PRINTING APPARATUS

Abstract

A printing apparatus **100** includes a supply section **1**, a printing-related section **3**, a recovery section **4**, an imaging section **5**, and a control section **6**, in which print data is first print data DT**1** or second print data DT**2**, the control section **6** includes first transmission means **61** for transmitting printing start commands, respectively, to printing sections **30***a* and **30***b*, imaging means **62** for causing the imaging section **5** to image a print medium X**1** to acquire imaging data DT**3**, measurement means **63** for acquiring an imaging measurement value from the imaging data DT**3**, calculation means **64** for calculating an expansion/contraction ratio from a reference measurement value and the imaging measurement value, correction means **65** for expanding and contracting a print image on the basis of the expansion/contraction ratio to generate the second print data DT**2**, and second transmission means **66** for transmitting printing start commands, respectively, to the printing sections **30***a* and **30***b* on the basis of the second print data DT**2**, and both respective error ranges of a distance in the conveyance direction and a distance in the width direction between a print image **7** in the first print data DT**1** and a print image **9** printed on the basis of the second print data DT**2** are within +1.0 mm.

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Background/Summary

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to a printing apparatus for applying a print image to a medium on the basis of print data, and more specifically, to a printing apparatus capable of making the size of a print image at the time of recovery substantially match the size of original print data using an automatic expansion/contraction correction function.

BACKGROUND OF THE INVENTION

[0002] In the field of printing, a printing apparatus is an apparatus that subjects a medium to printing on the basis of print data while conveying the medium and fixes a print image. In the printing apparatus, the medium is usually pulled toward the recovery section side by applying a predetermined tension to the medium, thereby causing a phenomenon that the medium extends at the time of conveyance.

[0003] This results in a phenomenon that the medium contracts in a width direction.

[0004] In order to fix the print image, an ink is dried or cured, thereby also causing the medium to expand and contract.

[0005] From the foregoing, there occurs a problem that the size of original print data and the size of a print image at the time of recovery actually printed do not match each other.

[0006] On the other hand, the original print data is previously corrected.

[0007] For example, when image data is printed on a medium, there has been known an image printing system for measuring the length of a reference line actually printed on the medium on the basis of reference data in a conveyance direction of the medium by a user using a scale or the like, comparing the length of the reference line with a calculational length of the reference line to calculate an expansion/contraction ratio of an image, and correcting the image data such that a corresponding image is printed at a calculational position on the medium (see, e.g., Japanese Patent Laid-Open No. 11-245472).

[0008] There has been known a printing apparatus including reference print data storage means for storing reference print data to be printed in a predetermined reference length range in a sub-scanning direction when printing is performed in an atmosphere at a reference temperature, printing mode setting means for setting a predetermined printing mode, first printing control means for printing reference print data stored in the reference print data storage means on a sheet when the predetermined printing mode is set by the printing mode setting means, measurement length input means for a user measuring a measurement length in the sub-scanning direction of the reference print data printed on the sheet by the first printing control means and inputting a value of the measurement length, calculation means for calculating an enlargement ratio by which print data to be printed is enlarged on the basis of the value of the measurement length inputted by the measurement length input means and a value of a reference length of the reference print data, print data processing means for performing processing for enlarging the print data to be printed in the sub-scanning direction using the enlargement ratio calculated by the calculation means, and second printing control means for printing the print data processed by the print data processing means on the sheet (see, e.g., Japanese Patent Laid-Open No. 2011-245868).

SUMMARY OF THE INVENTION

[0009] However, each of a printing apparatus using the image printing method disclosed in Japanese Patent Laid-Open No. 11-245472 and the printing apparatus disclosed in Japanese Patent Laid-Open No. 2011-245868 has a disadvantage that a human error may occur because a person measures a measurement value.

[0010] It cannot necessarily be said that a skilled person measures the measurement value, which may result in a deterioration in measurement accuracy.

[0011] The printing apparatus needs to be stopped by an amount of measurement by the person, resulting in a deterioration in productivity.

[0012] The present invention has been made in view of the above-described circumstances, and is directed to providing a printing apparatus capable of automatically calculating an expansion/contraction ratio and making the size of a print image at the time of recovery substantially match the size of original print data.

[0013] The inventors have intensively studied to solve the above-described problem, and have considered actually fixing a print image and then imaging the print image using first print data having a mark put on the print image, calculating an expansion/contraction ratio from a reference measurement value and an imaging measurement value, and correcting the print image on the basis of the expansion/contraction ratio.

[0014] To achieve this, the inventors have found that the above-described problem can be solved by causing a control section to include first transmission means, imaging means, measurement means, calculation means, correction means, and second transmission means, thereby completing the present invention.

[0015] The present invention provides a printing apparatus including a supply section for supplying a medium, a printing-related section including a printing section for printing at least a print image on the medium on the basis of print data and a fixing section for fixing the print image on the medium to obtain a print medium, a recovery section for recovering the print medium, an imaging section, arranged between the printing-related section and the recovery section, for imaging the print medium, a control section for controlling the printing, in which the print data is first print data or second print data, the control section includes at least first transmission means for transmitting a printing start command to the printing section on the basis of first print data having a plurality of marks put on the print image, imaging means for causing the imaging section to image the print medium to acquire imaging data, measurement means for measuring a distance in a conveyance direction between the marks and a distance in a width direction between the marks in the imaging data, to acquire an imaging measurement value including respective values of the distances, calculation means for calculating an expansion/contraction ratio from a reference measurement value including respective values of a distance in the conveyance direction between the marks and a distance in the width direction between the marks in the first print data and the imaging measurement value, correction means for expanding and contracting the print image on the basis of the expansion/contraction ratio to generate the second print data, and second transmission means for transmitting a printing start command to the printing section on the basis of the second print data, and both respective error ranges of a distance in the conveyance direction and a distance in the width direction between the print image in the first print data and the print image printed on the basis of the second print data are within +1.0 mm.

[0016] In the printing apparatus according to the present invention, it is preferable that the calculation means calculates an expansion/contraction ratio $X1$ in the conveyance direction by $X1=A1/B1$ from a value $A1$ of the distance in the conveyance direction between the marks in the first print data and a value $B1$ of the distance in the conveyance direction between the marks in the imaging data, and calculates an expansion/contraction ratio $X2$ in the width direction by $X2=A2/B2$ from a value $A2$ of the distance in the width direction between the marks in the first print data and a value $B2$ of the distance in the width direction between the marks in the imaging

data, the correction means calculates a value $D1$ of a distance in the conveyance direction of the print image in the second print data by $D1 = C1 \times X1$ from a value $C1$ of a distance in the conveyance direction of the print image in the first print data and the expansion/contraction ratio $X1$ in the conveyance direction, calculates a value $D2$ of a distance in the width direction of the print image in the second print data by $D2 = C2 \times X2$ from a value $C2$ of a distance in the width direction of the print image in the first print data and the expansion/contraction ratio $X2$ in the width direction, and expands or contracts the print image in the first print data to correspond to the value $D1$ of the distance in the conveyance direction of the print image in the second print data and the value $D2$ of the distance in the width direction of the print image in the second print data, to generate the second print data.

[0017] The present invention provides a printing apparatus including a supply section for supplying a medium, a printing-related section including a first printing section and a second printing section for printing at least a print image on the medium on the basis of print data and a first fixing section and a second fixing section for fixing the print image on the medium to obtain a print medium, a recovery section for recovering the print medium, an imaging section, arranged between the printing-related section and the recovery section, for imaging the print medium, and a control section for controlling the printing, in which the first printing section, the first fixing section, the second printing section, and the second fixing section are arranged in this order from the upstream side in the printing-related section, the print data is first print data or second print data including first correction data or second correction data, the control section includes at least first transmission means for transmitting printing start commands, respectively, to the first printing section and the second printing section on the basis of first print data having a plurality of marks each including a first mark and a second mark put on the print image, imaging means for causing the imaging section to image the print medium to acquire imaging data, measurement means for measuring a distance in a conveyance direction between the first marks printed by the first printing section and a distance in a width direction between the first marks in the imaging data to acquire a first imaging measurement value including respective values of the distances, and measuring a distance in the conveyance direction between the second marks printed by the second printing section and a distance in the width direction between the second marks in the imaging data to acquire a second imaging measurement value including respective values of the distances, calculation means for calculating a first expansion/contraction ratio for the first printing section from a first reference measurement value including respective values of a distance in the conveyance direction between the first marks and a distance in the width direction between the first marks in the first print data and the first imaging measurement value and calculating a second expansion/contraction ratio for the second printing section from a second reference measurement value including respective values of a distance in the conveyance direction between the second marks and a distance in the width direction between the second marks in the first print data and the second imaging measurement value, correction means for expanding and contracting data of a portion taken charge of by the first printing section in the print image on the basis of the first expansion/contraction ratio to generate the first correction data and expanding or contracting data of a portion taken charge of by the second printing section in the print image on the basis of the second expansion/contraction ratio to generate the second correction data, and second transmission means for transmitting a printing start command to the first printing section on the basis of the first correction data and transmitting a printing start command to the second printing section on the basis of the second correction data, and both respective error ranges of a distance in the conveyance direction and a distance in the width direction between the print image in the first print data and the print image printed on the basis of the second print data are within +1.0 mm.

[0018] In the printing apparatus according to the present invention, it is preferable that the calculation means calculates a first expansion/contraction ratio $X11$ in the conveyance direction by $X11 = A11/B11$ from a value $A11$ of the distance in the conveyance direction between the first marks

in the first print data and a value B11 of the distance in the conveyance direction between the first marks in the imaging data, calculates a first expansion/contraction ratio X12 in the width direction by X12=A12/B12 from a value A12 of the distance in the width direction between the first marks in the first print data and a value B12 of the distance in the width direction between the first marks in the imaging data, calculates a second expansion/contraction ratio X21 in the conveyance direction by X21=A21/B21 from a value A21 of the distance in the conveyance direction between the second marks in the first print data and a value B12 of the distance in the conveyance direction between the second marks in the imaging data, and calculates a second expansion/contraction ratio X22 in the width direction by X22=A22/B22 from a value A22 of the distance in the width direction between the second marks in the first print data and a value B22 of the distance in the width direction between the second marks in the imaging data, and the correction means calculates a value D11 of a distance in the conveyance direction of the print image in the first correction data by D11=C11×X11 from a value C11 of a distance in the conveyance direction of data of a portion taken charge of by the first printing section in the print image in the first print data and the first expansion/contraction ratio X11 in the conveyance direction, calculates a value D12 of a distance in the width direction of the print image in the first correction data by D12=C12×X12 from a value C12 of a distance in the width direction of the data of the portion taken charge of by the first printing section in the print image in the first print data and the first expansion/contraction ratio X12 in the width direction, and expands or contracts the data of the portion taken charge of by the first printing section in the print image in the first print data to correspond to the value D11 of the distance in the conveyance direction of the print image in the first correction data and the value D12 of the distance in the width direction of the print image in the first correction data to generate the first correction data, calculates a value D21 of a distance in the conveyance direction of the print image in the second correction data by D21=C21×X21 from a value C21 of a distance in the conveyance direction of data of a portion taken charge of by the second printing section in the print image in the first print data and the second expansion/contraction ratio X21 in the conveyance direction, calculates a value D22 of a distance in the width direction of the print image in the second correction data by D22=C22×X22 from a value C22 of a distance in the width direction of the data of the portion taken charge of by the second printing section in the print image in the first print data and the second expansion/contraction ratio X22 in the width direction, and expands or contracts the data of the portion taken charge of by the second printing section in the print image in the first print data to correspond to the value D21 of the distance in the conveyance direction of the print image in the second correction data and the value D22 of the distance in the width direction of the print image in the second correction data to generate the second correction data.

[0019] In the printing apparatus according to the present invention, it is preferable that the marks are respectively provided at four corners of the print image in the first print data.

[0020] In the printing apparatus according to the present invention, it is preferable that the marks are respectively provided at positions of the four notched corners of the print image in the first print data.

[0021] In the printing apparatus according to the present invention, it is preferable that the marks are respectively provided at positions of the four notched corners of the print image, a margin is provided between each of the marks and the print image, and a shortest distance between each of the marks and the print image is 10 mm or more.

[0022] In the printing apparatus according to the present invention, it is preferable that each of the marks includes at least a horizontal line for measuring a distance in the conveyance direction and a vertical line for measuring a distance in the width direction.

[0023] In the printing apparatus according to the present invention, it is preferable that the first print data is obtained by putting a plurality of marks and an accessory on the print image, the accessory has an upper refresh line provided above the horizontal line on the upper side, a plurality of intermediate refresh lines equally spaced apart from one another between the horizontal line on

the upper side and the horizontal line on the lower side, and the plurality of marks and the accessory are printed in the same color.

[0024] The printing apparatus according to the present invention includes the supply section, the printing-related section, and the recovery section. Accordingly, the medium is continuously supplied, whereby the print image can be printed on the medium, fixed thereon, and recovered.

[0025] At this time, the printing apparatus further includes the imaging section and the control section, and the control section includes the first transmission means, the imaging means, the measurement means, and the calculation means, so that the expansion/contraction ratio can be automatically calculated.

[0026] This makes it possible to exclude a human error in the printing apparatus.

[0027] Measurement between the marks is performed by the control section, resulting in an improvement in measurement accuracy.

[0028] Time and effort for a person to perform measurement can be saved, thereby making it possible to improve productivity.

[0029] In the printing apparatus, the control section further includes the correction means and the second transmission means, so that the print image can be automatically expanded and contracted on the basis of the expansion/contraction ratio to generate the second print data.

[0030] Therefore, the printing apparatus has an automatic expansion/contraction correction function for automatically measuring the expansion/contraction ratio and correcting the print data on the basis of the expansion/contraction ratio.

[0031] As needed, the automatic calculation of the expansion/contraction ratio and the correction of the print data based thereon (hereinafter referred to as "automatic expansion and contraction correction") may be performed only once, or the automatic expansion and contraction correction may be repeatedly performed.

[0032] The respective error ranges of the distance in the conveyance direction and the distance in the width direction are within the above-described range, thereby making it possible to set the size of the print image at the time of recovery to a desired size.

[0033] That is, it is possible to make the size of the print image at the time of recovery substantially match the size of original print data.

[0034] Here, in the printing-related section, the printing is performed with a tension applied, and the print image is further fixed, thereby making it easiest for the medium to expand and contract.

[0035] Accordingly, in the printing apparatus, the imaging section is arranged between the printing-related section and the recovery section.

[0036] This makes it possible to calculate the expansion/contraction ratio sufficiently considering the expansion and contraction of the medium in in the printing-related section in the printing apparatus.

[0037] In the printing-related section, the expansion/contraction ratio also varies depending on an amount of ink to be used to print the print image.

[0038] Accordingly, in the printing apparatus, print data having a plurality of marks put on the print image itself can be adopted as the first print data.

[0039] That is, while only the marks may be printed to measure the distance between the marks, the print image itself is intentionally printed, thereby making it possible to calculate the expansion/contraction ratio considering an influence of the ink in the printing of the print image.

[0040] In the printing apparatus according to the present invention, when the printing-related section includes the first printing section, the first fixing section, the second printing section, and the second fixing section, and are arranged in this order, the first expansion/contraction ratio in the first printing section and the second expansion/contraction ratio in the second printing section are calculated from the one imaging data.

[0041] The first correction data is generated by expanding or contracting the data of the portion taken charge of by the first printing section in the print image in the first print data on the basis of

the first expansion/contraction ratio, and the second correction data is generated by expanding or contracting the data of the portion taken charge of by the second printing section in the print image in the first print data on the basis of the second expansion/contraction ratio, thereby making it possible to make the size of the print image at the time of recovery substantially match the size of the original print data in the same manner as above even when the printing-related section includes the two printing sections and the two fixing sections.

[0042] The printing-related section includes the first printing section and the second printing section, thereby making it possible to perform multicolor printing, back printing with a white ink, and the like.

[0043] With the printing apparatus according to the present invention, the calculation means calculates the expansion/contraction ratio on the basis of the above-described equation, and the correction means corrects the print image on the basis of the above-described equation, thereby making it possible to efficiently make the size of the print image at the time of recovery substantially match the size of the original print data.

[0044] In the printing apparatus according to the present invention, when the marks in the first print data are respectively provided at the four corners of the print image, the expansion/contraction ratio can be calculated with higher accuracy.

[0045] In the printing apparatus according to the present invention, when the marks are respectively provided at the positions of the four notched corners of the print image, the marks in the imaging data are easily detected, thereby making it possible to measure the distance between the marks with higher accuracy.

[0046] The width of the medium can be made as small as possible to match the size of the print image.

[0047] In the printing apparatus according to the present invention, while the size of the medium may increase in the first fixing section when the printing-related section includes the first printing section and the second printing section, the marks are easily detected by providing the margin in the above-described range between each of the marks and the print image, thereby making it possible to measure the distance between the marks with higher accuracy.

[0048] When the second mark is printed by the second printing section, the second mark can be prevented from overlapping a print of the portion taken charge of by the first printing section in the print image.

[0049] In the printing apparatus according to the present invention, when each of the marks includes the horizontal line and the vertical line, the marks in the imaging data are easily detected, thereby making it possible to measure the distance between the marks with higher accuracy.

[0050] At this time, the first print data has the accessory and the plurality of marks and the accessory are printed in the same color, whereby a nozzle can be prevented from being clogged when the plurality of marks are printed.

Description

BRIEF DESCRIPTIONS OF THE DRAWINGS
[0051] FIG. **1** is a schematic side view illustrating a first embodiment of a printing apparatus according to the present invention;
[0052] FIG. **2** is a block diagram for describing a control section in the printing apparatus according to the first embodiment;
[0053] FIG. **3** is a diagram illustrating first print data based on which printing is performed in the printing apparatus according to the first embodiment;
[0054] FIG. **4** is a diagram illustrating imaging data in a print medium when printing is performed using the first print data illustrated in FIG. **3**;

[0055] FIG. **5** is a diagram for describing generation of second print data by correction means in the printing apparatus according to the first embodiment;

[0056] FIG. **6** is a flowchart for describing automatic expansion and contraction correction in the printing apparatus according to the first embodiment;

[0057] FIG. **7** is a schematic side view illustrating a second embodiment of the printing apparatus according to the present invention;

[0058] FIG. **8** is a diagram illustrating first print data based on which printing is performed in a printing apparatus according to a second embodiment;

[0059] FIG. **9** is a diagram illustrating imaging data in a print medium when printing is performed using the first print data illustrated in FIG. **8**; and

[0060] FIG. **10** is a diagram illustrating first print data based on which printing is performed in a printing apparatus according to another embodiment.

DESCRIPTIONS OF THE PREFERRED EMBODIMENTS

[0061] Preferred embodiments of the present invention will be described in detail below with reference to the drawings, as needed.

[0062] In the drawings, the same elements are respectively assigned the same reference numerals, and overlapping descriptions will be omitted.

[0063] A relationship among upper, lower, left, and right positions, for example, is based on a positional relationship illustrated in the drawings unless otherwise noted.

[0064] Further, dimensional ratios in the drawings are not limited to illustrated ratios.

[0065] A printing apparatus according to the present invention is an apparatus for applying a print image on a medium on the basis of print data.

[0066] In the printing apparatus, the medium is not particularly limited, but paper, a film, a fabric, a non-woven fabric, rubber, a metal, or the like can be adopted.

[0067] Among these, the medium is preferably a film that easily expands and contracts due to a tension or the like.

[0068] In this case, an effect of the present invention can be fully enjoyed.

[0069] The medium may be in an elongated shape or cut to a predetermined size.

[0070] The medium preferably has an elongated shape. In this case, an effect of the present invention can be fully enjoyed.

[0071] A print image includes patterns, characters, colors, or their combinations, and the size thereof is not particularly limited.

[0072] As a printing system, an on-demand type inkjet system such as a piezo system or a thermal system can be preferably adopted.

[0073] As a printing head system, a serial head system or a line head system can be adopted.

[0074] In the printing apparatus according to the present embodiment, the line head system is adopted.

[0075] In this specification, "upstream" means "upstream" in a conveyance direction of a medium, and "downstream" means "downstream" in the conveyance direction of the medium.

[0076] The "print medium" means one obtained by printing and fixing a print image on the above-described medium.

[0077] That is, a medium that has passed through the printing-related section **3** is a print medium.

First Embodiment

[0078] FIG. **1** is a schematic side view illustrating a first embodiment of a printing apparatus according to the present invention. The printing apparatus according to the first embodiment is an example in which an elongated medium is adopted and a line-type inkjet system is adopted.

[0079] As illustrated in FIG. **1**, a printing apparatus **100** according to the first embodiment includes a supply section **1** for supplying a medium X, a pretreatment section **2** for subjecting the medium X to pretreatment, a printing-related section **3** including a first printing section **30***a* and a second printing section **30***b* for printing at least a print image on the medium X on the basis of print data

and a first fixing section **31***a* and a second fixing section **31***b* for fixing the print image on the medium X to obtain a print medium X**1**, a recovery section **4** for recovering the print medium X**1**, an imaging section **5**, arranged between the printing-related section **3** and the recovery section **4**, for imaging the print medium X**1**, and a control section **6** for controlling printing.

[0080] In the printing apparatus **100**, the medium X is continuously fed by the supply section **1**.

[0081] First, the medium X is subjected to pretreatment by the pretreatment section **2**.

[0082] Then, the print image is continuously printed on the medium X by the printing-related section **3**, and the print image is fixed by drying, to obtain the print medium X**1**.

[0083] The print medium X**1** is wound and recovered by the recovery section **4**.

[0084] Therefore, in the printing apparatus **100**, it is possible to continuously obtain the print medium X**1** by providing the medium X with the print image.

[0085] The supply section **1** is a site for supplying, from a supply roll **10** around which the elongated medium X is wound in a roll shape, the medium X toward the downstream side.

[0086] In the supply section **1**, the medium X is sandwiched between a feed roller **11** and a nip roller (not illustrated), and the feed roller **11** is driven to rotate by a driving motor (not illustrated), thereby positively feeding the medium X.

[0087] At this time, a rotational resistance is applied to the supply roll **10** by a powder brake (not illustrated), so that a tension having a value corresponding to the magnitude of the rotational resistance (a brake force) is applied to the medium X.

[0088] The pretreatment section **2** is a site for subjecting the medium X to pretreatment for, for example, forming an ink receiving layer.

[0089] The pretreatment section **2** includes a corona treatment device **20** for subjecting the medium X to surface modification treatment (corona treatment), a coater treatment device **21** for applying an ink receiving liquid to the medium X using a flexographic system, and a dryer **22** for drying the medium X to which the ink receiving liquid is applied and forming the ink receiving layer.

[0090] The pretreatment section **2** has a cooling roller **23** downstream of the dryer **22**. Thus, the medium X is cooled.

[0091] The printing-related section **3** includes the first printing section **30***a* and the second printing section **30***b* for printing a print image, a mark, and the like (first print data described below) or a print image (second print data described below) on the medium X on the basis of the print data and the first fixing section **31***a* and the second fixing section **31***b* for fixing the print image on the medium X by drying to obtain the print medium X**1**.

[0092] In the printing-related section **3**, the first printing section **30***a*, the first fixing section **31***a*, the second printing section **30***b*, and the second fixing section **31***b* are arranged in that order from the upstream side.

[0093] Accordingly, the print image printed by the first printing section **30***a* is fixed by the first fixing section **31***a*, and the print image printed by the second printing section **30***b* is fixed by the second fixing section **31***b*.

[0094] The printing-related section **3** has a cooling roller **33***a* downstream of the first fixing section **31***a*, and has a cooling roller **33***b* downstream of the second fixing section **31***b*.

[0095] Accordingly, the medium X that has passed through the first fixing section **31***a* and the second fixing section **31***b* is cooled.

[0096] In the printing apparatus **100**, a print image is completed by printing based on data of a portion taken charge of by the first printing section **30***a* and printing based on data taken charge of by the second printing section **30***b*.

[0097] Marks, for example, include a first mark printed by the first printing section **30***a*, a second mark printed by the second printing section **30***b*, an accessory printed by the first printing section **30***a* and the second printing section **30***b*, and the like.

[0098] Details of these will be described below.

[0099] The first printing section **30***a* has line heads **32***a* capable of printing an ink, and the second

printing section **30***b* has line heads **32***b* capable of printing an ink.

[0100] As such an ink, a water-based ink, an oil-based ink, or the like is used.

[0101] Specifically, the first printing section **30***a* has the line heads **32***a* capable of printing a yellow ink, a magenta ink, a cyan ink, and a black ink, and the second printing section **30***b* has the line heads **32***b* capable of printing a white ink.

[0102] In this case, a full-color print image, for example, is printed by the first printing section **30***a*, and a print image with a white ink is then printed by the second printing section **30***b*, thereby making it possible to form a so-called back printing print image.

[0103] A print image with a white ink is printed by the first printing section **30***a*, and a full-color print image is then printed by the second printing section **30***b*, thereby making it possible to form a so-called surface printing print image.

[0104] The first fixing section **31***a* and the second fixing section **31***b* are each a hot air dryer that blows hot air onto the medium X to which the print image is applied and fixes the print image.

[0105] Accordingly, the first fixing section **31***a* and the second fixing section **31***b* each apply a thermal energy sufficient to dry the ink to the medium X.

[0106] At this time, a liquid component contained in the ink vaporizes by absorbing a predetermined thermal energy.

[0107] That is, an amount of the thermal energy to be applied to the medium X varies depending on an amount of the ink.

[0108] In the printing apparatus **100**, a constant tension is applied to the medium X by the supply section **1**, the recovery section **4**, and the like, and the thermal energy is applied to the medium X by the first fixing section **31***a* and the second fixing section **31***b* in the state.

[0109] When the thermal energy is further applied to the medium X on which the print image is fixed, the medium X is softened, thereby making it easy for the medium X to expand and contract.

[0110] Specifically, the medium X easily expands in a conveyance direction in which it is pulled, and correspondingly, easily contracts in a width direction.

[0111] As a result, for the print medium X**1** on which the print image is fixed, the vertical and horizontal sizes of the print image differ from the vertical and horizontal sizes of the print image in the first print data.

[0112] A thermal energy is applied by the first fixing section **31***a* and the second fixing section **31***b* to a print image based on the data of the portion taken charge of by the first printing section **30***a*, while a thermal energy is applied by only the second fixing section **31***b* to a print image based on the data of the portion taken charge of by the second printing section **30***b*. Accordingly, an influence received from expansion and contraction of the medium X by the print image based on the data of the portion taken charge of by the first printing section **30***a* and an influence received from expansion and contraction of the medium X by the print image based on the data of the portion taken charge of by the second printing section **30***b* differ from each other, and respective expansion/contraction ratios also differ from each other.

[0113] Therefore, in the printing apparatus **100**, the second print data previously considering the expansion and contraction is generated, based on which printing is performed.

[0114] The recovery section **4** is a site for recovering the print medium X**1** as a recovery roll **40** while winding the print medium X**1** around a shaft.

[0115] In the recovery section **4**, the print medium X**1** is sandwiched between a feed roller **41** and a nip roller (not illustrated), and the feed roller **41** is driven to rotate by a driving motor (not illustrated), thereby feeding the print medium X**1** into the recovery roll **40** at a constant tension.

[0116] The imaging section **5** images the print image side of the print medium X**1** to obtain imaging data.

[0117] That is, the imaging data is obtained by the imaging section **5** imaging a print image, a mark, and an accessory fixed on the print medium X**1**.

[0118] The imaging section **5** is arranged between the printing-related section **3** and the recovery

section **4**.

[0119] As described above, in the printing-related section **3**, the medium X easily expands and contracts. Accordingly, the imaging section **5** is arranged between the printing-related section **3** and the recovery section **4**, thereby making it possible to calculate an expansion/contraction ratio sufficiently considering the expansion and contraction of the medium X in the printing-related section **3**.

[0120] The printing-related section **3** includes the first printing section **30***a* and the second printing section **30***b*, so that the imaging section **5** is arranged between the printing-related section **3** and the recovery section **4**, thereby making it possible to calculate a first expansion/contraction ratio in the first printing section **30***a* and a second expansion/contraction ratio in the second printing section **30***b* from one imaging data.

[0121] As the imaging section **5**, a scanner sensor is preferably used.

[0122] Specifically, as the imaging section **5**, a CIS (contact image sensor) and a CCD (charge coupled device) sensor, for example, can be adopted.

[0123] Among them, the CIS that is small in size and low in power consumption is preferably adopted as the imaging section **5**.

[0124] The control section **6** is a site for controlling printing.

[0125] FIG. **2** is a block diagram for describing a control section in the printing apparatus according to the first embodiment. As illustrated in FIG. **2**, the control section **6** includes at least processing means **60**, first transmission means **61**, imaging means **62**, measurement means **63**, calculation means **64**, correction means **65**, and second transmission means **66**.

[0126] In the control section **6**, the first transmission means **61**, the imaging means **62**, the measurement means **63**, the calculation means **64**, and the second transmission means **66** are stored in a first computer **6***a*, and the processing means **60** and the correction means **65** are stored in a second computer **6***b*.

[0127] It is possible to appropriately perform data exchange between the first computer **6***a* and the second computer **6***b* by wire or wirelessly.

[0128] The processing means **60** is a so-called RIP (raster image processor), and converts submitted original data into a raster image and further converts raster imaging data into print data in such a format that the printing apparatus **100** can perform printing based thereon.

[0129] The conversion by the processing means **60** is known, and hence detailed description will be omitted.

[0130] The print data includes first print data or the second print data.

[0131] FIG. **3** is a diagram illustrating the first print data based on which printing is performed in the printing apparatus according to the first embodiment.

[0132] The second print data will be described below.

[0133] As illustrated in FIG. **3**, first print data DT**1** includes a print image **7**, a plurality of marks **70** each including a first mark **71** and a second mark **72**, and an accessory **8**.

[0134] That is, the first print data DT**1** is obtained by putting the plurality of marks **70** each including the first mark **71** and the second mark **72** on the print image **7** and further putting the accessory **8** thereon.

[0135] In the first print data DT**1**, it is possible to calculate an expansion/contraction ratio considering an influence of an ink in printing of the print image **7** in the printing-related section **3** by intentionally adding the print image **7** thereto.

[0136] The marks **70** are respectively provided at four corners of the print image **7**.

[0137] As a result, a distance in the conveyance direction and a distance in the width direction can be sufficiently kept, thereby making it possible to calculate the expansion/contraction ratio with higher accuracy.

[0138] At the four corners respectively provided with the marks **70**, the print image **7** remains notched.

[0139] That is, the marks **70** are respectively provided at positions where the four corners of the print image **7** are notched. This makes it easy to detect the marks **70** in the imaging data, thereby making it possible to measure a distance between the marks **70** with higher accuracy.

[0140] The marks **70** are not provided outside the print image **7** but provided by notching the print image **7** itself, thereby making it possible to make the size of the print image **7** as large as possible to match the width of the medium X.

[0141] At this time, there is provided a sufficient margin between each of the marks **70** and the print image **7**.

[0142] A shortest distance between each of the marks **70** and the print image **7** is preferably 10 mm or more.

[0143] In this case, the marks **70** are easily detected, thereby making it possible to measure the distance between the marks **70** with higher accuracy.

[0144] While the size of the medium X may be enlarged in the first fixing section **31***a*, the second mark **72** can be prevented from overlapping a print of the portion taken charge of by the first printing section **30***a* in the print image **7** when printed by the second printing section **30***b*.

[0145] The first mark **71** has at least a horizontal line **71***a* and a vertical line **71***b*.

[0146] Specifically, the first mark **71** has a cross pattern in which the horizontal line **71***a* and the vertical line **71***b* intersect each other at their center.

[0147] Thus, the first mark **71** is made to have a line shape, thereby making it easy to detect the first mark **71** in the imaging data.

[0148] A distance R**1***a* in the conveyance direction can be measured using the horizontal line **71***a*, and a distance Rib in the width direction can be measured using the vertical line **71***b*, resulting in an improvement in measurement accuracy.

[0149] Similarly, the second mark **72** has at least a horizontal line **72***a* and a vertical line **72***b*.

[0150] Specifically, the second mark **72** has a rectangular pattern including a pair of horizontal lines **72***a* and a pair of vertical lines **72***b*.

[0151] Thus, the second mark **72** is made to have a line shape, thereby making it easy to detect the second mark **72** in the imaging data.

[0152] A distance R**2***a* in the conveyance direction, described below, can be measured using the horizontal line **72***a*, and a distance R**2***b* in the width direction, described below, can be measured using the vertical line **72***b*, resulting in an improvement in measurement accuracy.

[0153] The cross pattern of the first mark **71** is printed to be arranged at the center of the rectangular pattern of the second mark **72**.

[0154] This makes it possible to even visually recognize a deviation of the first mark **71** relative to the second mark **72**.

[0155] That is, it can be recognized that a positional deviation of the first mark **71** printed by the first printing section **30***a* due to expansion and contraction of the medium X and a positional deviation of the second mark **72** printed by the second printing section **30***b* due to expansion and contraction of the medium X differ in degree.

[0156] In each of the first mark **71** and the second mark **72**, the respective lengths of the horizontal line and the vertical line can be optionally set depending on the size of the print image **7**.

[0157] When a distance **7***a* in the conveyance direction of the print image **7** is less than 30 inches, the respective lengths of the horizontal line and the vertical line are preferably the same.

[0158] On the other hand, when the distance **7***a* in the conveyance direction of the print image **7** is 30 inches or more, the length of the vertical line is preferably larger than the length of the horizontal line considering that the medium X greatly expands.

[0159] The first mark **71** is preferably printed by one of the line heads **32***a* in the first printing section **30***a*, and the second mark **72** is preferably printed by one of the line heads **32***b* in the second printing section **30***b*.

[0160] In these cases, the occurrence of a printing misalignment between the line heads can be

excluded.

[0161] That is, the printing misalignment between the line heads **32***a* can be prevented from being confused with the deviation due to the expansion and contraction of the medium X.

[0162] When the first mark **71** and the second mark **72** are printed to overlap each other, a color in which the first printing section **30***a* prints the first mark **71** and a color in which the second printing section **30***b* prints the second mark **72** are preferably respectively different colors.

[0163] If the first mark **71** and the second mark **72** are not printed to overlap each other, their respective colors may be the same.

[0164] If the medium X is transparent, the colors are not limited. However, if the medium X is colored, the colors are preferably different from the color of the medium X.

[0165] The accessory **8** has an automatic registration mark (not illustrated), upper refresh lines **81**, and intermediate refresh lines **82**.

[0166] When the automatic registration mark is provided as the accessory **8**, registration of the print image **7** can be automatically adjusted.

[0167] The automatic registration mark may be automatically expanded and contracted depending on an expansion/contraction ratio described below, or may be added without being expanded and contracted.

[0168] The upper refresh lines **81** are respectively provided above the upper left horizontal line **72***a* (second mark **72**) and above the upper right horizontal line **72***a* (second mark **72**), and the plurality of intermediate refresh lines **82** are provided to be equally spaced apart from one another between the upper left horizontal line **72***a* (second mark **72**) and the lower left horizontal line **72***a* (second mark **72**) and between the upper right horizontal line **72***a* (second mark **72**) and the lower right horizontal line **72***a* (second mark **72**).

[0169] The plurality of marks **70** and the accessory **8** are printed in the same color. As a result, the upper refresh line **81** or the intermediate refresh line **82** is printed just before the plurality of marks **70** are printed. Therefore, when the plurality of marks **70** are printed, a nozzle can be prevented from being clogged.

[0170] Although the upper refresh line **81** and the intermediate refresh line **82** are respectively horizontal lines, their respective shapes are not particularly limited.

[0171] The number of intermediate refresh lines **82** and a spacing thereamong are not particularly limited.

[0172] Referring to FIG. **2** again, in the control section **6**, the first transmission means **61** transmits printing start commands, respectively, to the first printing section **30***a* and the second printing section **30***b* on the basis of the first print data DT**1** generated by the processing means **60**.

[0173] Specifically, the printing start command to the first printing section **30***a* is a command to cause the first printing section **30***a* to print data of the portion taken charge of by the first printing section **30***a* in the first print data DT**1**, and the printing start command to the second printing section **30***b* is a command to cause the second printing section **30***b* to print data of the portion taken charge of by the second printing section **30***b* in the first print data DT**1**.

[0174] The portion taken charge of by the first printing section **30***a* and the portion taken charge of by the second printing section **30***b* in the first print data DT**1** can be appropriately set in consideration of an ink or the like arranged in each of the printing sections.

[0175] In the printing apparatus **100**, printing is started by the first printing section **30***a* and the second printing section **30***b*, respectively, at previously set timings in response to the printing start commands transmitted by the first transmission means **61**.

[0176] For example, the printing start command to the first printing section **30***a* is a command to start printing from a desired printing start location on the medium X.

[0177] The printing start command to the second printing section **30***b* is a command to read a printing start mark (not illustrated) printed by the first printing section **30***a* and start printing from the printing start location.

[0178] The imaging means **62** causes the imaging section **5** to image the print medium X**1** on which the first print data DT**1** is printed by the first printing section **30***a* and the second printing section **30***b*, sets an imaged still image as imaging data, and acquires the imaging data.

[0179] The imaging data may be obtained by imaging the still image of the print medium X**1** in a timely manner or obtained by imaging a moving image of the print medium X**1** to be conveyed once and picking up a still image in the moving image.

[0180] FIG. **4** is a diagram illustrating imaging data in a print medium when printing is performed using first print data illustrated in FIG. **3**.

[0181] In FIG. **4**, description of a misalignment of the print image **7** is omitted.

[0182] As illustrated in FIG. **4**, the measurement means **63** measures a distance R**3***a* in the conveyance direction between first marks **73** printed by the first printing section **30***a* and a distance R**3***b* in the width direction between the first marks **73** in imaging data DT**3**, to acquire a first imaging measurement value including values of the distances.

[0183] The measurement means **63** measures a distance R**4***a* in the conveyance direction between second marks **74** printed by the second printing section **30***b* and a distance R**4***b* in the width direction between the second marks **74** in the imaging data DT**3**, to acquire a second imaging measurement value including values of the distances.

[0184] That is, the first imaging measurement value corresponds to the printing by the first printing section **30***a*, and the second imaging measurement value corresponds to the printing by the second print section **30***b*.

[0185] If the print medium X**1** in the imaging data DT**3** is inclined, the imaging data DT**3** is subjected to rotation correction, as needed, such that a length direction of the print medium X**1** and the conveyance direction match each other.

[0186] Each of the first imaging measurement value and the second imaging measurement value may be measured from one imaging data DT**3**, or may be an average of measurements from a plurality of imaging data DT**3**.

[0187] From the viewpoint of an accuracy of the expansion/contraction ratio, each of the first imaging measurement value and the second imaging measurement value may be preferably an average of measurements from 5 to 100 imaging data DT**3**.

[0188] The calculation means **64** calculates a first expansion/contraction ratio for the first printing section **30***a* from a first reference measurement value (see FIG. **3**) including respective values of the distance R**1***a* in the conveyance direction between the first marks **71** and the distance R**1***b* in the width direction between the first marks **71** in the first print data DT**1** and the above-described first imaging measurement value.

[0189] The calculation means **64** calculates a second expansion/contraction ratio for the second printing section **30***b* from a second reference measurement value (see FIG. **3**) including respective values of the distance R**2***a* in the conveyance direction between the second marks **72** and the distance R**2***b* in the width direction between the second marks **72** in the first print data DT**1** and the above-described second imaging measurement value.

[0190] In the calculation means **64**, the first expansion/contraction ratio and the second expansion/contraction ratio are calculated as follows.

[0191] A first expansion/contraction ratio X**11** in the conveyance direction of the first printing section **30***a* is calculated by X**11**=A**11**/B**11** from a value A**11** of the distance R**1***a* in the conveyance direction between the first marks **71** in the first print data DT**1** and a value B**11** of the distance R**3***a* in the conveyance direction between the first marks **73** in the imaging data DT**3**.

[0192] A first expansion/contraction ratio X**12** in the width direction of the first printing section **30***a* is calculated by X**12**=A**12**/B**12** from a value A**12** of the distance R**1***b* in the width direction between the first marks **71** in the first print data DT**1** and a value B**12** of the distance R**3***b* in the width direction between the first marks **73** in the imaging data DT**3**.

[0193] Thus, the first expansion/contraction ratio, i.e., the first expansion/contraction ratio X**11** in

the conveyance direction and the first expansion/contraction ratio X**12** in the width direction are obtained.

[0194] Similarly, a second expansion/contraction ratio X**21** in the conveyance direction of the second printing section **30***b* is calculated by X**21**=A**21**/B**21** from a value A**21** of the distance R**2***a* in the conveyance direction between the second marks **72** in the first print data DT**1** and a value B**21** of the distance R**4***a* in the conveyance direction between second marks **74** in the imaging data DT**3**.

[0195] A second expansion/contraction ratio X**22** in the width direction of the second printing section **30***b* is calculated by X**22**=A**22**/B**22** from a value A**22** of the distance R**2***b* in the width direction between the second marks **72** in the first print data DT**1** and a value B**22** of the distance R**4***b* in the width direction between the second marks **74** in the imaging data DT**3**.

[0196] Thus, the second expansion/contraction ratio, i.e., the second expansion/contraction ratio X**21** in the conveyance direction and the second expansion/contraction ratio X**22** in the width direction are obtained.

[0197] FIG. **5** is a diagram for describing generation of second print data by correction means in the printing apparatus according to the first embodiment.

[0198] As illustrated in FIG. **5**, the correction means **65** expands and contracts data DS**1** of the portion taken charge of by the first printing section **30***a* in the print image **7** in the first print data DT**1** on the basis of the first expansion/contraction ratio to generate first correction data H**1**, and expands and contracts data DS**2** of the portion taken charge of by the second printing section **30***b* in the print image **7** in the first print data DT**1** on the basis of the second expansion/contraction ratio to generate second correction data H**2**.

[0199] That is, second print data DT**2** includes first the correction data H**1** and the second correction data H**2**.

[0200] Each of the first correction data H**1** and the second correction data H**2** (the second print data DT**2**) does not have a mark **70** or the like but has only a print image **9**.

[0201] Four corners of the print image **9** are not notched.

[0202] In the first print data DT**1**, a distance in the conveyance direction of the data DS**1** of the portion taken charge of by the first printing section **30***a* is the same as the distance **7***a* in the conveyance direction of the print image **7**, and a distance in the width direction of the data DS**1** of the portion taken charge of by the first printing section **30***a* is the same as a distance **7***b* in the width direction of the print image **7** (see FIG. **3**).

[0203] In the first print data DT**1**, a distance in the conveyance direction of the data DS**2** of the portion taken charge of by the second printing section **30***b* is the same as the distance **7***a* in the conveyance direction in the print image **7**, and a distance in the width direction of the data DS**2** of the portion taken charge of by the second printing section **30***b* is the same as the distance **7***b* in the width direction of the print image **7** (see FIG. **3**).

[0204] That is, in the first print data DT**1**, both the respective sizes of the data DS**1** of the portion taken charge of by the first printing section **30***a* and the data DS**2** of the portion taken charge of by the second printing section **30***b* are common to the size of the first print data DT**1** (the print image **7**) in either the conveyance direction or the width direction.

[0205] Therefore, the data DS**1** of the portion taken charge of by the first printing section **30***a* also includes a portion that is not printed by the first printing section **30***a*, and the data DS**2** of the portion taken charge of by the second printing section **30***b* includes a portion that is not printed by the second printing section **30***b*.

[0206] The respective sizes of the first correction data H**1** and the second correction data H**2** are expanded and contracted in the conveyance direction and the width direction, and thus do not match the size of the first print data DT**1**.

[0207] In the correction means **65**, the print image **9** in each of the first correction data H**1** and the second correction data H**2** (the second print data DT**2**) is corrected as follows.

[0208] A value D11 of a distance $91a$ in the conveyance direction in the first correction data H1 is calculated by D11=C11×X11 from a value C11 of a distance in the conveyance direction of the data DS1 of the portion taken charge of by the first printing section $30a$ in the print image 7 in the first print data DT1 and the first expansion/contraction ratio X11 in the conveyance direction.

[0209] A value D12 of a distance $91b$ in the width direction in the first correction data H1 is calculated by D12=C12×X12 from a value C12 of a distance in the width direction of the data DS1 of the portion taken charge of by the first printing section $30a$ in the print image 7 in the first print data DT1 and the first expansion/contraction ratio X12 in the width direction.

[0210] The correction means 65 expands or contracts the data DS1 of the portion taken charge of by the first printing section $30a$ in the print image 7 in the first print data DT1 to correspond to the value D11 of the distance $91a$ in the conveyance direction in the first correction data H1 and the value D12 of the distance $91b$ in the width direction in the first correction data H1, to generate the first correction data H1.

[0211] Similarly, a value D21 of a distance $92a$ in the conveyance direction in the second correction data H2 is calculated by D21=C21×X21 from a value C21 of a distance in the conveyance direction of the data DS2 of the portion taken charge of by the second printing section $30b$ in the print image 7 in the first print data DT1 and the second expansion/contraction ratio X21 in the conveyance direction.

[0212] A value D22 of a distance $92b$ in the width direction in the second correction data H2 is calculated by D22=C22×X22 from a value C22 of a distance in the width direction of the data DS2 of the portion taken charge of by the second printing section $30b$ in the print image 7 in the first print data DT1 and the second expansion/contraction ratio X22 in the width direction.

[0213] The correction means 65 expands or contracts the data DS2 of the portion taken charge of by the second printing section $30b$ in the print image 7 in the first print data DT1 to correspond to the value D21 of the distance $92a$ in the conveyance direction in the second correction data H2 and the value D22 of the distance $92b$ in the width direction in the second correction data H2, to generate the second correction data H2.

[0214] Thus, the second print data a DT2 including the first correction data H1 and the second correction data H2 is obtained.

[0215] The second transmission means 66 transmits printing start commands, respectively, to the first printing section $30a$ and the second printing section $30b$ on the basis of the second print data DT2 generated by the correction means 65.

[0216] Specifically, the printing start command to the first printing section $30a$ is a command to cause the first printing section $30a$ to print the first correction data H1, and the printing start command to the second printing section $30b$ is a command to cause the second printing section $30b$ to print the second correction data H2.

[0217] Respective timings of starting printing by the first printing section $30a$ and the second printing section $30b$ are the same as a timing of transmission by the first transmission means 61.

[0218] FIG. 6 is a flowchart for describing automatic expansion and contraction correction in the printing apparatus according to the first embodiment.

[0219] In the printing apparatus 100, the original data is first inputted to the second computer $6b$.

[0220] Then, the processing means 60 converts the original data and adds the marks 70 and the accessory 8 thereto, to generate the first print data DT1 (first step).

[0221] In the first print data DT1, the respective portions taken charge of by printing by the first printing section $30a$ and the second printing section $30b$ are set when the original data is converted.

[0222] The printing apparatus 100 is operated, and the first transmission means 61 transmits the printing start commands, respectively, to the first printing section $30a$ and the second printing section $30b$ on the basis of the first print data DT1 (second step).

[0223] The first printing section $30a$ and the second printing section $30b$ that have received the printing start commands start printing on the medium X, respectively, at previously set timings.

[0224] Then, the imaging means **62** causes the imaging section **5** to image the print medium X**1** that has passed through the printing-related section **3**, to acquire the imaging data DT**3** (third step).

[0225] Such imaging may be performed a plurality of times, as needed.

[0226] In the first computer **6***a*, the measurement means **63** measures the first imaging measurement value and the second imaging measurement value from the imaging data DT**3** (fourth step), and the calculation means calculates the first **64** expansion/contraction ratio from the first reference measurement value in the first print data DT**1** and the first imaging measurement value and calculates the second expansion/contraction ratio from the second reference measurement value in the first print data DT**1** and the second imaging measurement value (fifth step).

[0227] Then, in the second computer **6***b*, the correction means **65** generates the first correction data H**1** in the first printing section **30***a* and the second correction data H**2** in the second printing section **30***b* on the basis of the calculated first expansion/contraction ratio and second expansion/contraction ratio (sixth step). That is, the second print data DT**2** is generated.

[0228] Then, the second transmission means **66** transmits the printing start command to the first printing section **30***a* on the basis of the first correction data H**1** and transmits the printing start command to the second printing section **30***b* on the basis of the second correction data H**2** (seventh step).

[0229] The first printing section **30***a* and the second printing section **30***b* that have received the printing start commands start printing on the medium X, respectively, at previously set timings.

[0230] After a desired number of prints or prints having a predetermined length based on the first correction data H**1** and the second correction data H**2** (the second print data DT**2**) are made, the printing is finished.

[0231] In the printing apparatus **100**, the automatic expansion and contraction correction is performed through the first step to the seventh step.

[0232] After the seventh step, the first step to the seventh step may be repeated, as needed.

[0233] If it takes time in performing the third step to the sixth step, the printing may be stopped once.

[0234] In the printing apparatus **100**, both respective error ranges of a distance in the conveyance direction and a distance in the width direction between the print image **7** in the first print data DT**1** and the print image **9** to be printed on the basis of the first correction data H**1** and the second correction data H**2** (the second print data DT**2**) are within +1.0 mm and preferably within +0.1 mm.

[0235] That is, in the printing apparatus **100**, it is important to set the size of the print image at the time of recovery to a desired size with high accuracy.

[0236] This makes it possible to make the size of the print image at the time of recovery substantially match the size of the original print data.

[0237] The printing apparatus **100** has an automatic expansion/contraction correction function, as described above. That is, the printing apparatus **100** includes the imaging section **5** and the control section **6**, and the control section **6** includes the first transmission means **61**, the imaging means **62**, the measurement means **63**, and the calculation means **64**, thereby making it possible to automatically calculate the expansion/contraction ratio. Further, the printing apparatus **100** includes the correction means **65** and the second transmission means **66**, thereby making it possible to automatically generate the first correction data H**1** and the second correction data H**2** (the second print data DT**2**) respectively expanding and contracting the print image **7** on the basis of the expansion/contraction ratio.

[0238] This makes it possible to exclude a human error in the printing apparatus **100**.

[0239] Measurement between the first mark **71** and the second mark **72** is performed by the control section **6**, resulting in an improvement in measurement accuracy.

[0240] Time and effort for a person to perform measurement can be saved, thereby making it possible to improve productivity.

Second Embodiment

[0241] FIG. **7** is a schematic side view illustrating a second embodiment of a printing apparatus according to the present invention.

[0242] The printing apparatus according to the second embodiment is an example in which an elongated medium is adopted and a line-type inkjet system is adopted.

[0243] As illustrated in FIG. **7**, a printing apparatus **101** according to the second embodiment includes a supply section **1** for supplying a medium X, a pretreatment section **2** for subjecting the medium X to pretreatment, a printing-related section **3***a* including a printing section **30** for printing at least a print image on the medium X on the basis of print data and a fixing section **31** for fixing the print image on the medium X to obtain a print medium X**1**, a recovery section **4** for recovering the print medium X**1**, an imaging section **5**, arranged between the printing-related section **3***a* and the recovery section **4**, for imaging the print medium X**1**, and a control section **6** for controlling printing.

[0244] That is, the printing apparatus **101** according to the second embodiment is the same as the printing apparatus **100** according to the first embodiment except for the printing-related sections.

[0245] The printing-related section **3***a* includes the printing section **30** for printing a print image, a mark, and the like (first print data described below) or a print image (second print data described below) on the medium X on the basis of the print data, the fixing section **31** for fixing the print image on the medium X by drying to obtain the print medium X**1**, and a cooling roller **33** for cooling the medium X.

[0246] In the printing-related section **3***a*, the print image printed by the printing section **30** is fixed by the fixing section **31** and is cooled by the cooling roller **33**.

[0247] The printing section **30** has line heads **32** capable of printing an ink.

[0248] As such an ink, water-based ink, an oil-based ink, or the like is used.

[0249] A color is not particularly limited.

[0250] The fixing section **31** is a hot air dryer that blows hot air onto the medium X to which the print image is applied and fixes the print image.

[0251] Accordingly, the fixing section **31** applies a thermal energy sufficient to dry the ink to the medium X.

[0252] At this time, a liquid component contained in the ink vaporizes by absorbing a predetermined thermal energy.

[0253] That is, an amount of the thermal energy to be applied to the medium X varies depending on an amount of the ink.

[0254] In the printing apparatus **101**, a constant tension is applied to the medium X by the supply section **1**, the recovery section **4**, and the like, and the thermal energy is applied to the medium X by the fixing section **31** in the state.

[0255] When the thermal energy is further applied to the medium X on which the print image is fixed, the medium X is softened, thereby making it easy for the medium X to expand and contract.

[0256] Specifically, the medium X easily expands in a conveyance direction in which it is pulled, and correspondingly, easily contracts in a width direction.

[0257] As a result, for the print medium X**1** on which the print image is fixed, the vertical and horizontal sizes of the print image differ from the vertical and horizontal sizes of the print image in first print data.

[0258] The supply section **1**, the pretreatment section **2**, the recovery section **4**, and the imaging section **5** are respectively the same as the supply section **1**, the pretreatment section **2**, the recovery section **4**, and the imaging section **5** in the printing apparatus **100** according to the first embodiment, and hence descriptions thereof will be omitted.

[0259] The imaging section **5** is arranged between the printing-related section **3***a* and the recovery section **4**.

[0260] The control section **6** includes at least processing means **60**, first transmission means **61**, imaging means **62**, measurement means **63**, calculation means **64**, correction means **65**, and second

transmission means **66**, similarly to the control section **6** in the printing apparatus **100** according to the first embodiment, the first transmission means **61**, the imaging means **62**, the measurement means **63**, the calculation means **64**, and the second transmission means **66** are stored in a first computer **6**a, and the processing means **60** and the correction means **65** are stored in a second computer **6**b (see FIG. **2**).

[0261] The processing means **60** is a so-called RIP (raster image processor), and converts submitted original data into a raster image and further converts raster imaging data into print data in such a format that the printing apparatus **101** can perform printing based thereon.

[0262] The print data includes first print data or second print data.

[0263] FIG. **8** is a diagram illustrating the first print data based on which printing is performed in the printing apparatus according to the second embodiment.

[0264] As illustrated in FIG. **8**, first print data DT**1**a includes a print image **7**, marks **711** respectively provided at four notched corners of the print image **7**, and an accessory **8** having at least an upper refresh line **81** and an intermediate refresh line **82**. That is, the first print data DT**1**a is the same as the first print data DT**1** in the printing apparatus **100** according to the first embodiment except that it does not have the second mark **72**. In this case, the mark **711** corresponds to the first mark **71**.

[0265] The printing apparatus **101** according to the second embodiment includes only one printing section **30** and only one fixing section **31**, so that the marks **711** provided at the four corners may be of a single type.

[0266] In other words, the number of types of marks may be at least a number corresponding to the number of units including the printing section **30** and the fixing section **31**.

[0267] Each of the marks **711** has at least a horizontal line **71**a**1** and a vertical line **71**b**1**.

[0268] Specifically, the mark **711** has a cross pattern in which the horizontal line **71**a**1** and the vertical line **71**b**1** intersect each other at their center.

[0269] Thus, the mark **711** is made to have a line shape, thereby making it easy to detect the mark **711** in the imaging data.

[0270] A distance R**5**a in the conveyance direction can be measured using the horizontal line **71**a**1**, and a distance R**5**b in the width direction can be measured using the vertical line **71**b**1**, resulting an improvement in measurement accuracy.

[0271] The mark **711** is preferably printed by one of the line heads **32** in the printing section **30**.

[0272] In this case, the occurrence of a printing misalignment between the line heads **32** can be excluded.

[0273] That is, the printing misalignment between the line heads can be prevented from being confused with a deviation due to expansion and contraction of the medium X. Although the respective colors of the marks **711** are not limited, the colors preferably differ from the color of the medium X if the medium X is colored.

[0274] In the control section **6**, the first transmission means **61** transmits a printing start command to the printing section **30** on the basis of the first print data DT**1**a generated by the processing means **60**.

[0275] In the printing apparatus **101**, printing is started by the printing section **30** at a previously set timing in response to the printing start command transmitted by the first transmission means **61**.

[0276] For example, the printing start command to the printing section **30** is a command to start printing from a desired printing start location on the medium X.

[0277] The imaging means **62** causes the imaging section **5** to image the print medium X**1** on which the first print data DT**1**a is printed by the printing section **30**, sets an imaged still image as imaging data, and acquires the imaging data.

[0278] The imaging data may be obtained by imaging the still image of the print medium X**1** in a timely manner or obtained by imaging a moving image of the print medium X**1** to be conveyed once and picking up a still image in the moving image.

[0279] FIG. **9** is a diagram illustrating imaging data in a print medium when printing is performed using first print data illustrated in FIG. **8**.

[0280] In FIG. **9**, description of a misalignment of the print image **7** is omitted.

[0281] As illustrated in FIG. **9**, the measurement means **63** measures a distance R**6**a in the conveyance direction between marks **731** printed by the printing section **30** and a distance Rob in the width direction between the marks **731** in imaging data DT**3**a, to acquire an imaging measurement value including values of the distances.

[0282] If the print medium X**1** in the imaging data DT**3**a is inclined, the imaging data DT**3**a is subjected to rotation correction, as needed, such that a length direction of the print medium X**1** and the conveyance direction match each other.

[0283] The imaging measurement value may be measured from one imaging data DT**3**a, or may be an average of measurements from a plurality of imaging data DT**3**a.

[0284] The calculation means **64** calculates an expansion/contraction ratio for the printing section **30** from a reference measurement value (see FIG. **8**) including respective values of the distance R**5**a in the conveyance direction between the marks **711** and the distance R**5**b in the width direction between the marks **711** in the print data DT**1**a and the above-described imaging measurement value.

[0285] In the calculation means **64**, the expansion/contraction ratio is calculated as follows.

[0286] An expansion/contraction ratio X**1** in the conveyance direction of the printing section **30** is calculated by X**1**=A**1**/B**1** from a value A**1** of the distance R**5**a in the conveyance direction between the marks **711** in the print data DT**1**a and a value B**1** of the distance R**6**a in the conveyance direction between the marks **731** in the imaging data DT**3**a.

[0287] An expansion/contraction ratio X**2** in the width direction of the printing section **30** is calculated by X**2**=A**2**/B**2** from a value A**2** of the distance R**5**b in the width direction between the marks **711** in the print data DT**1**a and a value B**2** of the distance R**6**b in the width direction between the marks **731** in the imaging data DT**3**a.

[0288] Thus, the expansion/contraction ratio, i.e., the expansion/contraction ratio X**1** in the conveyance direction and the expansion/contraction ratio X**2** in the width direction are obtained.

[0289] The correction means **65** expands and contracts the print image **7** in the first print data DT**1**a on the basis of the expansion/contraction ratio to generate second print data.

[0290] The second print data does not have the mark **711** or the like but has only the print image.

[0291] Four corners of the print image are not notched.

[0292] In the correction means **65**, the print image in the second print data is corrected as follows.

[0293] A value D**1** of a distance in the conveyance direction of the print image in the second print data is calculated by D**1**=C**1**×X**1** from a value C**1** of a distance **7**a in the conveyance direction of the print image **7** in the first print data DT**1**a and the expansion/contraction ratio X**1** in the conveyance direction. A value D**2** of a distance in the width direction of the print image in the second print data is calculated by D**2**=C**2**×X**2** from a value C**2** of a distance **7**b in the width direction of the print image **7** in the first print data DT**1**a and the expansion/contraction ratio X**2** in the width direction.

[0294] The correction means **65** expands or contracts the print image **7** in the first print data DT**1**a to correspond to the value D**1** of the distance in the conveyance direction of the print image in the second print data and the value D**2** of the distance in the width direction of the print image in the second print data, to generate the second print data.

[0295] The second transmission means **66** transmits a printing start command to the printing section **30** on the basis of the second print data generated by the correction means **65**.

[0296] A timing of starting printing by the printing section **30** is the same as a timing of transmission by the first transmission means **61**.

[0297] Automatic expansion and contraction correction in the printing apparatus **101** according to the second embodiment is performed similarly to the automatic expansion and contraction

correction in the printing apparatus **100** according to the first embodiment.

[0298] In the printing apparatus **101**, the automatic expansion and contraction correction is performed by reading "first printing section and second printing section" in a flowchart illustrated in FIG. **6** as "printing section".

[0299] In the printing apparatus **101**, the original data is first inputted to the second computer **6***b*.

[0300] Then, the processing means **60** converts the original data and adds the marks **711** and the accessory **8** thereto, to generate the first print data DT**1***a* (first step).

[0301] The printing apparatus **101** is operated, and the first transmission means **61** transmits a printing start command to the printing section **30** on the basis of the first print data DT**1***a* (second step).

[0302] The printing section **30** that has received the printing start command starts printing on the medium X at a previously set timing.

[0303] Then, the imaging means **62** causes the imaging section **5** to image the print medium X**1** that has passed through the printing-related section **3***a*, to acquire the imaging data DT**3***a* (third step).

[0304] Such imaging may be performed a plurality of times, as needed.

[0305] In the first computer **6***a*, the measurement means **63** measures the imaging measurement value from the imaging data DT**3** (fourth step), and the calculation means **64** calculates the expansion/contraction ratio from the reference measurement value in the first print data DT**1***a* and the imaging measurement value (fifth step).

[0306] Then, in the second computer **6***b*, the correction means **65** generates the second print data on the basis of the calculated expansion/contraction ratio (sixth step).

[0307] Then, the second transmission means **66** transmits the printing start command to the printing section **30** on the basis of the second print data (seventh step).

[0308] The printing section **30** that has received the printing start command starts printing on the medium X at a previously set timing.

[0309] After a desired number of prints or prints having a predetermined length based on the second print data are made, the printing is finished.

[0310] In the printing apparatus **101**, the automatic expansion and contraction correction is performed through the first step to the seventh step.

[0311] After the seventh step, the first step to the seventh step may be repeated, as needed.

[0312] If it takes time in performing the third step to the sixth step, the printing may be stopped once.

[0313] In the printing apparatus **101**, both respective error ranges of a distance in the conveyance direction and a distance in the width direction between the print image **7** in the first print data DT**1***a* and a print image to be printed on the basis of the second print data are within ±1.0 mm and preferably within ±0.1 mm.

[0314] That is, in the printing apparatus **101**, it is important to set the size of the print image at the time of recovery to a desired size with high accuracy.

[0315] This makes it possible to make the size of the print image at the time of recovery substantially match the size of the original print data.

[0316] The printing apparatus **101** has an automatic expansion/contraction correction function, as described above. That is, the printing apparatus **101** includes the imaging section **5** and the control section **6**, and the control section **6** includes the first transmission means **61**, the imaging means **62**, the measurement means **63**, and the calculation means **64**, thereby making it possible automatically to calculate the expansion/contraction ratio. Further, the printing apparatus **101** includes the correction means **65** and the second transmission means **66**, thereby making it possible to automatically generate the second print data by expanding and contracting the print image **7** on the basis of the expansion/contraction ratio.

[0317] This makes it possible to exclude a human error in the printing apparatus **101**.

[0318] Measurement between the marks **711** is performed by the control section **6**, resulting in an improvement in measurement accuracy.

[0319] Time and effort for a person to perform measurement can be saved, thereby making it possible to improve productivity.

[0320] Although the preferred embodiments of the present invention have been described above, the present invention is not limited to the above-described embodiments.

[0321] Although the printing apparatus **100** according to the first embodiment includes the supply section **1**, the pretreatment section **2**, the printing-related section **3**, the recovery section **4**, the imaging section **5**, and the control section **6**, the pretreatment section **2** is not essential.

[0322] That is, in the pretreatment section **2**, the ink receiving layer is formed on the medium X, but a medium previously provided with an ink receiving layer may be adopted as the medium X.

[0323] The same applies to the printing apparatus **101** according to the second embodiment.

[0324] Although the printing apparatus **100** according to the first embodiment includes a unit of the first printing section **30**a and the first fixing section **31**a and a unit of the second printing section **30**b and the second fixing section **31**b, and the printing apparatus **101** according to the second embodiment includes a unit of the printing section **30** and the fixing section **31**, the number of units may be three or more.

[0325] Although in the printing apparatus **100** according to the first embodiment, a water-based ink, an oil-based ink, or the like is used in the first printing section **30**a and the second printing section **30**b, the present invention is not limited to this, but an energy ray curable ink such as a UV curable ink or an electron beam curable ink can also be used.

[0326] In this case, an energy ray irradiator is used instead of the hot air dryer as the first fixing section **31**a and the second fixing section **31**b.

[0327] In this case, the medium X may also be deformed because the volume thereof changes on the basis of curing of the energy ray curable ink.

[0328] The same applies to the printing apparatus **101** according to the second embodiment.

[0329] In the printing apparatus **100** according to the first embodiment, the imaging section **5** images the print image side of the print medium X**1**, but may image both surfaces thereof.

[0330] The same applies to the printing apparatus **101** according to the second embodiment.

[0331] In the printing apparatus **100** according to the first embodiment, the recovery section **4** recovers the print medium X**1** as the recovery roll **40** while winding the print medium X**1** around a shaft, but may recover the print medium X**1** by so-called shaking. The same applies to the printing apparatus **101** according to the second embodiment.

[0332] Although in the printing apparatus **100** according to the first embodiment, the first transmission means **61**, the imaging means **62**, the measurement means **63**, the calculation means **64**, and the second transmission means **66** are stored in the first computer **6**a, and the processing means **60** and the correction means **65** are stored in the second computer **6**b, the number of computers to be used to store them is not particularly limited.

[0333] The computers are general and each include an input unit, a calculation unit, a storage unit, an output unit, and the like.

[0334] The same applies to the printing apparatus **101** according to the second embodiment.

[0335] Although in the printing apparatus **100** according to the first embodiment, the expansion/contraction ratio is calculated for each unit of a printing section and a fixing section, the expansion/contraction ratio can also be calculated for each ink to be used.

[0336] In this case, the correction data is generated for each ink.

[0337] The same applies to the printing apparatus **101** according to the second embodiment.

[0338] Although in the printing apparatus **100** according to the first embodiment, the first print data DT**1** includes the print image **7**, the plurality of marks **70** each including the first mark **71** and the second mark **72**, and the accessory **8**, the accessory **8** is not essential.

[0339] The same applies to the printing apparatus **101** according to the second embodiment.

[0340] Although in the printing apparatus **100** according to the first embodiment, the first mark **71** has the cross pattern in which the horizontal line **71***a* and the vertical line **71***b* intersect each other at their center, and the second mark **72** has the rectangular pattern including the pair of horizontal lines **72***a* and the pair of vertical lines **72***b* (see FIG. **3**), the present invention is not limited to these.

[0341] FIG. **10** is a diagram illustrating first print data based on which printing is performed in a printing apparatus according to another embodiment.

[0342] As illustrated in FIG. **10**, in a first print data DT**4**, a first mark **75** has an inverted L pattern in which a horizontal line **75***a* and a vertical line **75***b* are connected to each other at their respective ends, and a second mark **76** has an inverted L pattern in which a horizontal line **76***a* and a vertical line **76***b* are connected to each other at their respective ends.

[0343] In this case, a distance in a conveyance direction can be measured using the horizontal line **75***a*, a distance in a width direction can be measured using the vertical line **75***b*, a distance in the conveyance direction can be measured using the horizontal line **76***a*, and a distance in the width direction can be measured using the vertical line **76***b*.

[0344] The same applies to the printing apparatus **101** according to the second embodiment.

[0345] In the printing apparatus **100** according to the first embodiment, the first to sixth steps may be performed as a preparation stage of product processing, or may be simultaneously performed during product processing.

[0346] In the latter case, automatic expansion and contraction correction is performed for each predetermined period, thereby making it possible to make the size of a print image at the time of recovery (the size of a print image of a product) match the size of original print data with good yield and stably.

[0347] The same applies to the printing apparatus **101** according to the second embodiment.

[0348] The printing apparatus according to the present invention can be used as an apparatus for applying a print image on a medium on the basis of print data.

[0349] With the printing apparatus according to the present invention, the size of a print image at the time of recovery can be made to substantially match the size of original print data using an automatic expansion/contraction function.

REFERENCE SIGNS LIST

[0350] **1** . . . supply section [0351] **100**, **101** . . . printing apparatus [0352] **11** . . . feed roller [0353] **2** . . . pretreatment section [0354] **20** . . . corona treatment device [0355] **21** . . . coater treatment device [0356] **22** . . . dryer [0357] **23**, **33**, **33***a*, **33***b* . . . cooling roller [0358] **3**, **3***a* . . . printing-related section [0359] **30** . . . printing section [0360] **30***a* . . . first printing section [0361] **30***b* . . . second printing section [0362] **31** . . . fixing section [0363] **31***a* . . . first fixing section [0364] **31***b* . . . second fixing section [0365] **32**, **32***a*, **32***b* . . . line head [0366] **4** . . . recovery section [0367] **41** . . . feed roller [0368] **5** . . . imaging section [0369] **6** . . . control section [0370] **6***a* . . . first computer [0371] **6***b* . . . second computer [0372] **60** . . . processing means [0373] **61** . . . first transmission means [0374] **62** . . . imaging means [0375] **63** . . . measurement means [0376] **64** . . . calculation means [0377] **65** . . . correction means [0378] **66** . . . second transmission means [0379] **7**, **9** . . . print image [0380] **70** . . . mark [0381] **71**, **711**, **73**, **75** . . . first mark [0382] **71***a*, **71***a***1**, **72***a*, **75***a*, **76***a* . . . horizontal line [0383] **71***b*, **71***b***1**, **72***b*, **75***b*, **76***b* . . . vertical line [0384] **72**, **74**, **76** . . . second mark [0385] **7***a*, **91***a*, **92***a*, R**1***a*, R**2***a*, R**3***a*, R**4***a*, R**5***a*, R**6***a* . . . distance in conveyance direction [0386] **7***b*, **91***b*, **92***b*, R**1***b*, R**2***b*, R**3***b*, R**4***b*, R**5***b*, R**6***b* . . . distance in width direction [0387] **8** . . . accessory [0388] **81** . . . upper refresh line [0389] **82** . . . intermediate refresh line [0390] DS**1** . . . data of portion taken charge of by first printing section in first print data DT**1** [0391] DS**2** . . . data of portion taken charge of by second printing section in first print data DT**1** [0392] DT**1**, DT**1***a*, DT**4** . . . first print data [0393] DT**2** . . . second print data [0394] DT**3**, DT**3***a* . . . imaging data [0395] H**1** . . . first correction data [0396] H**2** . . . second correction data [0397] X . . . medium [0398] X**1** . . . print medium

Claims

1. A printing apparatus comprising: a supply section for supplying a medium; a printing-related section including a printing section for printing at least a print image on the medium on the basis of print data and a fixing section for fixing the print image on the medium to obtain a print medium; a recovery section for recovering the print medium; an imaging section, arranged between the printing-related section and the recovery section, for imaging the print medium; and a control section for controlling the printing, wherein the print data is first print data or second print data, the control section includes at least first transmission means for transmitting a printing start command to the printing section on the basis of first print data having a plurality of marks put on the print image, imaging means for causing the imaging section to image the print medium to acquire imaging data, measurement means for measuring a distance in a conveyance direction between the marks and a distance in a width direction between the marks in the imaging data, to acquire an imaging measurement value including respective values of the distances, calculation means for calculating an expansion/contraction ratio from a reference measurement value including respective values of a distance in the conveyance direction between the marks and a distance in the width direction between the marks in the first print data and the imaging measurement value, correction means for expanding and contracting the print image on the basis of the expansion/contraction ratio to generate the second print data, and second transmission means for transmitting a printing start command to the printing section on the basis of the second print data, and both respective error ranges of a distance in the conveyance direction and a distance in the width direction between the print image in the first print data and the print image printed on the basis of the second print data are within ±1.0 mm.

2. The printing apparatus according to claim 1, wherein the calculate means calculates an expansion/contraction ratio ($X1$) in the conveyance direction by $X1=A1/B1$ from a value ($A1$) of the distance in the conveyance direction between the marks in the first print data and a value ($B1$) of the distance in the conveyance direction between the marks in the imaging data, and calculates the expansion/contraction ratio ($X2$) in the width direction by $X2=A2/B2$ from a value ($A2$) of the distance in the width direction between the marks in the first print data and a value ($B2$) of the distance in the width direction between the marks in the imaging data, and the correction means calculates a value ($D1$) of a distance in the conveyance direction of the print image in the second print data by $D1=C1 \times X1$ from a value ($C1$) of a distance in the conveyance direction of the print image in the first print data and the expansion/contraction ratio ($X1$) in the conveyance direction, calculates a value ($D2$) of a distance in the width direction of the print image in the second print data by $D2=C2 \times X2$ from a value ($C2$) of a distance in the width direction of the print in image the first print data and the expansion/contraction ratio ($X2$) in the width direction, and expands or contracts the print image in the first print data to correspond to the value ($D1$) of the distance in the conveyance direction of the print image in the second print data and the value ($D2$) of the distance in the width direction of the print image in the second print data, to generate the second print data.

3. A printing apparatus comprising: a supply section for supplying a medium; first printing a printing-related section including a section and a second printing section for printing at least a print image on the medium on the basis of print data and a first fixing section and a second fixing section for fixing the print image on the medium to obtain a print medium; a recovery section for recovering the print medium; an imaging section, arranged between the printing-related section and the recovery section, for imaging the print medium; and a control section for controlling the printing, wherein the first printing section, the first fixing section, the second printing section, and the second fixing section are arranged in this order from the upstream side in the printing-related section, the print data is first print data or second print data including first correction data or second correction data, the control section includes at least first transmission means for transmitting

printing start commands, respectively, to the first printing section and the second printing section on the basis of first print data having a plurality of marks each including a first mark and a second mark put on the print image, imaging means for causing the imaging section to image the print medium to acquire imaging data, measurement means for measuring a distance in a conveyance direction between the first marks printed by the first printing section and a distance in a width direction between the first marks in the imaging data to acquire a first imaging measurement value including respective values of the distances, and measuring a distance in the conveyance direction between the second marks printed by the second printing section and a distance in the width direction between the second marks in the imaging data to acquire a second imaging measurement value including respective values of the distances, calculation a first means for calculating expansion/contraction ratio for the first printing section from a first reference measurement value including respective values of a distance in the conveyance direction between the first marks and a distance in the width direction between the first marks in the first print data and the first imaging measurement value and calculating a second expansion/contraction ratio for the second printing section from a second reference measurement value including respective values of a distance in the conveyance direction between the second marks and a distance in the width direction between the second marks in the first print data and the second imaging measurement value, correction means for expanding and contracting data of a portion taken charge of by the first printing section in the print image on the basis of the first expansion/contraction ratio to generate e the first correction data and expanding or contracting data of a portion taken charge of by the second printing section in the print image on the basis of the second expansion/contraction ratio to generate the second correction data, and second transmission means for transmitting a printing start command to the first printing section on the basis of the first correction data and transmitting a printing start command to the second printing section on the basis of the second correction data, and both respective error ranges of a distance in the conveyance direction and a distance in the width direction between the print image in the first print data and the print image printed on the basis of the second print data are within ±1.0 mm.

4. The printing apparatus according to claim 3, wherein the calculation means calculates the first expansion/contraction ratio ($X\mathbf{11}$) in the conveyance direction by $X\mathbf{11}=A\mathbf{11}/B\mathbf{11}$ from a value ($A\mathbf{11}$) of the distance in the conveyance direction between the first marks in the first print data and a value ($B\mathbf{11}$) of the distance in the conveyance direction between the first marks in the imaging data, calculates the first expansion/contraction ratio ($X\mathbf{12}$) in the width direction by $X\mathbf{12}=A\mathbf{12}/B\mathbf{12}$ from a value ($A\mathbf{12}$) of the distance in the width direction between the first marks in the first print data and a value ($B\mathbf{12}$) of the distance in the width direction between the first marks in the imaging data, calculates the second expansion/contraction ratio ($X\mathbf{21}$) in the conveyance direction by $X\mathbf{21}=A\mathbf{21}/B\mathbf{21}$ from a value ($A\mathbf{21}$) of the distance in the conveyance direction between the second marks in the first print data and a value ($B\mathbf{21}$) of the distance in the conveyance direction between the second marks in the imaging data, and calculates the second expansion/contraction ratio ($X\mathbf{22}$) in the width direction by $X\mathbf{22}=A\mathbf{22}/B\mathbf{22}$ from a value ($A\mathbf{22}$) of the distance in the width direction between the second marks in the first print data and a value ($B\mathbf{22}$) of the distance in the width direction between the second marks in the imaging data, and the correction means calculates a value ($D\mathbf{11}$) of a distance in the conveyance direction of the print image in the first correction data by $D\mathbf{11}=C\mathbf{11}\times X\mathbf{11}$ from a value ($C\mathbf{11}$) of a distance in the conveyance direction of data of a portion taken charge of by the first printing section in the print image in the first print data and the first expansion/contraction ratio ($X\mathbf{11}$) in the conveyance direction, calculates a value ($D\mathbf{12}$) of a distance in the width direction of the print image in the first correction data by $D\mathbf{12}=C\mathbf{12}\times X\mathbf{12}$ from a value ($C\mathbf{12}$) of a distance in the width direction of the data of the portion taken charge of by the first printing section in the print image in the first print data and the first expansion/contraction ratio ($X\mathbf{12}$) in the width direction, expands or contracts the data of the portion taken charge of by the first printing section in the print image in the first print data to correspond to the value ($D\mathbf{11}$) of

the distance in the conveyance direction of the print image in the first correction data and the value (D12) of the distance in the width direction of the print image in the first correction data to generate the first correction data, calculates a value (D21) of a distance in the conveyance direction of the print image in the second correction data by D21=C21×X21 from a value (C21) of a distance in the conveyance direction of data of a portion taken charge of by the second printing section in the print image in the first print data and the second expansion/contraction ratio (X21) in the conveyance direction, calculates a value (D22) of a distance in the width direction of the print image in the second correction data by D22=C22×X22 from a value (C22) of a distance in the width direction of the data of the portion taken charge of by the second printing section in the print image in the first print data and the second expansion/contraction ratio (X22) in the width direction, and expands or contracts the data of the portion taken charge of by the second printing section in the print image in the first print data to correspond to the value (D21) of the distance in the conveyance direction of the print image in the second correction data and the value (D22) of the distance in the width direction of the print image in the second correction data to generate the second correction data.

5. The printing apparatus according to claim 1, wherein the marks are respectively provided at four corners of the print image in the first print data.

6. The printing apparatus according to claim 1, wherein the marks are respectively provided at positions of the four notched corners of the print image in the first print data.

7. The printing apparatus according to claim 3, wherein the marks are respectively provided at positions of the four notched corners of the print image, a margin is provided between each of the marks and the print image, and a shortest distance between each of the marks and the print image is 10 mm or more.

8. The printing apparatus according to claim 1, wherein each of the marks includes at least a horizontal line for measuring a distance in the conveyance direction, and a vertical line for measuring a distance in the width direction.

9. The printing apparatus according to claim 8, wherein the first print data is obtained by putting a plurality of marks and an accessory on the print image, the accessory includes an upper refresh line provided above the horizontal line on the upper side, a plurality of intermediate refresh lines equally spaced apart from one another between the horizontal line on the upper side and the horizontal line on the lower side, and the plurality of marks and the accessory are printed in the same color.

10. The printing apparatus according to claim 3, wherein the marks are respectively provided at four corners of the print image in the first print data.

11. The printing apparatus according to claim 3, wherein the marks are respectively provided at positions of the four notched corners of the print image in the first print data.

12. The printing apparatus according to claim 3, wherein each of the marks includes at least a horizontal line for measuring a distance in the conveyance direction, and a vertical line for measuring a distance in the width direction.

13. The printing apparatus according to claim 12, wherein the first print data is obtained by putting a plurality of marks and an accessory on the print image, the accessory includes an upper refresh line provided above the horizontal line on the upper side, a plurality of intermediate refresh lines equally spaced apart from one another between the horizontal line on the upper side and the horizontal line on the lower side, and the plurality of marks and the accessory are printed in the same color.