the ink-droplet landing positions at subsequent circumferential positions may be corrected relative to the landing positions at circumferential positions of the transport belt 23 at which the transport belt 23 is located at a central value.

[0095] In the case where the periodicity is recognized in the displacement characteristic data, that is, in the case where displacement amounts of the transport belt 23 in the direction intersecting with the transport direction can

be repeated using the positions in the transport system (the fabric transporting section 20), the positions y_1 , y_2 , and y_3 can be simply and easily obtained as positions at each of which the central value x_3 is given, by referring to the displacement characteristic data.

[0096] Further, in the case where the displacement characteristic data is obtained as, for example, a function $f(m, n, l)$, these m , n , and l being factors, a method that allows the central value x_3 to be obtained from a minimum value x_1 and a maximum value x_2 , and allows a position in the transport system (the fabric transporting section 20) to be derived as a position at which the factors m , n , and l give the central value x_3 may be employed.

[0097] In the present embodiment, the displacement characteristic data having been obtained in the image processing device 90 is stored in the memory 83 included in the apparatus controller 80. The apparatus controller 80 determines a reference position for the printing in the direction intersecting with the transport direction on the basis of the displacement characteristic data having been stored in the memory 83. Specifically, first, the apparatus controller 80 derives a position used for determining the target points and included in the transport system (the fabric transporting section 20) (the position being, for example, a circumferential position of the transport belt 23) on the basis of the displacement characteristic data, and drives the transport system (the fabric transporting section 20) to allow relative movement of the head 41 to the derived position. Next, the apparatus controller 80 derives target points (ink-droplet landing positions in the outward path of the scanning movement) on the basis of the displacement characteristic data, and drives the head moving section 41 to allow the head 41 to move to the target points.

[0098] The fabric printing apparatus 100 can perform the adjustment of the ink-droplet landing positions in the return path of the scanning movement (i.e., the correction of position discrepancies) so as to allow the ink-droplet landing positions in the return path to correspond to the target points.

[0099] As described above, the target points are points for determining a printing region in the main-scanning direction (the X-axis direction), and the determination of the target points is, namely, equivalent to the determination of the reference position for the printing in the direction intersecting with the transport direction.

[0100] Further, the target points are points for determining a printing region in the main-scanning direction (the X-axis direction), and thus, the determination of the target points based on the displacement characteristic data is, in other words, equivalent to the correction of the ink-droplet imparting positions in the direction intersecting with the transport direction. Correction of Ink Discharging Positions

[0101] In the present embodiment, in the case where the displacement characteristic data is obtained as characteristic data having periodicity, that is, in the case where the displacement characteristic data includes at

least one cycle of data in which the displacement values vary, based on displacement values each associated with and obtained at a corresponding one of circumferential positions of the transport belt 23 within one cycle, the apparatus controller 80 corrects ink-droplet imparting position in the direction intersecting with the transport direction at each of the circumferential positions.

[0102] Specifically, when one straight line extending in the transport direction (the Y-axis direction) is attempted to be printed without correction from a reference position in such a way that, for example, only a nozzle row through which the black ink is discharged is used, and the printing is performed through n passes at intervals of a pitch D , that is, a feed pitch in the transport direction (the Y-axis direction), in the case where the transport belt 23 is displaced in accordance with the displacement characteristic data shown in Fig. 6, the straight line to be printed results in discontinuous straight lines shown in Fig. 5. Since the displacement amount corresponding to each of circumferential positions of the transport belt 23 is already known from the displacement characteristic data, the apparatus controller 80 can allow the discontinuous straight lines to be printed as straight lines more similar to one straight line by correction-controlling the timing of the discharge of ink droplets so as to allow the timing to be associated with the position of each of the passes (that is, each of the circumferential positions of the transport belt 23).

[0103] More specifically, the apparatus controller 80 includes a data table in which each of ink-droplet discharge timing correction values is associated with a corresponding one of correction values in the X-axis direction. Allowing the driving control section 84 (see Fig. 2) to correct the timing of driving the head 41 at each pass by a correction value associated with each pass enables the position of a straight line to be printed to be corrected to an appropriated position.

[0104] Note that the correction value of the timing of the discharge of ink droplets can be simply and easily calculated from the movement speed of the carriage, and thus, a real-time correction that allows the movement speed of the carriage to be constantly detected and allows the ink discharge to be performed at timing at which an integrated value of the movement speed of the carriage coincides with a target correction value in the X-axis direction may be made.

[0105] As described above, according to the printing apparatus and the adjustment method for the printing apparatus, according to the present embodiment, the following advantageous effects are brought about.

[0106] The apparatus controller 80 corrects ink-droplet imparting positions in the direction intersecting with the transport direction on the basis of the displacement characteristic data indicating the displacement amounts of the transport belt 23 that arise in the direction intersecting with the transport direction along with the movements of the transport belt 23 in the transport direction. That is, the positions of the ink droplets imparted onto the fabric

1 which is transported by the transport belt 23 and whose position is displaced along with the displacements of the transport belt 23 are corrected on the basis of the displacement characteristic data indicating the displacement amounts of the transport belt 23 that arise in the direction intersecting with the transport direction along with the movements of the transport belt 23 in the transport direction. As a result, the correction relative to the displacements of the transport belt 23 in the direction intersecting with the transport direction is made with high accuracy, and the degradation of printing quality that occurs along with the displacements is further effectively reduced.

[0107] Further, the apparatus controller 80 determines a reference position for the printing in the direction intersecting with the transport direction on the basis of the displacement characteristic data indicating the displacement amounts of the transport belt 23 that arise in the direction intersecting with the transport direction along with the movements of the transport belt 23 in the transport direction. As a result, printing on the fabric 1 which is transported by the transport belt 23 and whose position is displaced along with the displacements of the transport belt 23 is performed at further appropriated positions.

[0108] Further, in the case where the displacement characteristic data indicating the displacement amounts of the transport belt 23 that arise in the direction intersecting with the transport direction along with the movements of the transport belt 23 in the transport direction is obtained as characteristic data having periodicity, that is, in the case where the displacement characteristic data includes at least one cycle of data in which the displacement amounts vary, based on displacement values each associated with and obtained at a corresponding one of circumferential positions of the transport belt 23 within the one cycle, the apparatus controller 80 corrects ink-droplet imparting positions in the direction intersecting with the transport direction at each of the circumferential positions. That is, the ink-droplet imparting positions on the fabric 1 which is transported by the transport belt 23 and whose position is displaced along with the displacements of the transport belt 23 are corrected on the basis of the displacement characteristic data, that is, data indicating displacement values each associated with a corresponding one of movement positions of the transport belt 23 in the transport direction. As a result, the correction with the displacements of the transport belt 23 in the direction intersecting with the transport direction is made with higher accuracy, and the degradation of printing quality is minimized.

[0109] Further, the fabric printing apparatus 100 is configured to, in order to measure the displacement values of the transport belt 23 that arise in the direction intersecting with the transport direction along with the movements of the transport belt 23 in the transport direction, include the image processing device 90 serving as an image processing section that obtains the displacement characteristic data by recognizing the image of the pre-

determined pattern having been printed by the printing section 40, and performing image processing on the recognized image of the predetermined pattern. Thus, for example, a user of the fabric printing apparatus 100 is able to update the displacement characteristic data so as to allow the displacement characteristic data to reflect the latest condition of the fabric printing apparatus 100. As a result, the correction with the displacements of the transport belt 23 in the direction intersecting with the transport direction is made with high accuracy, and the degradation of printing quality is minimized.

[0110] Further, the adjustment method for the fabric printing apparatus 100, according to the present embodiment, includes a step of obtaining displacement characteristic data indicating displacement values of the transport belt 23 that arise in the direction intersecting with the transport direction along with the movements of the transport belt 23 in the transport direction, and a step of determining circumferential positions of the transport belt 23 at which the adjustment of the fabric printing apparatus 100 is performed on the basis of the obtained displacement characteristic data. Moreover, at each of the circumferential positions having been determined in the above step, the adjustment of ink-droplet imparting positions in the direction intersecting with the transport direction is performed. That is, the adjustment of the ink-droplet imparting positions in the direction intersecting with the transport direction is performed at each of the circumferential positions having been determined on the basis of the displacement characteristic data indicating the displacement values of the transport belt 23 that arise along with the movements of the transport belt 23 in the transport direction. This configuration, therefore, enables the adjustment of the ink-droplet imparting positions to be performed at positions where the displacements of the transport belt 23 in the direction intersecting with the transport direction are further stable, and as a result, this configuration enables the adjustment to be performed further appropriately.

[0111] The adjustment of the ink-droplet imparting positions in the direction intersecting with the transport direction can be performed at circumferential positions of the transport belt 23 at each of which the transport belt 23 is located at the central value of the width within which the transport belt 23 is displaced in the direction intersecting with the transport direction. This configuration, therefore, enables the adjustment of the ink-droplet imparting positions to be performed at positions where the displacements of the transport belt 23 in the direction intersecting with the transport direction are further stable, and as a result, this configuration enables the adjustment to be performed further appropriately.

[0112] It should be noted that the invention is not limited to the aforementioned embodiment, and various modifications, improvements, and the like can be performed on the aforementioned embodiment. Some modification examples will be described below. Here, the same constitutional elements as constitutional elements of the

aforementioned embodiment will be denoted by the same reference signs as those of the constitutional elements of the aforementioned embodiment, and will be omitted from duplicated description.

Modification Example 1

[0113] In the aforementioned embodiment, a method has been described that determines circumferential positions of the transport belt 23 at which the transport belt 23 is located at the central value of the width within which the transport belt 23 is displaced in the direction intersecting with the transport direction to establish the target points in the adjustment of the fabric printing apparatus 100. However, the invention is not limited to this method.

[0114] A method of obtaining the most frequent position at which the transport belt 23 is most frequently located in the direction intersecting with the transport direction, and determining a circumferential position of the transport belt 23 at which the transport belt 23 is located at the most frequent position or positions, as a circumferential position of the transport belt 23 at which the adjustment of the fabric printing apparatus 100 is performed may be employed. According to this method, the adjustment of an ink-droplet imparting position in the direction intersecting with the transport direction is performed at the most frequent position at which the transport belt 23 is most frequently located in the direction intersecting with the transport direction, and thus, an effective adjustment that allows the ratio of a contribution of a period of time during which the adjustment result is reflected to be higher is achieved. A position to the side or the edge could also be used instead of or as well as the central position. Modification Example 2

[0115] In the aforementioned embodiment, an example in which, in order to measure the displacement values of the transport belt 23 that arise in the direction intersecting with the transport direction along with the movements of the transport belt 23 in the transport direction, the image processing device 90 includes the function of an "image processing section" configured to obtain the displacement characteristic data by recognizing the image of the predetermined pattern having been printed by the printing section 40, and performing image processing on the recognized image of the predetermined pattern has been described, but the fabric printing apparatus 100 need not include the "image processing section".

[0116] For example, a configuration that allows a manufacturer that manufactures the fabric printing apparatuses 100 to obtain, for each of the fabric printing apparatuses 100, displacement characteristic data in relation to the transport belt 23, and allows the manufacture to provide a user with the fabric printing apparatus 100 including the displacement characteristic data stored in the memory 83 or the storage section 94 may be employed. At the stage of a user's usage, the same adjustment and correction as those in the aforementioned embodiment can be performed by allowing the apparatus controller

80 to obtain the displacement characteristic data stored in the memory 83 or the storage section 94.

[0117] Alternatively, a method that allows the displacement characteristic data to be generated using a means other than the image processing device 90 by, at the execution of maintenance of the fabric printing apparatus 100, printing the predetermined pattern used for obtaining the displacement characteristic data and having been described in the aforementioned embodiment, and analyzing the result of the printing may be employed.

Claims

1. A printing apparatus (100) comprising:
 - a transport belt (23) configured to transport a printing medium (1) in a transport direction (Y);
 - a printing section (40) configured to perform printing by imparting ink droplets onto the printing medium having been transported; and
 - a control section (80) configured to control positions for imparting the ink droplets, wherein, based on displacement characteristic data indicating displacement amounts of the transport belt that arise in a direction intersecting with the transport direction along with movements of the transport belt in the transport direction, the control section is configured to correct the positions for imparting the ink droplets, in the direction intersecting with the transport direction.
2. The printing apparatus according to Claim 1, wherein the control section is configured to determine a reference position for the printing in the direction intersecting with the transport direction based on the displacement characteristic data.
3. The printing apparatus according to Claim 1 or Claim 2, wherein the displacement characteristic data includes at least one cycle (T) of data in which the displacement values vary, and wherein, based on at least one displacement amount which is among the displacement amounts and which is associated with and obtained at a corresponding one of at least one circumferential position of the transport belt within the one cycle, the control section is configured to correct positions for imparting the ink droplets, in the direction intersecting with the transport direction at each of the at least one circumferential position.
4. The printing apparatus according to any one of the preceding claims, further comprising, in order to measure the displacement values, an image processing section (90) configured to obtain the dis-

placement characteristic data by recognizing an image of a predetermined pattern having been printed by the printing section, and performing image processing on the recognized image of the predetermined pattern.

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5. An adjustment method for a printing apparatus (100) including a transport belt (23) configured to transport a printing medium (1) in a transport direction (Y), and a printing section (40) configured to perform printing by imparting ink droplets onto the printing medium having been transported, the adjustment method comprising:

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obtaining displacement characteristic data indicating displacement amounts of the transport belt that arise in a direction intersecting with the transport direction along with movements of the transport belt in the transport direction; and determining, based on the displacement characteristic data, at least one circumferential position of the transport belt at which an adjustment of the printing apparatus is performed, wherein an adjustment of positions for imparting the ink droplets, in the direction intersecting with the transport direction, is performed at each of said least one circumferential position having been determined.

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6. The adjustment method according to Claim 5, wherein, based on the displacement characteristic data, a central value of a width within which the transport belt is displaced in the direction intersecting with the transport direction is obtained, and at least one circumferential position of the transport belt at which the transport belt is located at the central value is determined as said at least one circumferential position of the transport belt at which the adjustment of the printing apparatus is performed.

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7. The adjustment method according to Claim 5 or Claim 6, wherein, based on the displacement characteristic data, a most frequent position at which the transport belt is most frequently located in the direction intersecting with the transport direction is obtained, and a circumferential position of the transport belt at which the transport belt is located at the most frequent position is determined as a circumferential position of the transport belt at which the adjustment of the printing apparatus is performed.

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FIG. 1

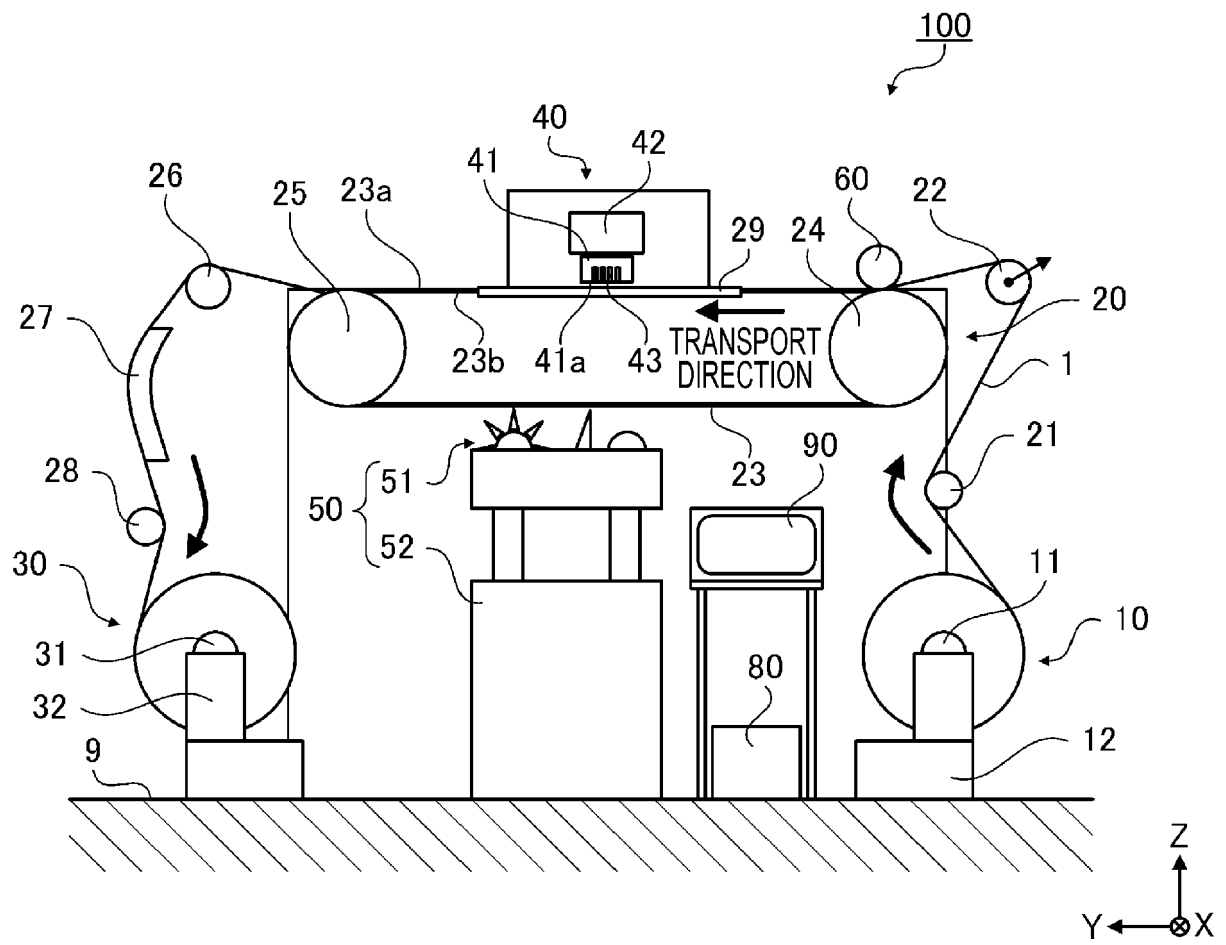


FIG. 2

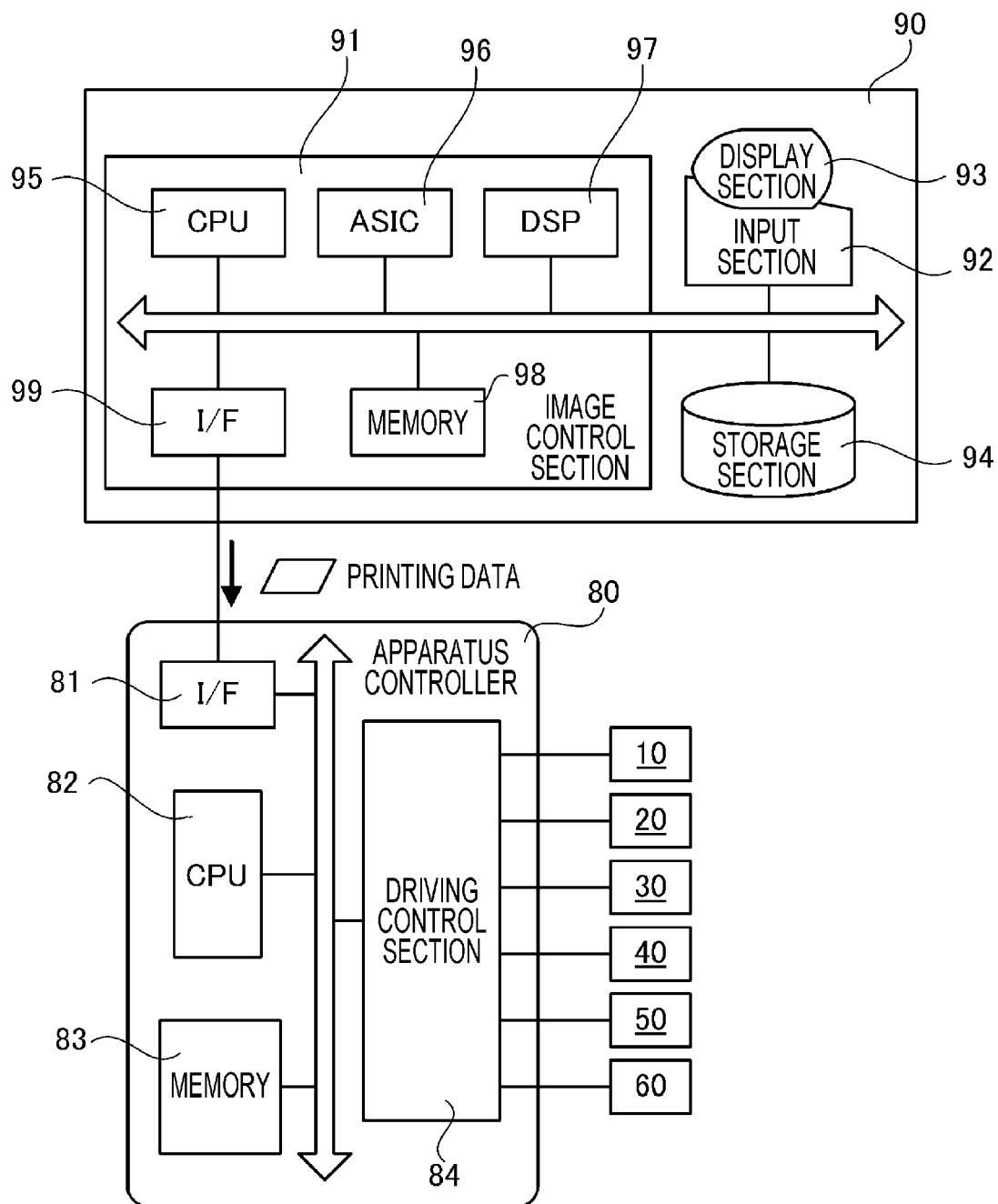


FIG. 3

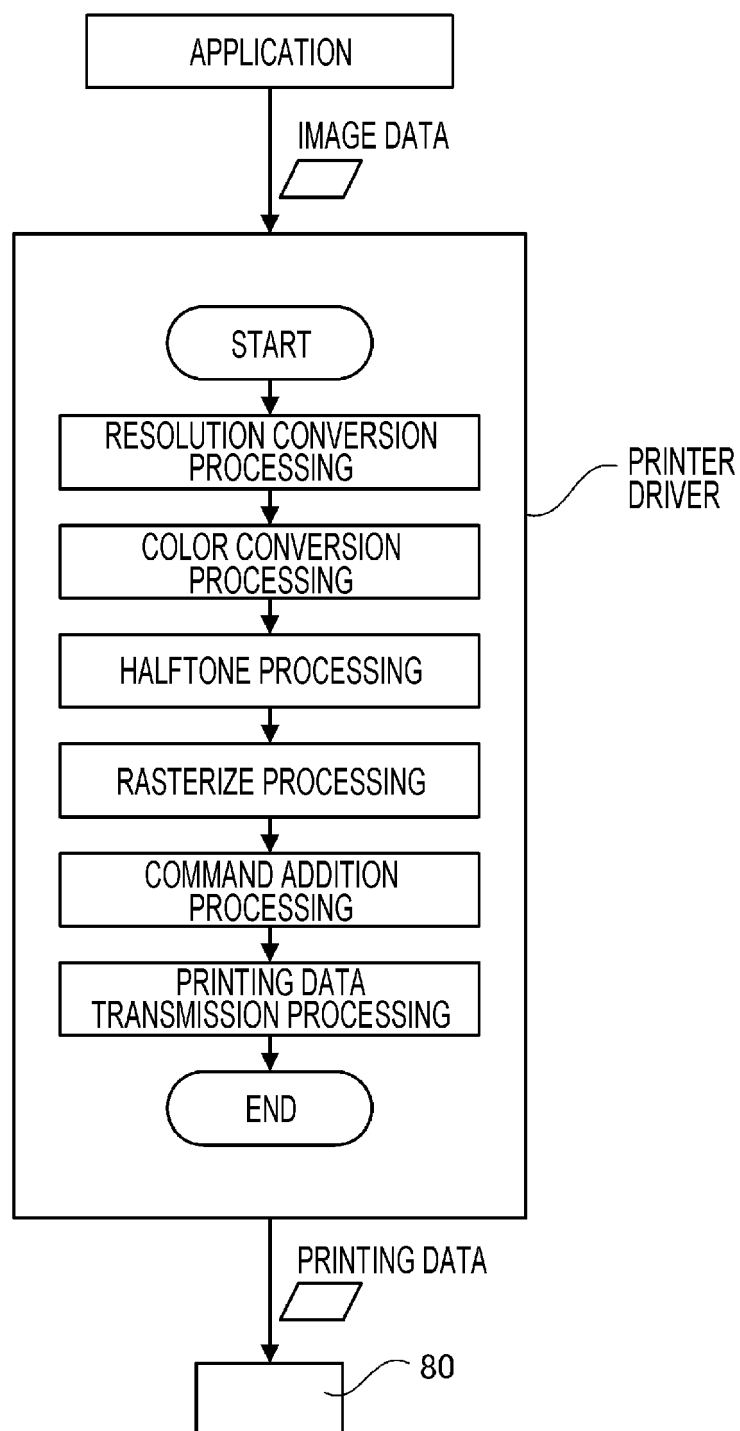


FIG. 4

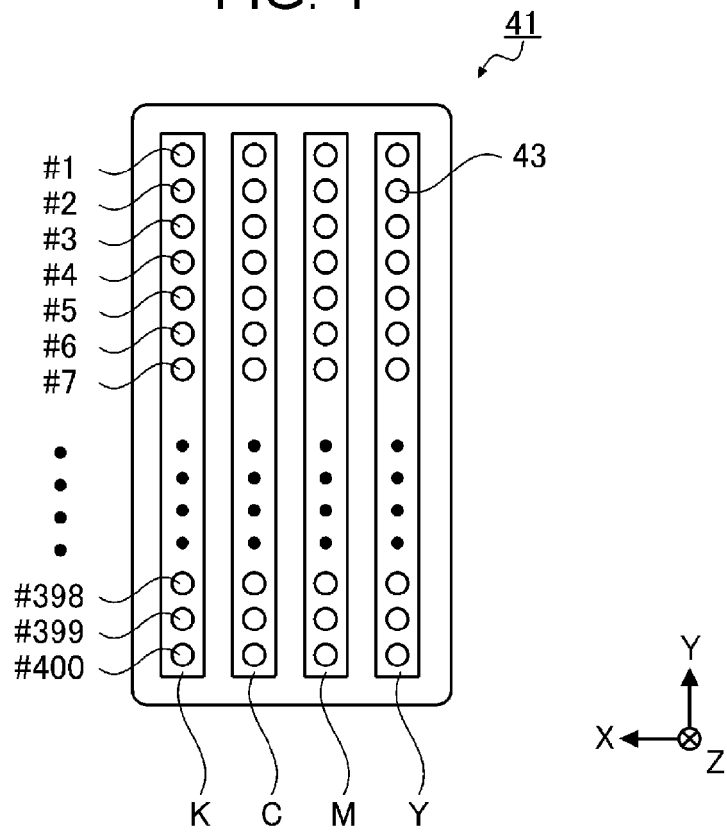


FIG. 5

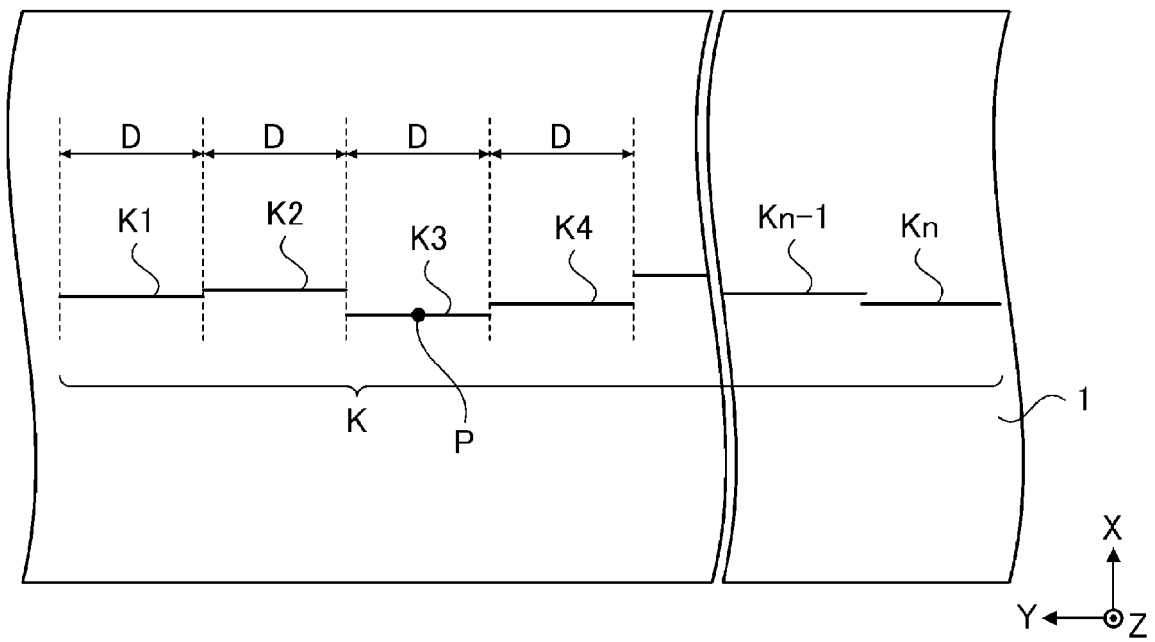


FIG. 6

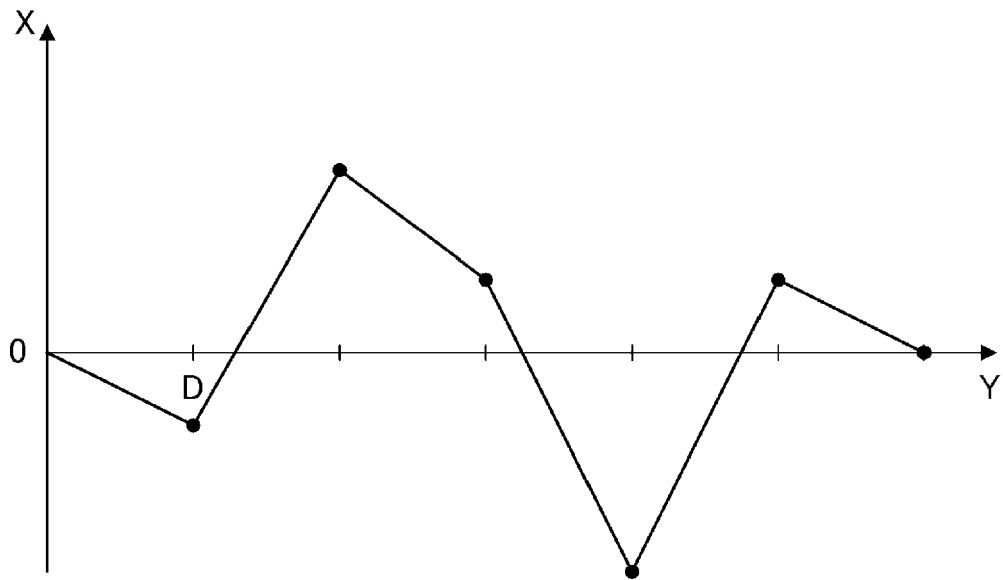
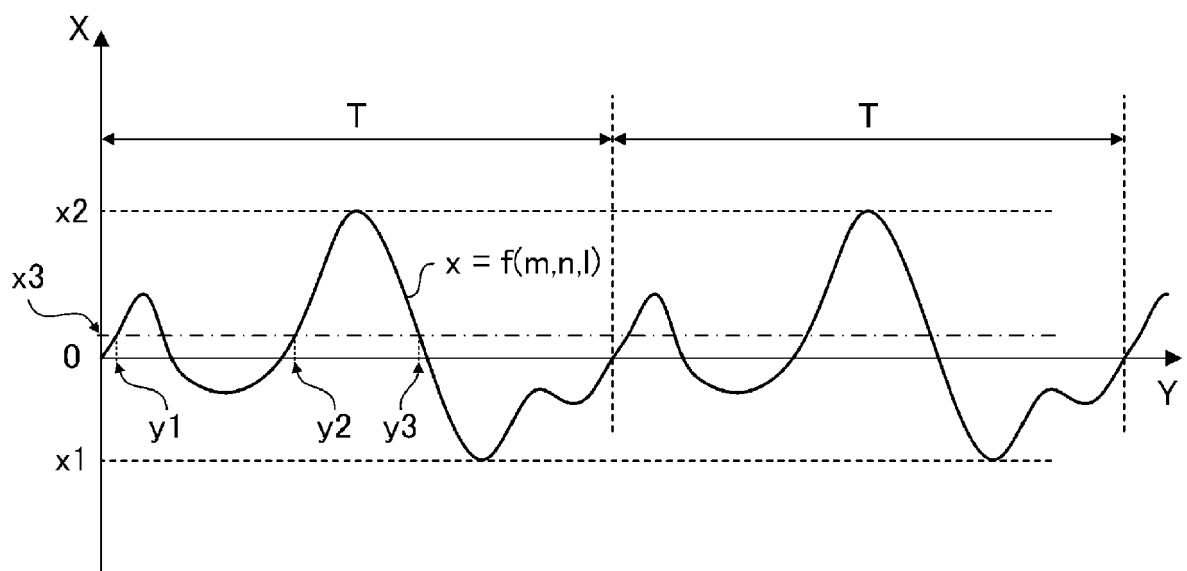


FIG. 7





EUROPEAN SEARCH REPORT

Application Number
EP 17 19 9592

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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 2005/219557 A1 (KOIKE YOSHIKAZU [JP]) 6 October 2005 (2005-10-06) * paragraphs [0040], [0045] - [0060]; claims 12-16; figures 1-4 *	1-6	INV. B41J11/00 B41J15/04
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X	US 2005/219292 A1 (KOIKE YOSHIKAZU [JP]) 6 October 2005 (2005-10-06) * paragraphs [0038] - [0056]; claims 3, 4; figures 1-5 *	1-3,5	
A	JP 2000 221860 A (MATSUSHITA ELECTRIC IND CO LTD) 11 August 2000 (2000-08-11) * paragraphs [0030] - [0037]; figures 2, 3 *	4	
			TECHNICAL FIELDS SEARCHED (IPC)
			B41J
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 16 March 2018	Examiner Gaubinger, Bernhard
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 17 19 9592

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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