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(54) **PRINTER AND PRINTING METHOD**

(57) Provided is a printer for developing target reproduced colors on a printing medium containing a plurality of regions having different color development characteristics from each other. Liquid drops for developing colors are fed to a region of base texture and a region of nap raising texture of a printing medium P from ink jets head 4 and 5 respectively corresponding to these regions to develop target reproduced colors on the printing medium P.

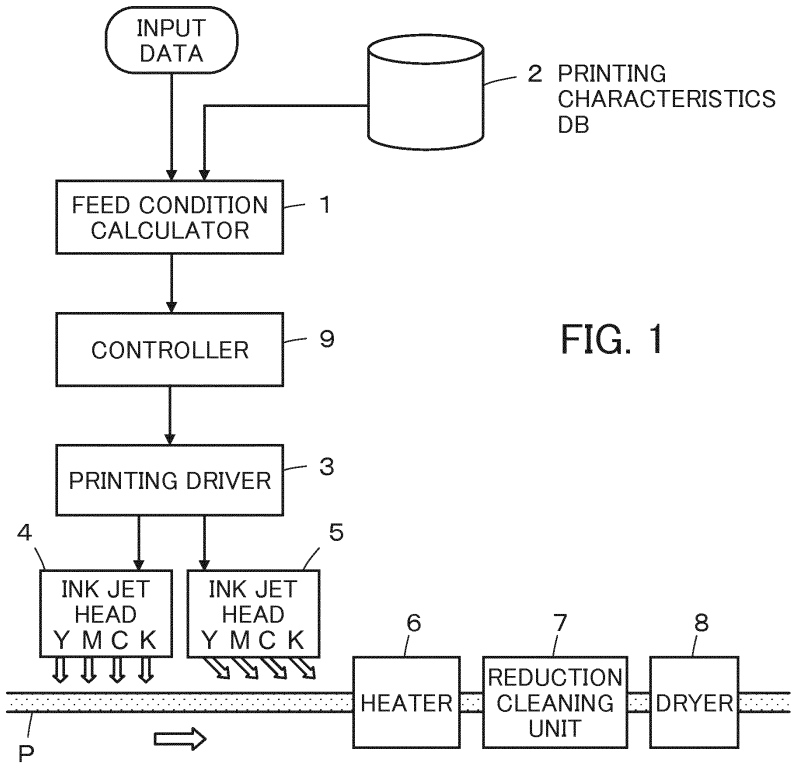

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to a printer and a printing method and in particular to a printer and a printing method for printing onto a printing medium containing a plurality of regions having different color development characteristics.

BACKGROUND ART

[0002] Cloth, textiles, and the like are widely used in daily commodities, and are available in diversified forms and materials. Accordingly, there is a demand for developing colors that are substantially the same as target reproduced colors.
Among such diversified textiles are, for example, a nap raising fabric obtained by raising the surface of a base texture of a fabric, a piled fabric with piles on the surface of a base texture, a hook and loop fastener with resin-made hooks and loops attached to a base texture. With a printing medium comprising a plurality of regions different from each other such as a nap raising portion and the base texture, a piled portion and the base texture, the hook-and-loop region of a fastener and the base texture, the ink deposition ratio and the ink color development ratio, for example, vary with region, so that the color development varies with region, though printing be done under the same printing conditions. In addition, because these regions may be located close to each other or one above the other in the thickness direction, control to obtain a desired color development by controlling, for example, the deposition position in ink jet printing is difficult. To solve such a problem, used is a method in which the printing conditions are changed with respect to the color development characteristics in the respective regions to achieve development of colors substantially the same as target reproduced colors.

[0003] Patent Literature 1, for example, proposes developing consistent colors in the cross section of the tips of the nap raising texture by ejecting ink drops with the nozzle diameters changed according to, for example, diameter and length of the raised fibers of a nap raising fabric.

PRIOR ART LITERATURE

PATENT LITERATURE

[0004]

Patent Literature 1: JP 2799595 B

SUMMARY OF INVENTION

TECHNICAL PROBLEMS

[0005] However, though a consistent color development be obtained only in the nap raising texture, when printing is to be implemented on a printing medium containing a plurality of regions having different color development characteristics from each other such as a nap raising fabric, a piled fabric, and a fabric having a fastener, it would be difficult to develop colors substantially the same as target reproduced colors in the individual regions of the printing medium.

[0006] The present invention has been made to solve the above problems in the art and to provide a printer and a printing method capable of developing target reproduced colors on a printing medium containing a plurality of regions having different color development characteristics from each other.

SOLUTION TO PROBLEMS

[0007] To achieve the above objects, a printer according to the invention is a printer for printing onto a printing medium containing regions having different color development characteristics from each other to develop target reproduced colors, the printer comprising: liquid drop feeders for feeding liquid drops for developing colors advantageously in respective regions of the printing medium, a calculator for calculating feed conditions of liquid drops respectively fed from the liquid drop feeders so that the target reproduced colors are developed on the printing medium, a driver for driving the liquid drop feeders, and a controller for controlling the driver based on the feed conditions calculated by the calculator.

[0008] The liquid drop feeders may include a first ink jet device for feeding ink drops by ink jet method. The liquid drop feeders may include a second ink jet device for feeding ink drops by ink jet method in a different direction from the first

ink jet device. The liquid drop feeders may include an atomizer for feeding atomized ink drops. The liquid drop feeders may include a hydrophilizing solution feeder for feeding liquid drops of a hydrophilizing solution for hydrophilizing the printing medium. The liquid drop feeders may include a first atomizer for feeding electrically charged atomized ink drops and a second atomizer for feeding atomized ink drops without electrification thereof.

[0009] The calculator may calculate feed conditions of liquid drops to be fed respectively from the liquid drop feeders based on information on the regions of the printing medium and information on the target reproduced colors to be printed onto the printing medium.

Database may be further included which contains previously stored therein color development information for developing colors in the regions of the printing medium with the liquid drop feeders corresponding thereto, whereas the calculator may extract the color development information for developing the target reproduced colors in the regions of the printing medium from the database based on the information on the regions of the printing medium to be printed and the information on the target reproduced colors to calculate feed conditions of liquid drops to be fed from the liquid drop feeders.

[0010] Measuring units for measuring colors of the printing medium developed by supply of liquid drops from the liquid drop feeders, and a measurement value input unit for inputting results of measurement of colors on the printing medium obtained with the measuring units to the calculator may be further included; whereas the calculator may correct calculated feed conditions of liquid drops fed from the liquid drop feeders based on the results of measurement of colors on the printing medium and the information on target reproduced colors, and the controller may control the driver so that the liquid drops are fed with the feed conditions corrected by the calculator.

[0011] Further, another printer according to the invention is a printer for printing onto a printing medium containing a plurality of regions having different color development characteristics from each other to develop target reproduced colors, the printer comprising: a corona treatment device for hydrophilizing at least one region of a plurality of regions of the printing medium through corona treatment, an ink jet device for feeding ink drops onto the printing medium by ink jet method, and an ink feeder for developing the target reproduced colors on the printing medium by controlling the corona treatment device and the ink jet device.

[0012] The regions of the printing medium include a region composed of a nap raising texture. The regions of the printing medium may include a region composed of a piled fabric. The plurality of regions of the printing medium may include a region composed of a fastener hook-and-loop region.

[0013] A printing method according to the invention is a printing method for printing onto a printing medium containing a plurality of regions having different color development characteristics from each other to develop target reproduced colors, the printing method comprising: feeding liquid drops for developing colors from liquid drop feeders that feed inks advantageously to the respective regions of the printing medium to develop the target reproduced colors on the printing medium.

Another printing method is a printing method for printing onto a printing medium containing a plurality of regions having different color development characteristics from each other and developing target reproduced colors, the method comprising: hydrophilizing at least one of a plurality of regions of the printing medium through corona treatment, and feeding ink drops to the printing medium by ink jet method to develop the target reproduced colors.

ADVANTAGEOUS EFFECTS OF INVENTION

[0014] The present invention enables target reproduced colors to be developed on a printing medium containing a plurality of regions having different color development characteristics from each other.

BRIEF DESCRIPTION OF DRAWINGS

[0015]

[FIG. 1] FIG. 1 is a block diagram illustrating a configuration of a printer according to Embodiment 1 of the invention.
[FIG. 2] FIG. 2 is a block diagram illustrating information stored in a printing characteristics database.
[FIG. 3] FIG. 3 is a block diagram illustrating a configuration of a printer according to Embodiment 2.
[FIG. 4] FIG. 4 is a block diagram illustrating part of a configuration of a printer according to Embodiment 3.
[FIG. 5] FIG. 5 is a block diagram illustrating part of a configuration of a printer according to Embodiment 4.
[FIG. 6] FIG. 6 is a block diagram illustrating part of a configuration of a printer according to a variation of Embodiment 4.
[FIG. 7] FIG. 7 is a block diagram illustrating part of a configuration of a printer according to another variation of Embodiment 4.
[FIG. 8] FIG. 8 is a block diagram illustrating part of a configuration of a printer according to Embodiment 5.
[FIG. 9] FIG. 9 is a block diagram illustrating part of a configuration of a printer according to Embodiment 6.
[FIG. 10] FIG. 10 is a block diagram illustrating part of a configuration of a printer according to a variation of Em-

bodiment 6.

[FIG. 11] FIG. 11 is a block diagram illustrating part of a configuration of a printer according to another variation of Embodiment 6.

DESCRIPTION OF EMBODIMENTS

[0016] The present invention is described in detail below based on the preferred embodiments shown in the accompanying drawings.

Embodiment 1

[0017] FIG. 1 illustrates a configuration of a printer according to Embodiment 1 of the present invention. The printer comprises a feed condition calculator 1, a printing characteristics database (DB) 2, a controller 9, a printing driver 3, and ink jet heads 4 and 5.

[0018] Information on a printing medium P containing regions of base texture and regions of nap raising texture having different color development characteristics from each other and information on target reproduced colors of a print image to be printed on the printing medium P are input to the feed condition calculator 1 as input data by an operator. The information on the printing medium P includes information on, for example, materials, material fiber diameter, and number of the fibers of the individual regions of the printing medium P. The target reproduced color information includes information on, for example, target reproduced color chromaticities in individual regions of the printing medium P.

The feed condition calculator 1 is connected to the printing characteristics database 2. The feed condition calculator 1 searches the printing characteristics database 2 based on the information on the printing medium P and the target reproduced colors to extract the kinds of inks and ink feed parameters for the ink jet heads 4 and 5 representing developed colors the closest to the target reproduced colors for individual regions of the printing medium P. The ink feed parameters include voltage, frequency, and waveform that are outputted to the ink jet heads 4 and 5. The feed condition calculator 1 calculates the point in time at which the ink jet heads 4 and 5 shoot inks based on the movement speed of the printing medium P.

[0019] The feed condition calculator 1 is connected to the controller 9. The controller 9 controls printing onto the printing medium P by inputting the printing driver 3 with electric signals representing the kinds of inks and the ink feed parameters extracted by the feed condition calculator 1 at a point in time when the inks are to be shot from the ink jet heads 4 and 5. The controller 9 is connected to the printing driver 3. The printing driver 3 drives the ink jet heads 4 and 5 according to the electric signals inputted from the controller 9.

The printing driver 3 is connected to the ink jet heads 4 and 5. The ink jet heads 4 and 5 are so-called ink jet type printing heads for ejecting inks by using, for example, expansion and contraction of piezoelectric elements. The ink jet heads 4 and 5 eject four kinds of inks Y, M, C, and K. The ink jet head 4 shoots inks at the printing medium P from the perpendicular direction. The ink jet head 4 is capable of printing on regions of both the base texture and the nap raising texture but capable of printing more advantageously onto regions of the base texture than the nap raising texture. The ink jet head 5 shoots inks at the printing medium P from a diagonal direction and hence causes colors to develop more advantageously in, for example, regions of the nap raising texture of the printing medium P.

[0020] Downstream of the ink jet heads 4 and 5 in the printing medium P feed direction, there are provided treatment equipments to ensure that the color materials in the inks reach the printing medium P first. For example, where the printing medium P is composed of a polyester fiber, a disperse dye is used as color material, and the treatment equipments provided include a heater 6, a reduction cleaning unit 7, and a dryer 8 in sequence. The heater 6 applies heating treatment to the printed printing medium P. The reduction cleaning unit 7 performs reduction cleaning of the printing medium P and uses, for example, a reduction cleaner aid such as hydrosulphite. The dryer 8 is provided to dry the printing medium P. Where the printing medium P is made of a material other than polyester such as silk, cotton, or wool fiber, an appropriate color material is used and appropriate treatment equipments are provided accordingly.

[0021] FIG. 2 shows information stored in the printing characteristics database 2. The printing characteristics database 2 stores color development information on each of the combinations of a plurality of kinds of inks, a plurality of ink feed parameters, and a plurality of kinds of regions of the printing medium for the ink jet heads 4 and 5. The feed condition calculator 1 selects color development information representing color development the closest to target reproduced colors for the individual regions of the printing medium P and extracts a combination of kinds of inks and ink feed parameters of the ink jet heads 4 and 5 satisfying that color development information. The color development information may be, for example, ink deposition ratio and color development ratio. The deposition ratio is a ratio of a shot amount of ink shot at the individual regions of the printing medium to an amount of color material caught in the individual regions of the printing medium. The color development ratio is a degree of color development in the individual regions of the printing medium expressed in terms of, for example, optical reflectance or K/S, as inks are shot at the individual regions of the printing medium in a given unit amount. Where K/S is used to express the color development ratio, the color

development ratio is expressed by a following expression (1) when, for example, color development is to be implemented with one color of ink. Where color development is achieved by mixing a plurality of inks, such as four colors of inks, the color development ratio is expressed by a following equation (2).

[0022] Kubelka and Munk showed that K/S has the following characteristics.

$$K/S = (1-Rc)^2/2Rc \quad \cdots (1)$$

$$(K/S)mix = Jy(K/S)y + Jm(K/S)m + Jc(K/S)c + Jk(K/S)k \cdots (2)$$

[0023] The equation (1) shows the relation between color material's absorption intensity K, light scattering intensity S of light from the printing medium, and reflectance Rc for each wavelength. In the equation (2), (K/S)mix denotes K/S in a region where a plurality of color materials are printed and mixed; (K/S)y, (K/S)m, (K/S)c, and (K/S)k denote K/S where unit amounts of the four color materials are deposited, respectively; and Jy, Jm, Jc, and Jk denote the amounts attachment of the four colors of color materials onto the printing medium. Thus, K/S where a plurality of color materials is mixed is expressed as linear sum of ratios K/S of the respective color materials that vary with the amounts of attachment. Using the linearity, the color development resulting from attachment of each of the color materials in any given amount can be calculated.

"Ink" herein is defined as color material dissolved or dispersed in a given concentration. "Color materials" are used to develop colors and include dyes, pigments, coloring matter, and coating materials.

[0024] Next, the operation of the printer illustrated in FIG. 1 will be described.

[0025] First, the feed condition calculator 1 searches the printing characteristics database 2 based on operator-entered information on the printing medium P and information on the target reproduced colors of a print image to be printed on the printing medium P. The feed condition calculator 1 searches the information on the kinds of regions of printing media in the printing characteristics database 2 for regions representing the same kinds as those of the base texture and the nap raising texture of the printing medium P.

Then, the feed condition calculator 1 converts the reproduction target in the individual regions of the base texture and the nap raising texture of the printing medium P into color development information target representing color development. The color development information may be deposition amounts of color materials Y, M, C, and K in the inks deposited onto the individual regions of the base texture and the nap raising texture. The color development information may be colorimetric values such as L*a*b* obtained from optical reflectance of the individual regions of the base texture and the nap raising texture.

The feed condition calculator 1 uses data in the printing characteristics database 2 and obtains the ink feed parameters for all the kinds of inks for the ink jet heads 4 and 5 (YMCK x 2 = 8 kinds) such that the color development information on the individual regions of the base texture and the nap raising texture are the color development information target. Using data in the printing characteristics database 2, the feed condition calculator 1 may also predict the color development given the ink feed parameters of all the kinds of inks for the ink jet heads 4 and 5, and calculate color development information to obtain a combination of ink feed parameters by the optimization method such that the color development information is the color development information target. Specifically, K/S is used with the Kubelka-Munk equation to obtain the relation between printing amount and color development information. Then, use may be made of an optimization method exemplified by linear programming method using simplex procedure, successive approximation method, and genetic method. The feed condition calculator 1 may also obtain a plurality of combinations of ink feed parameters that are close to the target color reproduction in the printing characteristics database 2 and obtain optimal ink feed parameters by interpolation thereof.

[0026] Subsequently, the feed condition calculator 1 calculates the point in time at which the regions of the base texture and the nap raising texture of the printing medium P reach the positions at which the inks ejected from the ink jet heads 4 and 5 land on the printing medium P based on the travel speed at which the printing medium P is moved by a printing medium moving means, not shown.

[0027] Thus, the kinds of inks and ink feed parameters extracted by the feed condition calculator 1 for the individual regions of the printing medium P and the point in time at which the inks are to be shot as calculated by the feed condition calculator 1 are outputted to the controller 9. The controller 9 outputs the ink feed parameters to the printing driver 3 at a point in time at which the respective inks are to be shot as calculated by the feed condition calculator 1, whereupon the printing driver 3 outputs drive signals according to the ink feed parameters to the head sections of the ink jet head 4 and the ink jet head 5 corresponding to the kinds of inks so that the inks are shot at the individual regions of the printing medium P.

[0028] This enables development of colors substantially the same as the target reproduced colors on the printing medium P composed of regions of the base texture and the nap raising texture having different color development characteristics.

[0029] In conjunction with the movement of the printing medium P, inks are repeatedly shot at all the regions according to the ink feed parameters extracted for the individual regions of the printing medium P. The printing medium P, now printed, is heated by the heater 6, subjected to reduction cleaning through the reduction cleaning unit 7, and dried by the drier 8. The process ends when the printing medium P on which the whole image entered in the feed condition calculator 1 has been printed has undergone heating treatment, drying/cleaning treatment, and drying treatment.

[0030] According to the printer of this embodiment, the ink jet head 4 capable of advantageously printing onto the region of the base texture and the ink jet head 5 capable of advantageously printing onto the region of the nap raising texture are provided, and the ink jet head 4 and the ink jet head 5 are controlled to print onto the respective regions of the printing medium P, enabling development of colors substantially the same as the target reproduced colors in the printing medium P composed of regions of the base texture and the nap raising texture having different color development characteristics from each other.

Embodiment 2

[0031] FIG. 3 illustrates a configuration of the printer according to Embodiment 2. According to Embodiment 2, the optical properties of the printing medium P are measured after the printing onto the printing medium P and, based on the measurements, correction is made to achieve development of colors substantially the same as the target reproduced colors. As compared with the printer according to Embodiment 1 illustrated in FIG. 1, the printer according to this embodiment additionally comprises measuring devices 20, 21 downstream of the dryer 8 in the printing medium P feed direction. The measuring devices 20, 21 are connected to a print result measurement value input unit 22, which in turn is connected to the feed condition calculator 1.

The measuring units 20, 21 measure the optical properties of the printing medium P from the front side and the reverse side thereof, respectively, to determine the amount of color development and are each composed of a diffusion colorimeter having an integrating sphere or an optical sensor calibrated with a diffusion colorimeter.

The print result measurement value input unit 22 enters the measurement values obtained by the measuring units 20, 21 in the feed condition calculator 1 to feed back the print results of the printing medium P. The feed condition calculator 1 obtains corrected ink feed condition values with which the inks are to be shot for the individual regions of the printing medium P. The ink feed condition values are corrected so that the measurement values entered from the print result measurement value input unit 22 enable development of colors substantially the same as the target reproduced colors.

[0032] First, as in Embodiment 1, the feed condition calculator 1 searches the printing characteristics database 2 based on information on the printing medium P and color development information of a print image to be printed on the printing medium P. The feed condition calculator 1 selects color development information showing color development closest to the target reproduced colors for the individual regions of the printing medium P and extracts a combination of kinds of inks and ink feed parameters of the ink jet heads 4 and 5 satisfying that color development information. The feed condition calculator 1 calculates the point in time at which the ink jet heads 4 and 5 shoot inks based on the travel speed of the printing medium P. The ink feed parameters extracted by the feed condition calculator 1 for the individual regions of the printing medium P and the point in time at which the inks are to be shot calculated by the feed condition calculator 1 are entered in the controller 9.

The controller 9 outputs the entered ink feed parameters to the printing driver 3 at a point in time at which the respective inks are to be shot, whereupon the printing driver 3 outputs drive signals according to the ink feed parameters to the head sections of the ink jet head 4 and the ink jet head 5 to shoot the inks at the individual regions of the printing medium P. The printing medium P, now printed, is heated by the heater 6, subjected to reduction cleaning through the reduction cleaning unit 7, and dried by the drier 8. The dried printing medium P then undergoes colorimetry through the measuring units 20, 21 implemented from the front and the reverse side of the printing medium P, and the measurement values obtained are entered in the feed condition calculator 1 via the print result measurement value input unit 22.

In a case that the entered measurement values are outside an allowable range of chromaticities of the target reproduced colors, the feed condition calculator 1 corrects the ink feed parameters of the inks to be ejected from the respective head sections of the ink jet head 4 and the ink jet head 5 so that the measurement values entered from the print result measurement value input unit 22 coincide with the chromaticities of the target reproduced colors. The ink feed parameters of the inks corrected by the feed condition calculator 1 are outputted to the controller 9, which then controls the drive of the respective head sections of the ink jet head 4 and the ink jet head 5 effected by the printing driver 3 based on the ink feed parameters, thereby achieving printing onto the printing medium P. When a first attempt at correction fails to contain the measurements in an allowable range of chromaticities of the target reproduced colors, the above correction is preferably repeated until the measurements are contained in the allowable range.

[0033] According to Embodiment 2, because the results of printing onto the printing medium P are fed back to achieve

printing onto the printing medium P with corrected ink feed parameters, displacement of or change in the amount of color development can be effectively controlled, though the accuracy of the initial calculations be poor or the physical properties of, for example, the inks and the printing medium P change with time or due to the environment.

[0034] The feed condition calculator 1 may be adapted to have a learning function whereby the ink feed parameters corrected by feedback of the print results are stored in the printing characteristics database 2 whenever correction is made or whereby the ink feed parameters stored in the printing characteristics database 2 are renewed with the corrected ink feed parameters. Through such learning effected each time printing is implemented, the accuracy of the information stored in the printing characteristics database 2 can be continually enhanced.

Embodiment 3

[0035] In the printer according to Embodiments 1 and 2, the ink jet head 5 may be replaced by a color material ink atomizer 31 as illustrated in FIG. 4. The color material ink atomizer 31 atomizes ink with ultrasonic wave for printing and supplies the printing medium P with ink drops having small kinetic energy. Accordingly, the color material ink atomizer 31 is appropriate for use in printing onto regions of the printing medium P where the deposition ratio changes with the kinetic energy and is appropriately used to advantageously develop colors in a region of, for example, the nap raising texture of the printing medium P. The ink jet head 4 is appropriately used to advantageously develop colors in, for example, a region of the base texture of the printing medium P.

The printing characteristics database 2 stores color development information on each of the combinations of a plurality of kinds of inks, a plurality of ink feed parameters, and a plurality of kinds of regions of the printing medium for the ink jet head 4 and the color material ink atomizer 31. The printing medium P comprises the base texture and the nap raising texture. The nap raising texture lies on the underside of the printing medium P as seen in FIG. 3.

[0036] For individual regions of the printing medium P, the feed condition calculator 1 extracts and calculates a combination of the kinds of inks and the ink feed parameters of the ink jet head 4 and the color material ink atomizer 31 representing developed colors closest to the target reproduced colors from the printing characteristics database 2 and performs calculation, as in Embodiment 1. The ink feed parameters for the individual regions of the printing medium P extracted by the feed condition calculator 1 are entered in the controller 9. The controller 9 outputs the entered ink feed parameters to the printing driver 3 at a point in time at which the respective inks are to be shot, whereupon the printing driver 3 outputs drive signals according to the ink feed parameters to the ink jet head 4 and the color material ink atomizer 31. In response to the output of the drive signals from the printing driver 3, the ink jet head 4 feeds inks to the region of the base texture of the printing medium P, while the color material ink atomizer 31 feeds inks to the region of the nap raising texture of the printing medium P.

[0037] According to this embodiment of the printer, the ink jet head 4 is provided for a region of the base texture whereas the color material ink atomizer 31 is provided for a region of the nap raising texture, and the ink jet head 4 and the color material ink atomizer 31 are controlled to print onto the respective regions of the printing medium P, enabling development of colors substantially the same as the target reproduced colors in the printing medium P composed of regions of the base texture and the nap raising texture having different color development characteristics from each other.

Embodiment 4

[0038] In the printer according to Embodiment 1 or 2, the ink jet head 5 may be replaced by an ink jet head 32 as illustrated in FIG. 5. The ink jet head 32 is disposed upstream of the ink jet head 4 in the printing medium P feed direction to hydrophilize the printing medium P by ejecting a hydrophilizing treatment solution by ink jet method. Thus, the ink jet head 32 shoots a hydrophilizing treatment solution at, for example, an open region (i.e., region where the fabric is not closely structured) such as a fastener hook-and-loop region to improve the ink disposition ratio. Therefore, the use of both the ink jet heads 32 and 4 is appropriate for printing onto the printing medium P containing, for example, a fastener hook-and-loop region while the use of only the ink jet head 4 is appropriate for developing target reproduced colors in a region of, for example, the base texture of the printing medium P. The hydrophilizing solution used herein is, for example, gum arabic, guar gum, locust bean gum, silane gum, sodium alginate, carboxymethyl cellulose, or sodium polyacrylate used with a surfactant.

The printing characteristics database 2 contains color development information corresponding to each of the combinations of a plurality of kinds of inks, a plurality of ink feed parameters, a plurality of hydrophilizing solution feed parameters, and a plurality of kinds of regions of the printing medium for the ink jet heads 4 and 32. The hydrophilizing solution parameters include voltage, frequency, and waveform that are outputted to the ink jet head 32. The printing medium P comprises regions of the base texture and the fastener hook-and-loop region.

The hydrophilizing treatment solution ejected from the ink jet head 32 does not result in color development but increases the deposition ratio of the color materials shot at the fastener hook-and-loop region from the ink jet head 4. The printing characteristics database 2 contains combinations of hydrophilizing solution feed parameters and YMCK ink feed pa-

rameters and the change in deposition ratio of color materials shot at the fastener hook-and-loop region with a combination of these parameters.

[0039] As in Embodiment 1, the feed condition calculator 1 searches the printing characteristics database 2 based on information on the printing medium P and information on the target reproduced colors. The feed condition calculator 1 searches the information on the kinds of regions of printing media in the printing characteristics database 2 for the regions representing the same kinds as those of the base texture and the fastener hook-and-loop region of the printing medium P. Subsequently, the feed condition calculator 1 selects color development information showing color development closest to target reproduced colors for the region of the base texture of the printing medium P and extracts a combination of kinds of inks and ink feed parameters of the ink jet head 4 satisfying that color development information. Likewise, the feed condition calculator 1 selects color development information showing color development the closest to target reproduced colors for the fastener hook-and-loop region of the printing medium P and extracts a combination of hydrophilizing solution feed parameters of the ink jet head 32 and kinds of inks and ink feed parameters of the ink jet head 4 satisfying that color development information. The hydrophilizing solution feed parameters and the ink feed parameters extracted by the feed condition calculator 1 are entered in the controller 9. The controller 9 outputs the entered hydrophilizing solution feed parameters or ink feed parameters to the printing driver 3 at a point in time at which the hydrophilizing solution or the inks are to be shot respectively, whereupon the printing driver 3 outputs drive signals according to the hydrophilizing solution feed parameters or the ink feed parameters to the head section of the ink jet head 32 or the ink jet head 4. Thus, the ink jet head 32 feeds the hydrophilizing treatment solution to the fastener hook-and-loop region of the printing medium P, whereupon the ink jet head 4 feeds inks and to the region of the base texture of the printing medium P.

[0040] This embodiment of the printer achieves development of colors substantially the same as the target reproduced colors in the printing medium P comprising the base texture region and the fastener hook-and-loop region having different color development characteristics from each other by printing onto different regions of the printing medium P by controlling the ink jet head 4 that, when used alone, is capable of advantageously printing onto a region of the base texture and the ink jet head 32 that improves the printing ratio in a fastener hook-and-loop region.

In this embodiment, a hydrophilizing solution is used assuming that the inks ejected from the jet head 4 are based mostly on water, but even when nonaqueous inks are used, a solution having a high affinity with the used inks may be employed. In this embodiment, the printing medium P is hydrophilized with the hydrophilizing solution, but the ink jet head 32 may be replaced by a corona treatment device or a plasma irradiator for modifying the surface of the printing medium P. FIG. 6 illustrates a printer using a corona treatment device 41 instead of the ink jet head 32. The corona treatment device 41 is disposed upstream of the ink jet head 4 in the printing medium P feed direction and comprises a power supply unit 42 for applying a voltage and discharge electrodes 43 that generate corona discharge upon application of voltage from the power supply unit 42. The corona treatment device 41 generates corona discharge between the discharge electrodes 43 to advantageously hydrophilize at least one region of a plurality of regions of the printing medium P by corona treatment in order to improve the ink deposition ratio. To further increase the efficiency of hydrophilization of the printing medium P, both the corona treatment device 41 and the ink jet head 32 may be used for hydrophilizing treatment.

As illustrated in FIG. 7, in this embodiment of the printer, an ink jet head 10 for shooting penetrant at the printing medium P by ink jet method may be additionally connected to the printing driver 3. The ink jet head 10 is disposed downstream of the ink jet head 32 and upstream of the ink jet head 4 in the printing medium P feed direction. A hydrophilizing treatment solution is fed by the ink jet head 32 to the fastener hook-and-loop region of the printing medium P, while penetrant is fed to the region of the base texture where the fabric is closely structured in the printing medium P. Because the region of the base texture has been previously supplied with the penetrant from the ink jet head 10, when the inks are subsequently fed from the ink jet head 4 to the printing medium P, the deposition ratio of the color material inks fed from the ink jet head 4 to the region of the base texture decreases, so that the color material inks can be preferentially deposited on an open region such as a fastener hook-and-loop region. The "penetrant" is a solvent or a dispersion medium for dissolving or dispersing a color material; "ink" is a color material dissolved or dispersed in a penetrant to a given concentration.

Embodiment 5

[0041] In the printer according to Embodiment 1 or 2, the ink jet heads 4 and 5 may be replaced by color material ink atomizers 33 and 34 as illustrated in FIG. 8. The color material ink atomizer 33 implements printing upon atomizing the inks with ultrasonic wave without electrifying the inks. The color material ink atomizer 34 is disposed upstream of the color material ink atomizer 33 in the printing medium P feed direction and implements printing by atomizing ink drops with ultrasonic wave and thereafter electrifying the ink drops. The electrification of the inks of the color material ink atomizer 34 is achieved by generating an electric field between the ink discharge section for discharging inks and the printing medium P with an electric field generator 35. Thus, the color material ink atomizer 34 is capable of advantageously depositing inks on an region of the printing medium P charged oppositely from the ink drops and may be appropriately

used to advantageously develop colors identical to the target reproduced colors by, for example, imparting a desired electrification to the region of the nap raising texture of the printing medium P. On the other hand, the color material ink atomizer 33 is appropriately used to advantageously develop colors in, for example, a region of the base texture of the printing medium P. For selective electrification of the printing medium P, use may be made of, for example, a method using an ion generator such as a corona electrifier to electrify the tips of the nap raising fibers, a method whereby the nap raising fibers are electrified by friction electrification, and a method whereby an area of the textile's electric resistance is reduced by, for example, feeding a surfactant to allow electrification of an area not supplied with the surfactant.

The printing characteristics database 2 contains color development information on each of the combinations of a plurality of kinds of inks, a plurality of ink feed parameters, and a plurality of kinds of regions of the printing medium for the color material ink atomizer 33 and the color material ink atomizer 34. The printing medium P comprises the base texture and the nap raising texture.

The nap raising texture lies on the underside of the printing medium P as seen in FIG. 3.

[0042] As in Embodiment 1, the feed condition calculator 1 extracts a combination of the kinds of inks and the ink feed parameters of the color material ink atomizer 33 and the color material ink atomizer 34 representing developed colors the closest to the target reproduced colors from the printing characteristics database 2 for individual regions of the printing medium P. The ink feed parameters for the individual regions of the printing medium P extracted by the feed condition calculator 1 are entered in the controller 9. The controller 9 outputs the entered ink feed parameters to the printing driver 3 at a point in time at which the respective inks are to be shot, whereupon the printing driver 3 outputs drive signals according to the ink feed parameters to the color material ink atomizer 33 and the color material ink atomizer 34. By now, the ink drops atomized by the color material ink atomizer 34 are electrified by the electric field generator 35. In response to the output of the drive signals from the printing driver 3, the color material ink atomizer 33 feeds inks to the region of the base texture of the printing medium P, while the color material ink atomizer 34 feeds inks to the region of the nap raising texture of the printing medium P.

[0043] According to this embodiment of the printer provided with the color material ink atomizer 33 for the region of the base texture and the color material ink atomizer 34 for the region of the nap raising texture, the color material ink atomizers 33 and 34 are controlled to print onto the respective regions of the printing medium P, making it possible to develop colors substantially the same as the target reproduced colors in the printing medium P composed of regions of the base texture and the nap raising texture having different color development characteristics from each other.

Embodiment 6

[0044] In the printer according to Embodiment 2, the measuring units 20, 21 may be measuring units appropriate for the properties of the respective regions of the printing medium P. As illustrated in FIG. 9, for example, when the amount of color development in the printing medium P having regions of the base texture and the nap raising texture is to be measured, there may be provided diffuse illumination 51a and 51b above and below the printing medium P, respectively; optical sensors 52a and 52b for measuring the optical reflectance from above and below the printing medium P; and an optical sensor 53 for measuring the optical reflectance from a diagonal direction of the printing medium P.

The diffuse illumination 51a, 51b and the optical sensors 52a, 52b may be disposed either above or below the printing medium P, provided that the optical properties of the printing medium P can be measured. As illustrated in FIG. 10, for example, the diffuse illumination 51a and the optical sensor 52a may be disposed only above the printing medium P.

As illustrated in FIG. 11, the measuring units 20, 21 may include an air nozzle 54 for blowing air onto a portion of the nap raising texture to be measured by the optical sensor 53 from a diagonal direction to flatten it and cause it to lie in a horizontal direction to improve the measuring accuracy.

[0045] Embodiments 1 to 6 of the printer use two out of the ink jet head 4, the ink jet head 5, the ink jet head 32, the color material ink atomizer 31, the color material ink atomizer 33, the color material ink atomizer 34, and the corona treatment device 41 for printing onto the printing medium P but may use a combination of three or more thereof. The invention may also be applied to a case where the printing medium P consists of three or more regions having different color development characteristics.

[0046] The color development characteristics of the individual regions of the printing medium P depend on the combination of the kinds of inks, ink feeders, and the ink feed parameters. The color development characteristics of the individual regions may be described using the deposition ratio of the color material in ink. Alternatively, the value K/S for individual wavelengths may be used. These combinations can be stored in the printing characteristics database 2.

The color development characteristics of the individual regions depend on the combination of kinds of inks that affect the deposition ratio of, for example, the hydrophilizing solution; ink feed parameters and color material ink feeders as far as the ink feeders are concerned; and the ink feed parameters. These may be included in the data that are stored in the printing characteristics database 2.

Using the printing characteristics database 2, optimum liquid drop feeders and kinds of inks can be selected for a plurality of regions of a printing medium onto which printing is done from a plurality of liquid drop feeders and a plurality of kinds

of inks so that printing can be implemented with ink feed parameters appropriate therefor and development of target reproduced colors can be achieved.

EXAMPLES

Example 1

[0047] Described below is an example for obtaining ink feed parameters in Embodiment 1 of the printer, where color development is achieved by shooting one kind of ink from the ink jet head 4 for large drop printing and the ink jet head 5 for small drop printing at individual regions of the nap raising texture and the base texture using data stored in the printing characteristics database 2.

As shown in Table 1, the printing characteristics database 2 stores data representing deposition ratios in individual regions in cases where printing amounts normalized with maximum printing amounts of the ink jet heads 4 and 5 are deposited.

As can be seen, in order to implement 23% printing in the base texture region and 27% printing in the nap raising texture region so that the print in the nap raising texture region is slightly darker, 20% printing is to be done with the ink jet head 4 and 30% printing with the ink jet head 5. For this calculation, a known optimization calculation method may be used; for data not stored in the printing characteristics database 2, a known interpolation method may be used.

In a case that a plurality of kinds of inks are used, the color development attained by the ink jet heads 4 and 5 in the individual regions as stored in the printing characteristics database 2 may be expressed using K/S at the respective wavelengths.

[0048] [Table 1]

Table 1

	Ink jet head 4: 10%	Ink jet head 4: 20%	Ink jet head 4: 30%
Base texture	7	14	21
Raised texture	3	6	9
	Ink jet head 5: 10%	Ink jet head 5: 20%	Ink jet head 5: 30%
Base texture	3	6	9
Raised texture	7	14	21

Example 2

[0049] Described below is an example for obtaining ink feed parameters and hydrophilizing treatment solution feed parameters in Embodiment 4 of the printer, where color development is achieved by shooting inks and a hydrophilizing treatment solution from the ink jet head 4 and the ink jet head 32 at individual regions of the nap raising texture and the base texture using data stored in the printing characteristics database 2.

For a treatment for changing the deposition ratio in a particular region of the printing medium P as where the hydrophilizing treatment solution is used, stored data as shown in Table 2 are advantageously used. As shown in Table 2, the printing characteristics database 2 stores deposition ratios in the individual regions for the respective combinations of printing amounts of the hydrophilizing treatment solution ejected from the ink jet head 32 and printing amounts of inks ejected from the ink jet head 4.

As in Example 1, the printing characteristics database 2 may be used to obtain such ink feed parameters and hydrophilizing solution feed parameters as allow target reproduced colors to be obtained in the individual regions of the printing medium P.

[0050] [Table 2]

Table 2

		Ink jet head 4: 10%	Ink jet head 4: 20%	Ink jet head 4: 30%
Hydrophilizing treatment solution: 0%	Base texture	8	16	24
	Raised texture	2	4	6

(continued)

		Ink jet head 4: 10%	Ink jet head 4: 20%	Ink jet head 4: 30%
Hydrophilizing treatment solution: 100%	Base texture	4	8	12
	Raised texture	6	12	18

DESCRIPTION OF SYMBOLS

[0051]

1	feed condition calculator
2	printing characteristics database
3	printing driver
4, 5, 32	ink jet head
6	heater
7	reduction cleaning unit
8	dryer
9	controller
20, 21	measuring unit
22	print result measurement value input unit
31, 33, 34	color material ink atomizer
35	electric field generator
41	corona treatment device
42	power supply unit
43	discharge electrode
51a, 51b	diffuse illumination
52a, 52b, 53	optical sensor 54 air nozzle

Claims

1. A printer for printing onto a printing medium containing regions having different color development characteristics from each other to develop target reproduced colors, the printer comprising:

liquid drop feeders for feeding liquid drops for developing colors advantageously in respective regions of the printing medium,
a calculator for calculating feed conditions of liquid drops respectively fed from the liquid drop feeders so that the target reproduced colors are developed on the printing medium,
a driver for driving the liquid drop feeders, and
a controller for controlling the driver based on the feed conditions calculated by the calculator.

2. The printer according to Claim 1,
wherein the liquid drop feeders include a first ink jet device for feeding ink drops by ink jet method.

3. The printer according to Claim 2,
wherein the liquid drop feeders include a second ink jet device for feeding ink drops by ink jet method in a different direction from the first ink jet device.

4. The printer according to Claim 2,
wherein the liquid drop feeders include an atomizer for feeding atomized ink drops.

5. The printer according to Claim 2,
wherein the liquid drop feeders include a hydrophilizing solution feeder for feeding liquid drops of a hydrophilizing solution for hydrophilizing the printing medium.

6. The printer according to Claim 1,
wherein the liquid drop feeders include a first atomizer for feeding electrically charged atomized ink drops and a

second atomizer for feeding atomized ink drops without electrification thereof.

7. The printer according to any one of Claims 1 to 6, wherein
the calculator calculates feed conditions of liquid drops to be fed respectively from the liquid drop feeders based on information on the regions of the printing medium and information on the target reproduced colors to be printed onto the printing medium.

8. The printer according to Claim 7,
further comprising database containing color development information for developing colors in the regions of the printing medium with the liquid drop feeders respectively corresponding thereto,
wherein the calculator extracts the color development information for developing the target reproduced colors in the regions of the printing medium from the database based on the information on the regions of the printing medium to be printed and the information on the target reproduced colors to calculate feed conditions of liquid drop to be fed from the liquid drop feeders.

9. The printer according to Claim 7 or 8, further comprising:

measuring units for measuring colors of the printing medium developed by supply of liquid drops from the liquid drop feeders, and
a measurement value input unit for inputting results of measurement of colors on the printing medium obtained with the measuring units to the calculator,
wherein the calculator corrects calculated feed conditions of liquid drops fed from the liquid drop feeders based on the results of measurement of colors on the printing medium and the information on target reproduced colors, and
wherein the controller controls the driver so that the liquid drops are fed with the feed conditions corrected by the calculator.

10. A printer for printing onto a printing medium containing regions having different color development characteristics from each other to develop target reproduced colors, the printer comprising:

a corona treatment device for hydrophilizing at least one of the regions of the printing medium through corona treatment,
an ink jet device for feeding ink drops onto the printing medium by ink jet method, and
an ink feeder for developing the target reproduced colors on the printing medium by controlling the corona treatment device and the ink jet device.

11. The printer according to any one of Claims 1 to 10, wherein
the regions of the printing medium include a region 3composed of a nap raising texture.

12. The printer according to any one of Claims 1 to 11, wherein
the regions of the printing medium include a region composed of a pile fabric.

13. The printer according to any one of Claims 1 to 12, wherein
the regions of the printing medium include a region composed of a fastener hook-and-loop region.

14. A printing method for printing onto a printing medium containing regions having different color development characteristics from each other to develop target reproduced colors, the printing method comprising:

feeding liquid drops for developing colors from liquid drop feeders that feed inks advantageously to the respective regions of the printing medium to develop the target reproduced colors on the printing medium.

15. A printing method for printing onto a printing medium containing regions having different color development characteristics from each other to develop target reproduced colors, the printing method comprising:

hydrophilizing at least one of the regions of the printing medium through corona treatment, and
feeding ink drops to the printing medium by ink jet method to develop the target reproduced colors.

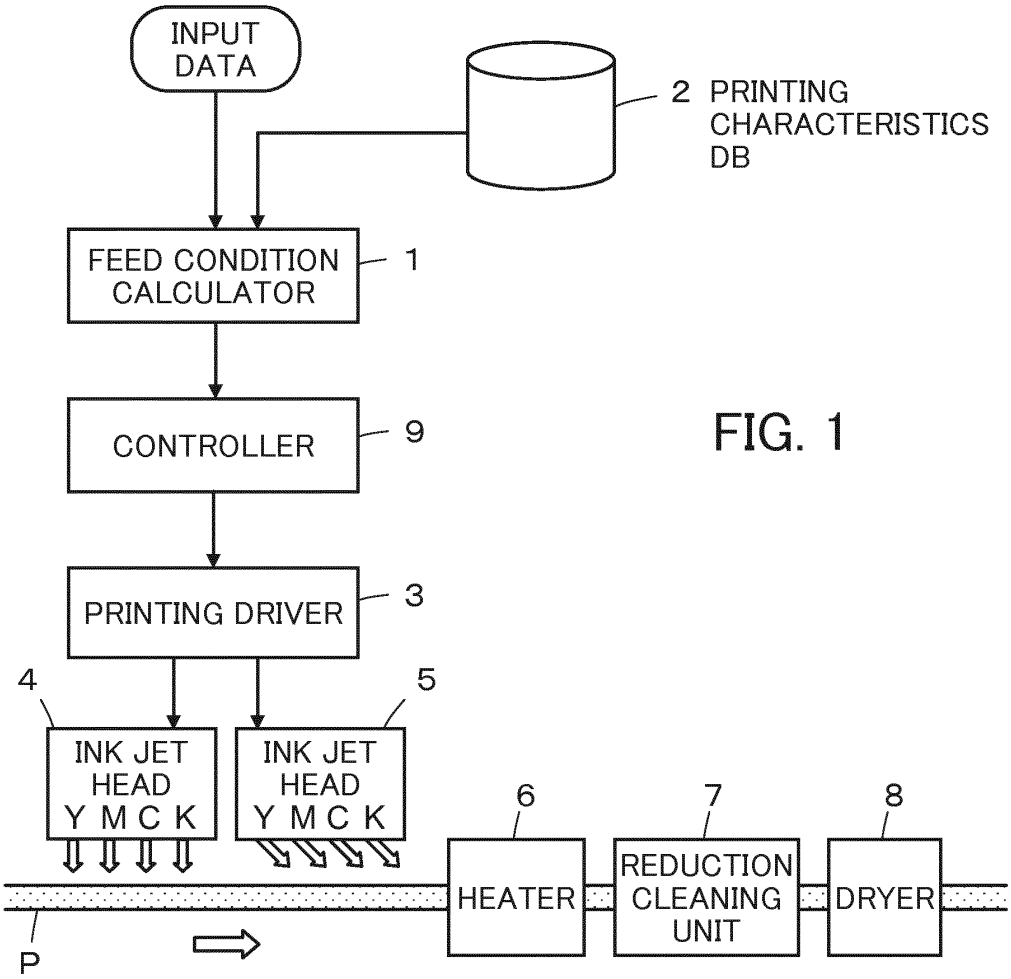
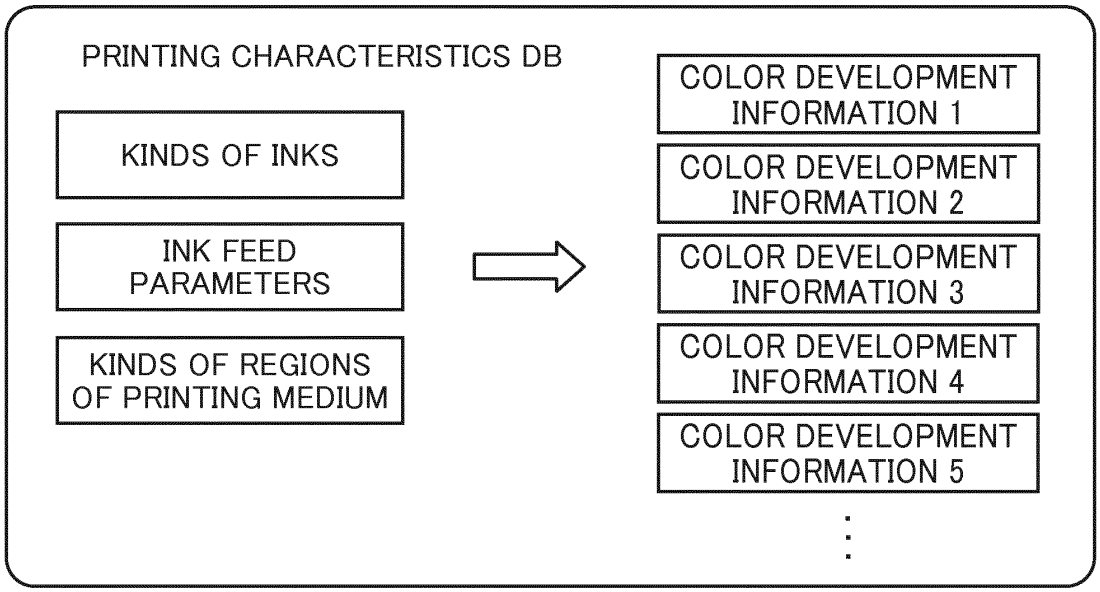

INPUT DATA
2 PRINTING CHARACTERISTICS DB
FEED CONDITION CALCULATOR
1
CONTROLLER
9
PRINTING DRIVER
3
4
5
INK JET HEAD Y M C K
INK JET HEAD Y M C K
6
7
8
HEATER
REDUCTION CLEANING UNIT
DRYER
P

FIG. 1

FIG. 2


PRINTING CHARACTERISTICS DB
KINDS OF INKS
INK FEED PARAMETERS
KINDS OF REGIONS OF PRINTING MEDIUM
COLOR DEVELOPMENT INFORMATION 1
COLOR DEVELOPMENT INFORMATION 2
COLOR DEVELOPMENT INFORMATION 3
COLOR DEVELOPMENT INFORMATION 4
COLOR DEVELOPMENT INFORMATION 5

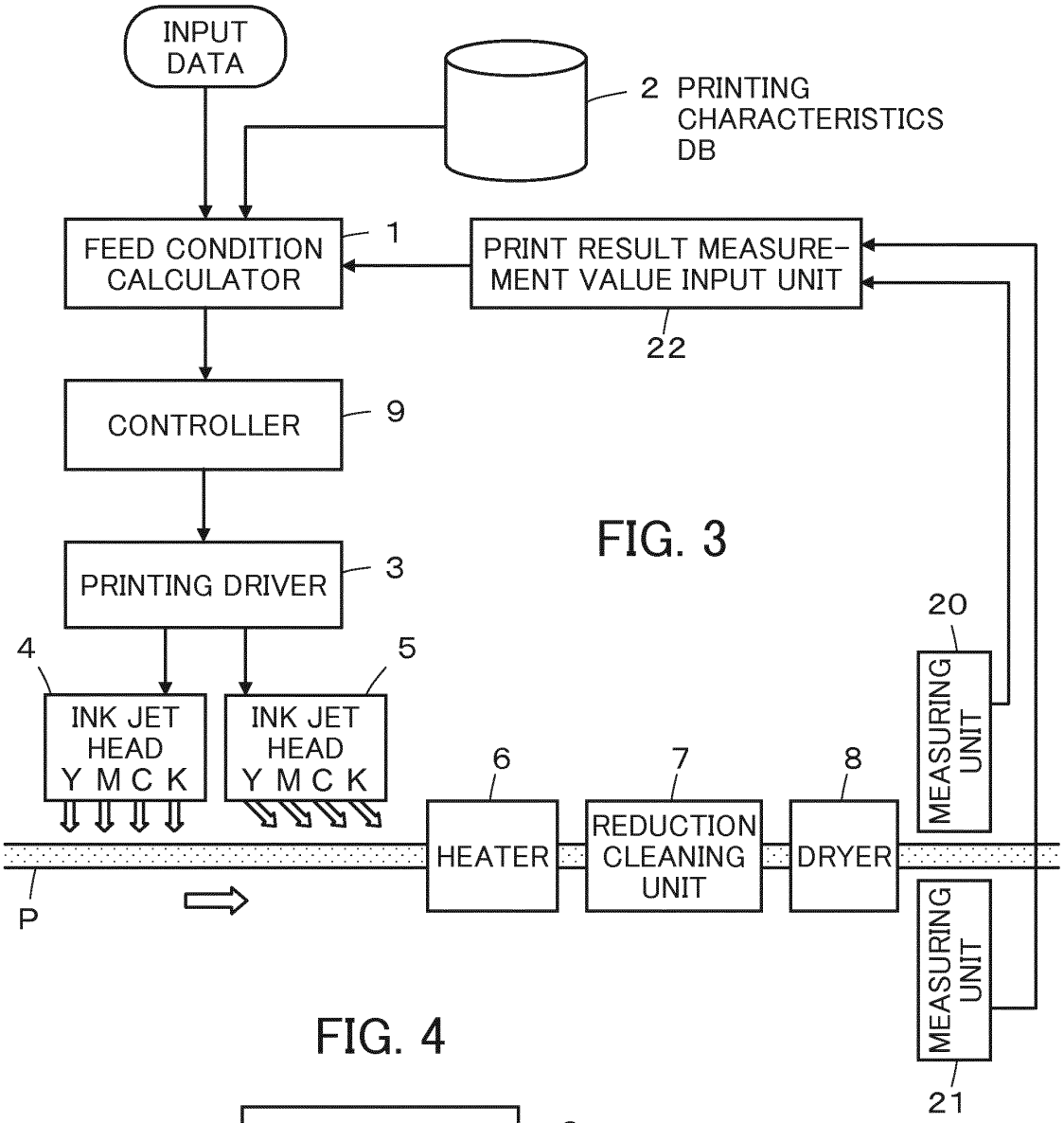

INPUT DATA
2 PRINTING CHARACTERISTICS DB
FEED CONDITION CALCULATOR
1
PRINT RESULT MEASUREMENT VALUE INPUT UNIT
22
CONTROLLER
9
PRINTING DRIVER
3
4
5
INK JET HEAD Y M C K
INK JET HEAD Y M C K
6
7
8
HEATER
REDUCTION CLEANING UNIT
DRYER
20
MEASURING UNIT
MEASURING UNIT
21
P

FIG. 3

FIG. 4

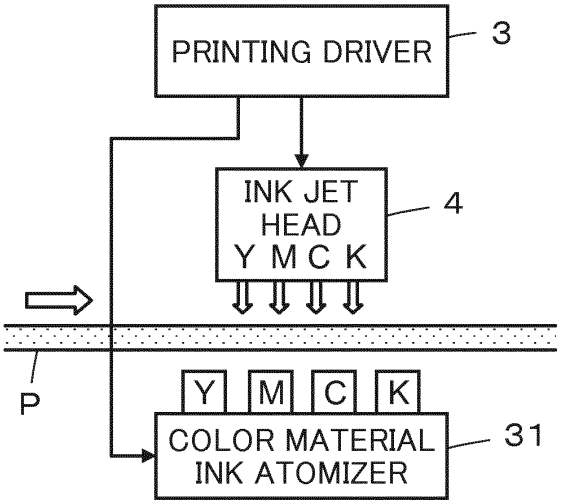

PRINTING DRIVER
3
INK JET HEAD Y M C K
4
P
Y
M
C
K
COLOR MATERIAL INK ATOMIZER
31

FIG. 5

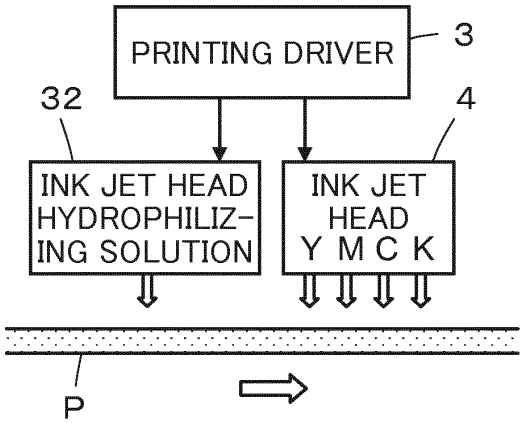


FIG. 6

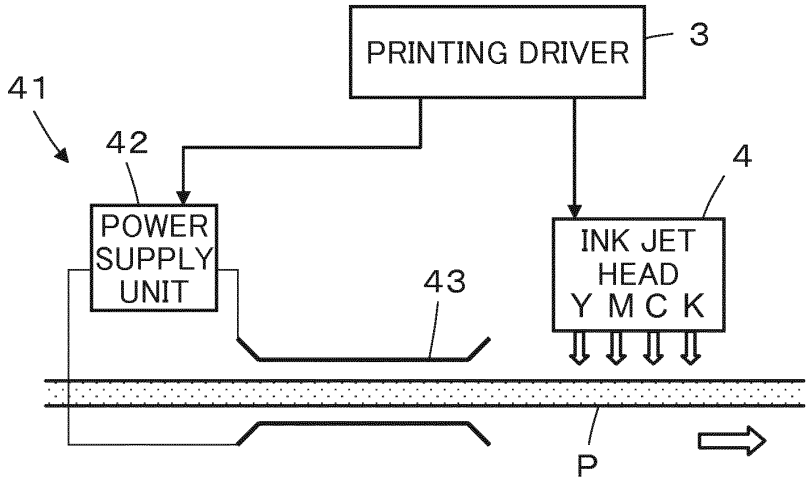


FIG. 7

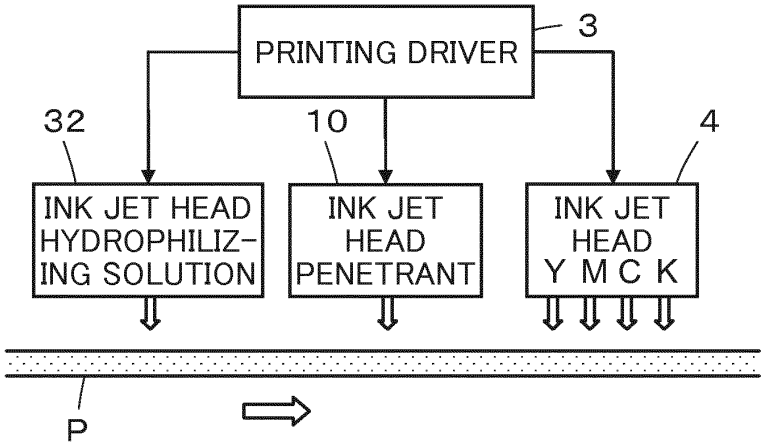


FIG. 8

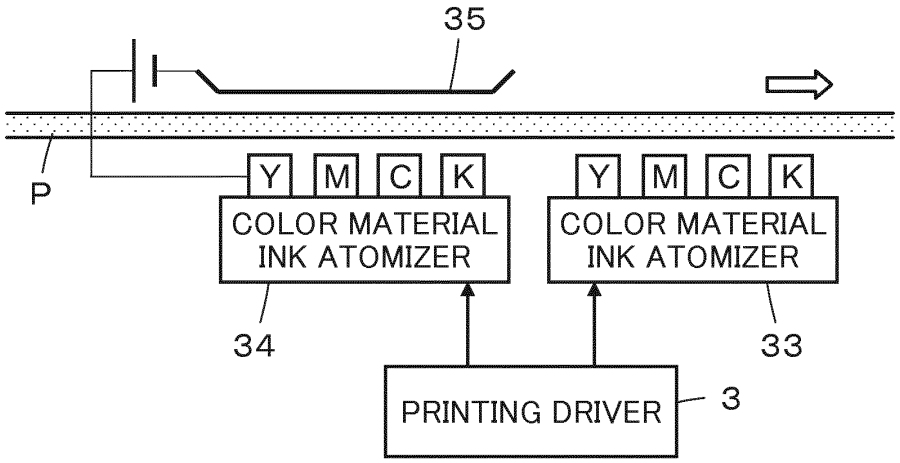


FIG. 9

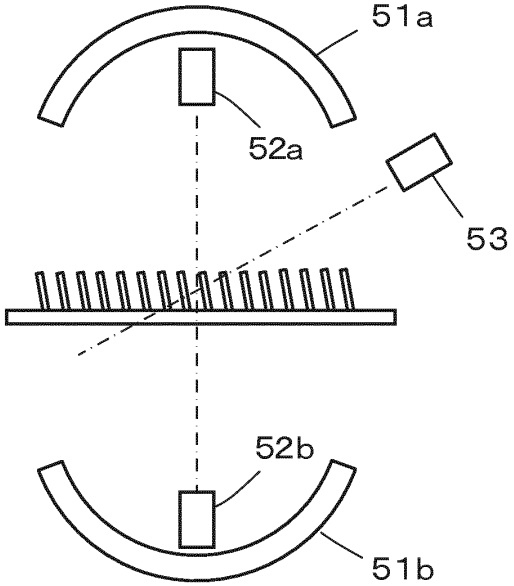


FIG. 10

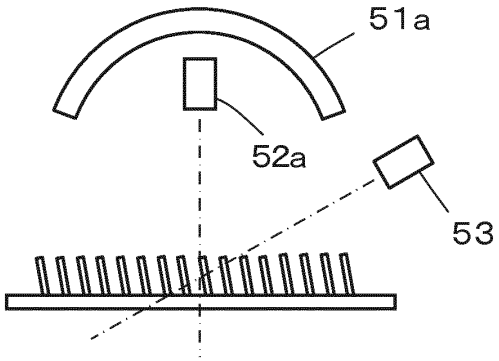
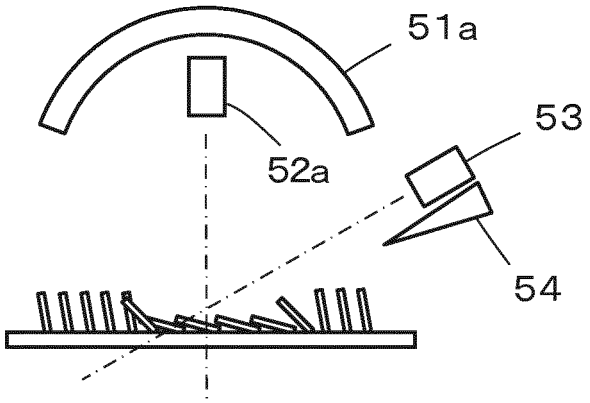


FIG. 11



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/050836

A. CLASSIFICATION OF SUBJECT MATTER
D06B1/08(2006.01)i, *B41J2/01*(2006.01)i, *D06P5/00*(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D06B1/00-23/30, B41J2/01-2/21, B41J3/00-3/62, D06P5/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2011
Kokai Jitsuyo Shinan Koho 1971-2011 Toroku Jitsuyo Shinan Koho 1994-2011

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2005-536377 A (ZACH, Moshe), 02 December 2005 (02.12.2005), claims; paragraphs [0001] to [0004], [0013], [0018] to [0019], [0022] to [0027], [0032], [0038], [0052] & WO 2004/018215 A1 claims; page 1, line 1 to page 3, line 3; page 6, line 26 to page 7, line 2; page 8, line 9 to page 9, line 16; page 10, line 9 to page 16, line 9; page 17, line 27 to page 18, line 28; page 21, line 24 to page 22, line 5; page 28, lines 1 to 9 & US 2004/0036726 A1 & EP 1534528 A	1,2,7,11-14 3-6,8,9,15 10

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
07 March, 2011 (07.03.11)	15 March, 2011 (15.03.11)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/050836

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2005-290639 A (Ricoh Co., Ltd.), 20 October 2005 (20.10.2005), claims; paragraphs [0003], [0005], [0021] to [0023]; fig. 1 to 2 (Family: none)	10-13 5,15 1-4,6-9,14
Y A	JP 2004-90505 A (Omron Corp.), 25 March 2004 (25.03.2004), paragraphs [0007] to [0015]; fig. 3, 5 (Family: none)	3 1,2,4-15
Y A	JP 52-31187 A (Teijin Seiki Co., Ltd.), 09 March 1977 (09.03.1977), Detailed Explanation of the Invention; drawings (Family: none)	4,6 1-3,5,7-15
Y A	JP 61-6363 A (Suminoe Textile Co., Ltd.), 13 January 1986 (13.01.1986), example 1; fig. 1 & US 4648250 A example 1; fig. 1	4,6 1-3,5,7-15
Y A	JP 2003-247179 A (Upepo & Maji Inc.), 05 September 2003 (05.09.2003), claims; paragraph [0010] (Family: none)	8 1-7,9-15
Y A	WO 2004/094151 A1 (Shima Seiki Mfg., Ltd.), 04 November 2004 (04.11.2004), claims; page 1, line 7 to page 3, line 4; fig. 1 to 4 & JP 2006-231520 A	9 1-8,10-15
Y A	JP 3-69631 A (Seiren Co., Ltd.), 26 March 1991 (26.03.1991), claims; page 3, upper left column, 2nd line from the bottom to upper right column, line 11 (Family: none)	15 1-14

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/050836

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

The inventions in claims 1 - 9 and claims 11 - 13 dependent thereon, and claim 14 relate to a printing device equipped with a plurality of droplet-supplying devices (said droplet-supplying device is not limited to an ink jet device); and a printing method utilizing the printing device.

The inventions in claim 10 and claims 11 - 13 dependent thereon, and claim 15 relate to a printing device equipped with an ink jet device and corona treatment device; and a printing method utilizing the printing device.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2799595 B **[0004]**