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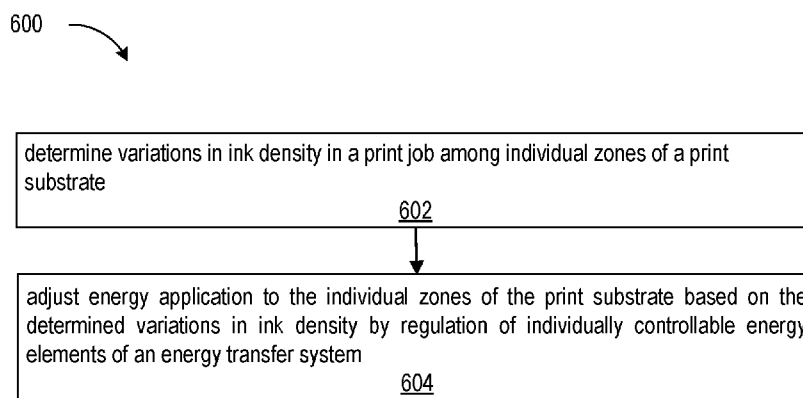


FIG. 6

(57) Abstract: Systems, apparatuses, and methods may provide for technology to treat ink for a printer (100, 102, 701). Such ink treating includes determining variations in ink density in a print job among individual zones (300) of a print substrate (101). Energy application is adjusted to the individual zones of the print substrate. Such energy application is adjusted to the individual zones of the print substrate based on the determined variations in ink density. Such energy application is adjusted by regulation of individually controllable energy elements (109) of an energy transfer system.

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ADJUSTING ENERGY APPLICATION TO INDIVIDUAL ZONES OF A PRINT SUBSTRATE BASED ON VARIATIONS IN INK DENSITY

BACKGROUND

[0001] In some printer treating systems, there is often a focus on printed versus non-printed areas. In such systems, drying operations vary between withholding drying for a non-printed area (e.g., where no energy is required for drying) and applying drying to a full density area where fluid is printed (e.g., which may require energy to dry and cure the ink).

[0002] In some printer drying systems, a maximum energy output is provided for all drying operations. Such drying operations are typically applied in the most homogenous way possible across all the substrate to ensure the proper drying and curing in all the areas.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] Various examples will be described below by referencing the following drawings, in which:

[0004] FIG. 1 is a schematic view illustrating a printer to treat ink via regulation of individually controllable energy elements in response to determined variations in ink density associated with a print job performed on a substrate;

[0005] FIG. 2 is an illustration of a printed substrate according to an example;

[0006] FIG. 3 is an illustration of individual zones of the print substrate according to an example;

[0007] FIG. 4 is an illustration of an example an ink density map for the individual zones of the print substrate according to an example;

[0008] FIG. 5 is an illustration of an example an energy map for the individual zones of the print substrate according to an example;

[0009] FIG. 6 is an illustration of a flowchart of an example method for regulation of individually controllable energy elements in response to determined variations in ink density according to an example;

[0010] FIG. 7 is an illustration of a flowchart of a further example method for regulation of individually controllable energy elements in response to determined variations in ink density according to an example;

[0011] FIG. 8 is a block diagram illustrating a computer program product according to an example;

[0012] FIG. 9 is a block diagram illustrating an example printer according to an example; and

[0013] FIG. 10 is a block diagram illustrating a hardware apparatus including a semiconductor package according to an example.

DETAILED DESCRIPTION

[0014] As discussed above, existing solutions typically rely on providing a uniform maximum required energy on all the areas in a homogenous way. This can be achieved by using homogeneous energy delivery systems and by having control volumes that equalize the total energy across an entire print. For multiple airflow outlets can be used that send heated airflow towards a substrate to be accumulated on the entire print.

[0015] Disadvantageously, such homogenous heating operations may include expenditure of an unnecessary amount of energy, which impacts user perception, cost per copy and the requirements of power facilities.

[0016] In some drying systems, energy delivery may be done selectively. In one example, a scanning-type adjustable drying system may move across the scan axis and provides drying to a portion of the substrate at every instant (e.g., using a light-emitting diode (LED) module system mounted on a printing carriage). Other adjustable drying systems may utilize other techniques to provide selective drying that is adjusted in response to variations in the ink density, etc.

[0017] As will be described in greater detail below, adjustable treating systems (e.g., to dry, cure, etc.) can be used in combination with techniques for determining variations in the ink density, the type of printed fluids, the type of substrate, the like, and/or combinations thereof.

[0018] In some examples, a density of ink in a plurality of sections of a plot may be determined. For example, a density of ink may be determined using an on-line densitometer, a print job analysis, the like, and/or combinations thereof. An amount of treating energy (e.g., to dry, cure, etc.) to be applied to individual portions of the plurality of sections may be determined based on the ink density determination.

[0019] For example, an ink densitometer may scan a printed document to determine variations in ink usage across a plurality of analyzed areas. Additionally, or alternatively, an image analyzer may be utilized to determine variations in ink usage across a plurality of analyzed areas based on print job

instructions. In response to determined variations in ink usage, the energy used on each of the analyzed areas may be adjusted on an area-by-area basis.

[0020] As will be discussed in greater detail below, systems, apparatuses, and methods described in some implementations herein provide for technology to treat ink (e.g., to dry, cure, etc.) for a printer. Such ink treating includes determining variations in ink density in a print job among individual zones of a print substrate. Energy application is adjusted to the individual zones of the print substrate. Such energy application is adjusted to the individual zones of the print substrate based on the determined variations in ink density. Such energy application is adjusted by regulation of individually controllable energy elements of an energy transfer system.

[0021] Advantageously, systems, apparatuses, and methods described herein may provide for technology that provides improved energy efficiency by selectively applying treating energy where it is needed most. For example, energy consumption on some printers is extremely high. Accordingly, even reducing a portion of that energy will have a significant impact on the global consumption, power site facilities, and on the cost per copy for the costumer.

[0022] Using the techniques discussed herein, total energy usage may be reduced in many instances by selectively applying treating energy where it is needed most. For example, uniform application of a maximum required energy in all the areas may be avoided. Additionally, the techniques discussed herein provided a fine-tuned energy usage based on various attributes such as ink density, ink fluids, substrate composition, the like, and/or combinations thereof. For example, the techniques discussed herein may provide a reduction energy

consumption on a case-by-case basis in response to such various attributes. Such fine-tuned energy usage also may allow extraction of the potential of various heating technologies (e.g., radiation via LEDs). Accordingly, improved printer performance (e.g., in printing speed, warm-up time, the like, and/or combinations thereof) may be achieved by utilizing the techniques discussed herein to deliver adaptative energy levels in response to variations in printed content. For example, such printing speed may be limited by overall energy consumption in cases where a maximum amount of energy is already being consumed from an available power source.

[0023] FIG. 1 is a schematic view illustrating a printer 100 to treat ink via regulation of individually controllable energy elements in response to determined variations in ink density associated with a print job performed on a substrate 101. In the illustrated example, printer 100 includes a control unit 102, an ink dispenser 104, a densitometer 106, and an energy transfer system 108. It will be appreciated that printer 100 may be implemented with additional components that have not been included here for clarity.

[0024] As used herein, the term “print job” refers to instructions for applying ink to a substrate during printing operations. In some implementations, variations in ink density may be determined based on analysis of data from the print job. For example, an image analysis may include determining a plot width to limit an overall treating exposure area (e.g., in a low resolution analysis) to a determining a plurality of zones with a range of ink densities within the plot (e.g., in a more detailed analysis).

[0025] As used herein, the term “substrate” refers to an individual sheet or a continuous roll of printable material. Such substrates may vary in material composition and/or physical properties.

[0026] As used herein, the term “densitometer” refers to devices capable of sensing ink density, including devices that are limited only to densitometer functions, devices perform densitometer functions in addition to other functions, a spectro-densitometer (e.g., a spectrophotometer adapted to sense ink density), the like, and/or combinations thereof. Additionally, or alternatively, devices capable of sensing ink usage (e.g., drop counters), devices capable of measuring ink flux, etc. may be utilized as a densitometer in some implementations.

[0027] As used herein, the term “ink fluid type” or “types of ink fluid” refers to a category of ink material property, composition, usage, etc. For example, determining an ink fluid type may include determining whether an ink fluid is a colorant, a pretreatment, an overcoat, etc.

[0028] As used herein, the term “energy transfer system” refers to mechanisms that transfer energy towards a printed substrate to treat ink on the printed substrate. Such energy transfer systems 108 may transfer energy by one or more of radiative energy transfer, conductive energy transfer, convective energy transfer, or inductive energy transfer, the like, and/or combinations thereof.

[0029] Additionally, such energy transfer systems 108 may include a plurality of individually controlled energy elements 109. For example, such individually controlled energy elements 109 may include one or more of light-

emitting diodes (LED) (e.g., ultraviolet light-emitting diodes (UV-LED), heat lamps (e.g., halogen heat lamps, vertical-cavity surface-emitting lasers (VCSEL), hot airflows (e.g., as a combination of air fans and heater resistors), heated platens on a media path, thermal blankets on a media path, the like, and/or combinations thereof.

[0030] As used herein, the term “treating” refers to a process that transfer energy towards a printed substrate to perform drying remove fluid from ink on the printed substrate, perform curing, other processes that requires energy transfer, the like, and/or combinations thereof. Such treating may involve transfer energy by one or more of radiative energy transfer, conductive energy transfer, convective energy transfer, inductive energy transfer, the like, and/or combinations thereof.

[0031] In some examples, the control unit 102 is in communication with the energy transfer system 108. In some implementations, the control unit 102 may include computer readable instructions 103 (e.g., software, firmware, hardware, the like, and/or combinations thereof), which may implement techniques described herein for regulation of individually controllable energy elements in response to determined variations in ink density. For example, the control unit 102 is to determine variations in ink density in a print job among individual zones of a print substrate 101. In response to the determined variations in ink density, the control unit 102 is to adjust energy application to the individual zones of the print substrate by regulation of the individually controllable energy elements 109.

[0032] In operation, in some examples, adjusting the energy application by control unit 102 may be performed by adjusting an amount of light applied from the individually controllable energy elements 109 to the individual zones of the print substrate.

[0033] Additionally, or alternatively, in some implementations, adjusting the energy application by control unit 102 may be performed via one or more physical barriers used to selectively impede energy application from the energy transfer system to the individual zones of the print substrate.

[0034] In some implementations, the control unit 102 is further to determine a material property of the print substrate. In response, the control unit 102 may adjust energy application to the individual zones of the print substrate 101 based on the determined material property of the print substrate 101.

[0035] As used herein, the term “material property of the print substrate” refers to a degree of deformation during treating, a degree of ink absorption during printing, a degree of fluid retention during treating, the like, and/or combinations thereof.

[0036] In operation, in some examples, the control unit is further to determine one or more types of ink fluids in the print job among the individual zones of the print substrate. In response, the control unit may adjust energy application to the individual zones of the print substrate based on the determined one or more types of ink fluids.

[0037] In some implementations, the control unit 102 is further to request printing of ink to the print substrate 101 based on the print job. The control unit 102 is further to receive a scan of optical density from the

densitometer 106 of the ink printed by ink dispenser 104. In such an example, the determined variations in ink density is based on analysis of the optical density.

[0038] In some examples, the determined variations in ink density may be based on analysis of data from the print job. In such an example, this may be done in addition to or instead of sensing by densitometer 106.

[0039] All or portions of the computer readable instructions 103 of the control unit 102 may be associated with another computing device (e.g., a mobile device). The operations of the computer readable instructions 103 of the control unit 102 are described in greater detail below in FIG. 6 and/or FIG. 7.

[0040] Referring to FIGS. 2-5, FIG. 2 is an illustration of a printed substrate 200, FIG. 3 is an illustration of individual zones 300 of the print substrate, FIG. 4 is an illustration of an example an ink density map 400 for the individual zones of the print substrate, and FIG. 5 is an illustration of an example an energy map 500 for the individual zones of the print substrate according to an example.

[0041] In operation, as discussed above, some implementations described herein propose a system that translates image content or ink usage on the printed substrate 200 (e.g., see FIG. 2), to the energy map 500 (e.g., see FIG. 5) based on the ink density map 400 (e.g., see FIG. 4) split among individual zones 300 of the print substrate (e.g., see FIG. 3) and applies it on the control of a drying or curing systems, modulating the energy used on each area.

[0042] In some implementations, more or less granularity may be utilized on the grid used for the split among individual zones 300 of the print substrate (e.g., see FIG. 3) (e.g., and/or on the different levels of image inputs of

ink density map 400 (e.g., see FIG. 4) and energy outputs of the energy map 500 (e.g., see FIG. 5)), depending on the calculation power of the processing unit used in a given printer.

[0043] In some implementations, an initial phase can be done in a similar way as halftoning processes. For example, a relation of image inputs and the desired outputs may be utilized. In the case of a halftoning process, the number of drops to print may be determined. Similarly, in implementations described herein, the energy to apply (e.g., electrical intensity, number of LEDs, local airflow, etc.) on each section of the plot to dry or cure the ink may be determined.

[0044] In some examples, lookup tables with multiple nodes of image content and the optimal output may be utilized to determine the amount of energy to apply. In such an example, other intermediate nodes can be interpolated by defined nodes. The inputs can be the ink fluids and their densities, and the outputs can be defined for each substrate, for example. Accordingly, determining a varied energy output pattern may be done based on analyzing the image input before printing and/or by using an ink densitometer to scan the print output.

[0045] In some implementations, a system controller (e.g., control unit 102 illustrated in FIG. 1) may adjust the energy applied on each of the sections. For example, such a system controller, in combination with a position encoder for a scanning system, may adjust the energy applied on each of the sections (e.g., as might be done in an example using a light-emitting diode (LED) module system mounted on a printing carriage). On a fixed energy transfer system, adjusting the

energy applied on each of the sections may be done by modulating the energy on the multiple sections of the drying or curing system.

[0046] Advantageously, in some of the implementations described herein, a printer could save a percentage of an approximately thirty percent of the energy previously designated for homogeneous drying. Energy saving will typically vary depending on the image and the ink density applied.

[0047] FIG. 6 is an illustration of a flowchart of an example method 600 for regulation of individually controllable energy elements in response to determined variations in ink density according to an example. As illustrated, the method 600 may generally be implemented in a printing system, such as, for example, the printer 100 (FIG. 1), already discussed.

[0048] In an example, the method 600 may be implemented in computer readable instructions (e.g., software), configurable computer readable instructions (e.g., firmware), fixed-functionality computer readable instructions (e.g., hardware), etc., or any combination thereof.

[0049] Illustrated processing block 602 provides for determining variations in ink density. For example, variations in ink density may be determined in a print job among individual zones of a print substrate.

[0050] Illustrated processing block 604 provides for adjusting energy application. For example, energy application to the individual zones of the print substrate may be adjusted based on the determined variations in ink density by regulation of individually controllable energy elements of an energy transfer system.

[0051] It will be appreciated that some or all of the operations in method 600 are described using a “pull” architecture (e.g., polling for new information followed by a corresponding response) may instead be implemented using a “push” architecture (e.g., sending such information when there is new information to report), and *vice versa*.

[0052] Additional and/or alternative operations for method 600 are described in greater detail below in the description of FIG. 7.

[0053] FIG. 7 is an illustration of a flowchart of another example method 700 for regulation of individually controllable energy elements according to an example. As illustrated, the method 800 may generally be implemented in a printing system, such as, for example, printer 701.

[0054] In the illustrated example, printer 701 may include a control unit 702, an ink dispenser 704, a densitometer 706, and/or an energy transfer system 708. Energy transfer system may include a plurality of energy transfer elements 709.

[0055] In an example, the method 700 may be implemented in computer readable instructions (e.g., software), configurable computer readable instructions (e.g., firmware), fixed-functionality computer readable instructions (e.g., hardware), etc., or any combination thereof.

[0056] Illustrated processing block 712 provides for receiving a print job. Illustrated processing block 714 provides for determining variations in ink density. For example, variations in ink density may be determined in a print job among individual zones of a print substrate.

[0057] As illustrated here, the determined variations in ink density may be based on analysis of data from the print job.

[0058] Illustrated processing block 716 provides for determining one or more types of ink fluids. For example, one or more types of ink fluids in the print job may be determined among the individual zones of the print substrate.

[0059] Illustrated processing block 718 provides for receiving print substrate data. Illustrated processing block 720 provides for determining a material property of the print substrate based on the received print substrate data. For example, the determined material property of the print substrate may be based on one or more of a degree of deformation during drying (or other treating process), a degree of ink absorption during printing, or a degree of fluid retention during drying (or other treating process).

[0060] In some examples, print substrate data may be input into the printer 701 by a user, scanned via a barcode or the like associated with the print substrate data, determined via one or more sensors in a sensor array, the like, and/or combinations thereof. For example, user selection data may be obtained from a media category selection.

[0061] Illustrated processing block 722 provides for transferring print instructions. For example, print instructions may be transferred from the control unit 702 to the ink dispenser 704.

[0062] Illustrated processing block 724 provides for printing ink to the print substrate. For example, ink may be printed to the print substrate based on the print job.

[0063] Illustrated processing block 726 provides for scanning optical density of the printed ink. For example, optical density of the printed ink may be scanned with the densitometer 706.

[0064] Illustrated processing block 728 provides for transferring optical density data. For example, optical density data may be transferred from the densitometer 706 to the control unit 702.

[0065] In such an example, the determined variations in ink density is based on analysis of the optical density.

[0066] Illustrated processing block 730 provides for adjusting energy application. For example, energy application to the individual zones of the print substrate may be adjusted based on the determined variations in ink density by regulation of individually controllable energy elements of an energy transfer system.

[0067] In some examples, energy application to the individual zones of the print substrate may be adjusted based on the determined one or more types of ink fluids.

[0068] Additionally, or alternatively, energy application to the individual zones of the print substrate may be adjusted based on the determined material property of the print substrate.

[0069] Illustrated processing block 732 provides for transferring energy to dry the printed ink. For example, energy may be transferred to dry (or other treating process) the printed ink via the plurality of energy elements 709 of the energy transfer system 708.

[0070] In some examples, adjusting the energy application is performed by adjusting an amount of light applied from the individually controllable energy elements to the individual zones of the print substrate.

[0071] Additionally, or alternatively, in some implementations, adjusting the energy application is performed via one or more physical barriers used to selectively impede energy application from the energy transfer system to the individual zones of the print substrate.

[0072] It will be appreciated that some or all of the operations in method 700 are described using a “pull” architecture (e.g., polling for new information followed by a corresponding response) may instead be implemented using a “push” architecture (e.g., sending such information when there is new information to report), and *vice versa*.

[0073] FIG. 8 illustrates a block diagram of an example computer program product 800. In some examples, as shown in FIG. 8, computer program product 800 includes a machine-readable storage 802 that may also include computer readable instructions 804. In some implementations, the machine-readable storage 802 may be implemented as a non-transitory machine-readable storage. In some implementations the computer readable instructions 804, which may be implemented as software, for example. In an example, the computer readable instructions 804, when executed by a processor 806, implement one or more aspects of the method 600 (FIG. 6), the method 700 (FIG. 7), and/or the printer 100 (FIG. 1), already discussed, already discussed.

[0074] In some implementations, computer readable instructions 804 may include operations for regulation of individually controllable energy elements

according to an example. Illustrated processing block 812 provides for determining variations in ink density. For example, variations in ink density may be determined in a print job among individual zones of a print substrate. Illustrated processing block 814 provides for adjusting energy application. For example, energy application to the individual zones of the print substrate may be adjusted based on the determined variations in ink density by regulation of individually controllable energy elements of an energy transfer system.

[0075] FIG. 9 shows an illustrative example of the printer 102. In the illustrated example, the printer 102 may include a processor 902 and a memory 904 communicatively coupled to the processor 902. The memory 904 may include computer readable instructions 906, which may be implemented as software, for example. In an example, the computer readable instructions 906, when executed by the processor 902, implement one or more aspects of the method 600 (FIG. 6), the method 700 (FIG. 7), and/or the printer 100 (FIG. 1), already discussed.

[0076] In some implementations, the processor 902 may include a general purpose controller, a special purpose controller, a storage controller, a storage manager, a memory controller, a micro-controller, a general purpose processor, a special purpose processor, a central processor unit (CPU), the like, and/or combinations thereof.

[0077] Further, implementations may include distributed processing, component/object distributed processing, parallel processing, the like, and/or combinations thereof. For example, virtual computer system processing may implement one or more of the methods or functionalities as described herein, and

the processor 902 described herein may be used to support such virtual processing.

[0078] In some examples, the memory 904 is an example of a computer-readable storage medium. For example, memory 904 may be any memory which is accessible to the processor 902, including, but not limited to RAM memory, registers, and register files, the like, and/or combinations thereof. References to “computer memory” or “memory” should be interpreted as possibly being multiple memories. The memory may for instance be multiple memories within the same computer system. The memory may also be multiple memories distributed amongst multiple computer systems or computing devices.

[0079] In some implementations, computer readable instructions 906 may include operations for regulation of individually controllable energy elements according to an example. Illustrated processing block 912 provides for determining variations in ink density. For example, variations in ink density may be determined in a print job among individual zones of a print substrate. Illustrated processing block 914 provides for adjusting energy application. For example, energy application to the individual zones of the print substrate may be adjusted based on the determined variations in ink density by regulation of individually controllable energy elements of an energy transfer system.

[0080] FIG. 10 shows an illustrative semiconductor apparatus 1000 (e.g., chip and/or package). The illustrated apparatus 1000 includes one or more substrates 1002 (e.g., silicon, sapphire, or gallium arsenide) and computer readable instructions 1004 (such as, configurable computer readable instructions (e.g., firmware) and/or fixed-functionality computer readable instructions (e.g.,

hardware)) coupled to the substrate(s) 1002. In an example, the computer readable instructions 1004 implement one or more aspects of the method 600 (FIG. 6), the method 700 (FIG. 7), and/or the printer 100 (FIG. 1), already discussed.

[0081] In some implementations, computer readable instructions 1004 may include transistor array and/or other integrated circuit/IC components. For example, configurable firmware logic and/or fixed-functionality hardware logic implementations of the computer readable instructions 1004 may include configurable computer readable instructions such as, for example, programmable logic arrays (PLAs), field programmable gate arrays (FPGAs), complex programmable logic devices (CPLDs), or fixed-functionality computer readable instructions (e.g., hardware) using circuit technology such as, for example, application specific integrated circuit (ASIC), complementary metal oxide semiconductor (CMOS) or transistor-transistor logic (TTL) technology, the like, and/or combinations thereof.

[0082] In some implementations, computer readable instructions 1004 may include operations for regulation of individually controllable energy elements according to an example. Illustrated processing block 1012 provides for determining variations in ink density. For example, variations in ink density may be determined in a print job among individual zones of a print substrate. Illustrated processing block 1014 provides for adjusting energy application. For example, energy application to the individual zones of the print substrate may be adjusted based on the determined variations in ink density by regulation of individually controllable energy elements of an energy transfer system.

[0083] As discussed above, some implementations described herein advantageously provide for technology that eliminates line width variability throughout a single swath, which improves the quality of any type of lines (e.g., lines with various numbers of pixels). Additionally, or alternatively, the techniques described herein may provide for technology that is a solution for both printers with only one printhead of each ink or several printheads of each ink. Further, the techniques described herein may provide for technology that robustly addresses odd/even misalignments, because a general line width may vary but will be maintained along the swath when utilizing the techniques described herein. Additionally, or alternatively, the techniques described herein may provide for technology that is performed without increasing a number of printing passes; therefore, a consistent throughput may be maintained.

[0084] All definitions, as defined and used herein, should be understood to control over dictionary definitions, definitions in documents incorporated by reference, and/or ordinary meanings of the defined terms.

[0085] Furthermore, for ease of understanding, certain functional blocks may have been delineated as separate blocks; however, these separately delineated blocks should not necessarily be construed as being in the order in which they are discussed or otherwise presented herein. For example, some blocks may be able to be performed in an alternative ordering, simultaneously, etc.

[0086] Although a number of illustrative examples are described herein, it should be understood that numerous other modifications and examples can be devised by those skilled in the art that will fall within the spirit and scope of the

principles of the foregoing disclosure . More particularly, reasonable variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the foregoing disclosure, the drawings and the appended claims without departing from the spirit of the foregoing disclosure. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art. The examples may be combined to form additional examples.

CLAIMS

We claim:

1. An ink treating method, for a printer, comprising:
determining variations in ink density in a print job among individual zones of a print substrate; and
adjusting energy application to the individual zones of the print substrate based on the determined variations in ink density by regulation of individually controllable energy elements of an energy transfer system.
2. The ink treating method of claim 1, further comprising:
determining one or more types of ink fluids in the print job among the individual zones of the print substrate; and
adjusting energy application to the individual zones of the print substrate based on the determined one or more types of ink fluids.
3. The ink treating method of claim 1, further comprising:
determining a material property of the print substrate; and
adjusting energy application to the individual zones of the print substrate based on the determined material property of the print substrate.
4. The ink treating method of claim 3, wherein the determined material property of the print substrate is based on one or more of a degree of deformation during treating, a degree of ink absorption during printing, or a degree of fluid retention during treating.
5. The ink treating method of claim 1, wherein the determined variations in ink density is based on analysis of data from the print job.
6. The ink treating method of claim 1, further comprising:
printing ink to the print substrate based on the print job; and
scanning optical density of the printed ink with a densitometer,

wherein the determined variations in ink density is based on analysis of the optical density.

7. The ink treating method of claim 1, wherein adjusting the energy application is performed by adjusting an amount of light applied from the individually controllable energy elements to the individual zones of the print substrate.

8. The ink treating method of claim 1, wherein adjusting the energy application is performed via one or more physical barriers used to selectively impede energy application from the energy transfer system to the individual zones of the print substrate.

9. A printer, comprising:

an energy transfer system comprising a plurality of individually controllable energy elements; and

a control unit in communication with the energy transfer system, the control unit to:

determine variations in ink density in a print job among individual zones of a print substrate; and

adjust energy application to the individual zones of the print substrate based on the determined variations in ink density by regulation of the individually controllable energy elements.

10. The printer of claim 9, wherein the determined variations in ink density is based on analysis of data from the print job.

11. The printer of claim 9, wherein the control unit is further to:

request printing of ink to the print substrate based on the print job;

receive a scan of optical density of the printed ink from a densitometer,

wherein the determined variations in ink density is based on analysis of the optical density.

12. The printer of claim 9, wherein adjusting the energy application is performed by adjusting an amount of light applied from the individually controllable energy elements to the individual zones of the print substrate.

13. The printer of claim 9, wherein adjusting the energy application is performed via one or more physical barriers used to selectively impede energy application from the energy transfer system to the individual zones of the print substrate.

14. At least one computer readable storage medium, comprising a set of instructions, which when executed by a computing device, cause the computing device to:

- determine variations in ink density in a print job among individual zones of a print substrate; and

- adjust energy application to the individual zones of the print substrate based on the determined variations in ink density by regulation of individually controllable energy elements of an energy transfer system.

15. The at least one computer readable storage medium of claim 14, wherein the set of instructions, which when executed by the computing device, cause the computing device further to:

- determine one or more types of ink fluids in the print job among the individual zones of the print substrate;

- determine a material property of the print substrate, wherein the determined material property of the print substrate is based on one or more of a degree of deformation during treating, a degree of ink absorption during printing, or a degree of fluid retention during treating; and

- adjust energy application to the individual zones of the print substrate based on the determined one or more types of ink fluids and based on the determined material property of the print substrate.

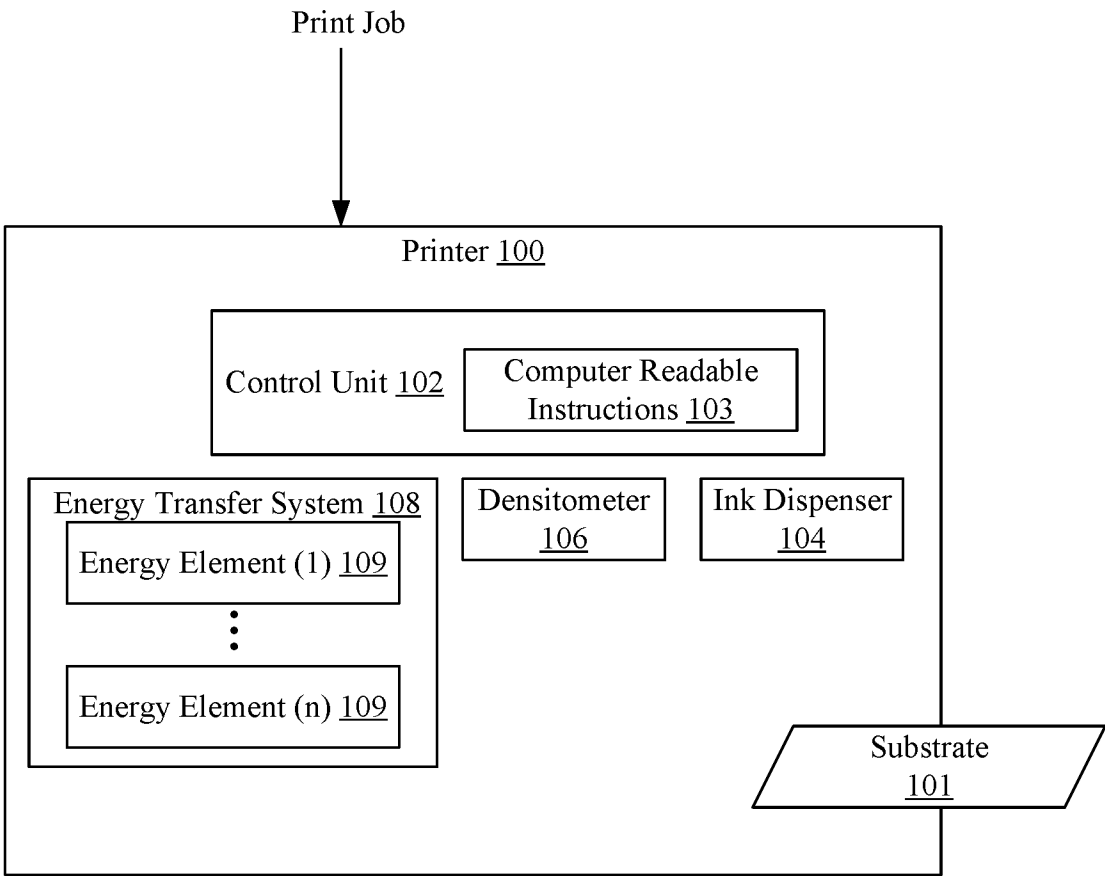


FIG. 1

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200

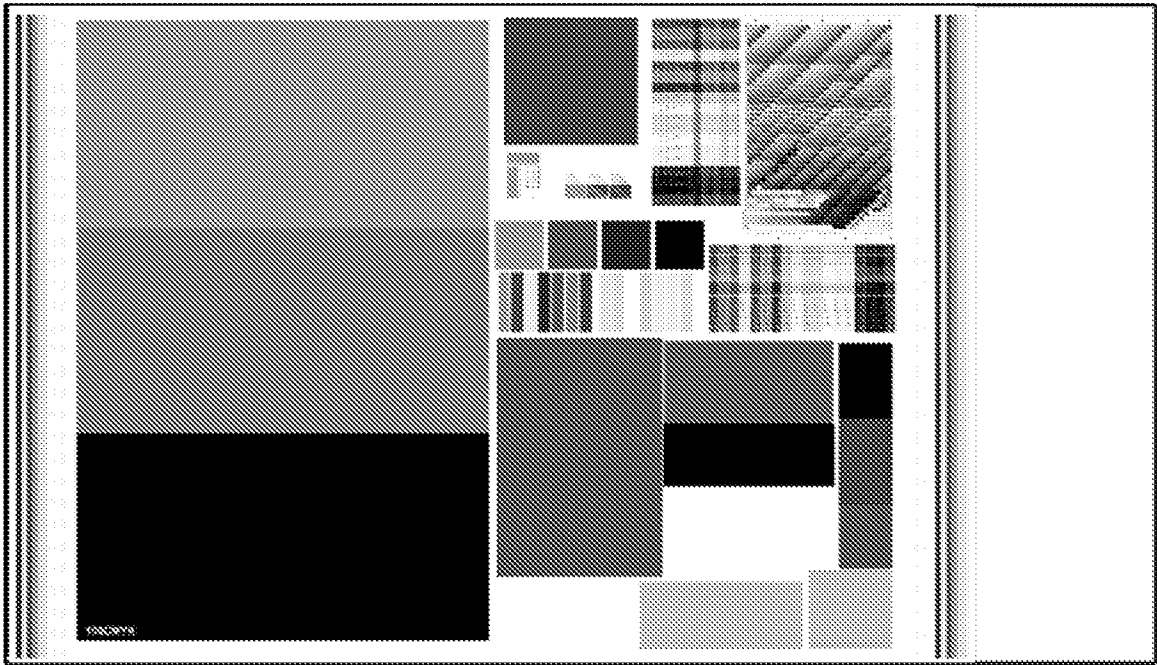


FIG. 2

300

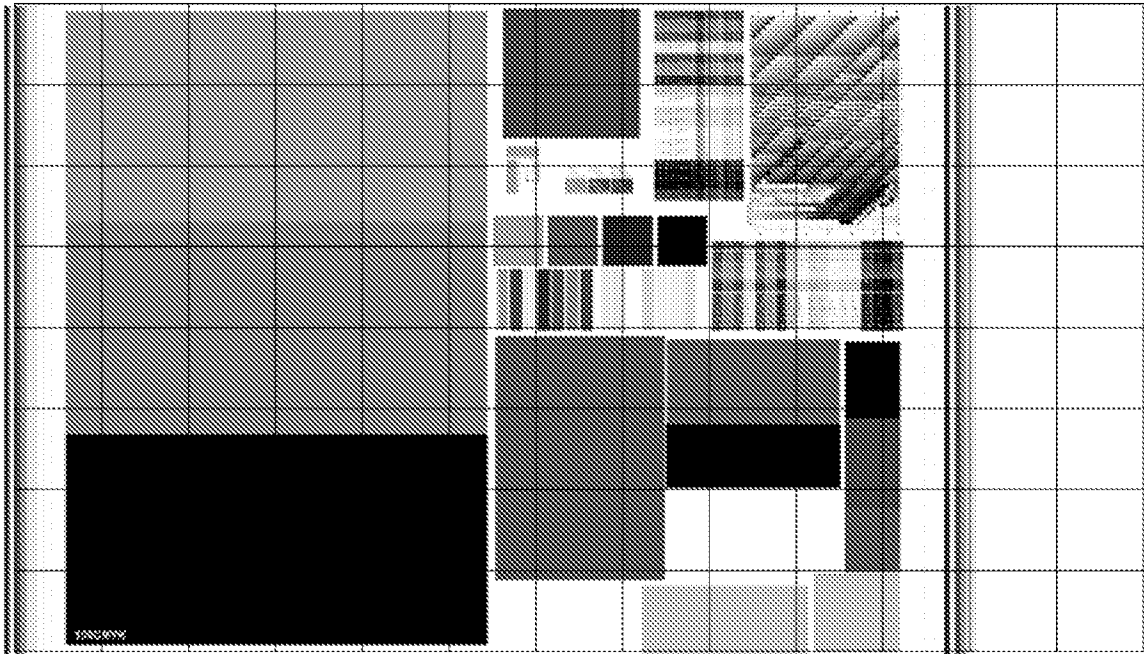


FIG. 3

400

High primary	Mid composite	Mid composite	Mid composite	Mid composite	High composite	High secondary	Mid composite	High composite	High primary	Empty	Empty	Empty
High primary	Mid composite	Mid composite	Mid composite	Mid composite	High composite	High composite	Mid composite	High composite	High primary	Empty	Empty	Empty
High primary	Mid composite	Mid composite	Mid composite	Mid composite	Mid composite	High composite	Mid composite	Mid composite	High primary	Empty	Empty	Empty
High primary	Mid CM	Mid CM	Mid CM	Mid CM	High primary	High primary	High secondary	High composite	High composite	Empty	Empty	Empty
High primary	Mid CM	Mid CM	Mid CM	Mid CM	High composite	Mid composite	Mid composite	High composite	High primary	Empty	Empty	Empty
High composite	High composite	High composite	High composite	High composite	High composite	High composite	High composite	High composite	High primary	Empty	Empty	Empty
High composite	High composite	High composite	High composite	High composite	High composite	High composite	High composite	High composite	High primary	Empty	Empty	Empty
High composite	High composite	High composite	High composite	High composite	Empty	Low composite	Low composite	High primary	High primary	Empty	Empty	Empty

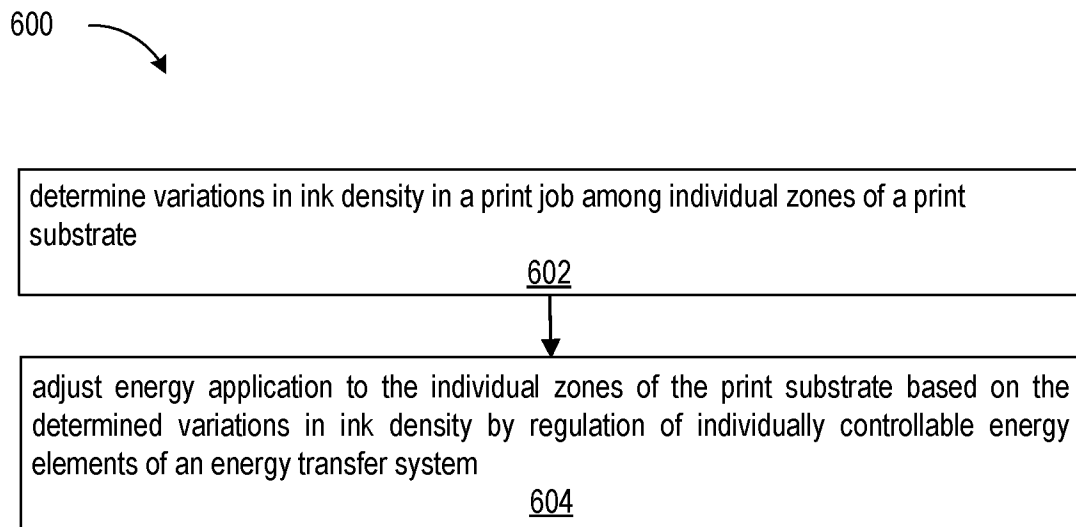
FIG. 4

500

80%	75%	75%	75%	75%	75%	100%	100%	85%	75%	75%	80%	0%	0%
80%	75%	75%	75%	75%	75%	100%	100%	100%	100%	100%	80%	0%	0%
80%	75%	75%	75%	75%	75%	75%	75%	100%	100%	100%	80%	0%	0%
80%	65%	65%	65%	65%	65%	80%	80%	80%	90%	100%	100%	0%	0%
80%	65%	65%	65%	65%	65%	100%	100%	75%	75%	100%	80%	0%	0%
100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	75%	80%	0%	0%
100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	80%	80%	0%	0%
100%	100%	100%	100%	100%	100%	100%	100%	40%	40%	80%	80%	0%	0%

FIG. 5

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**FIG. 6**

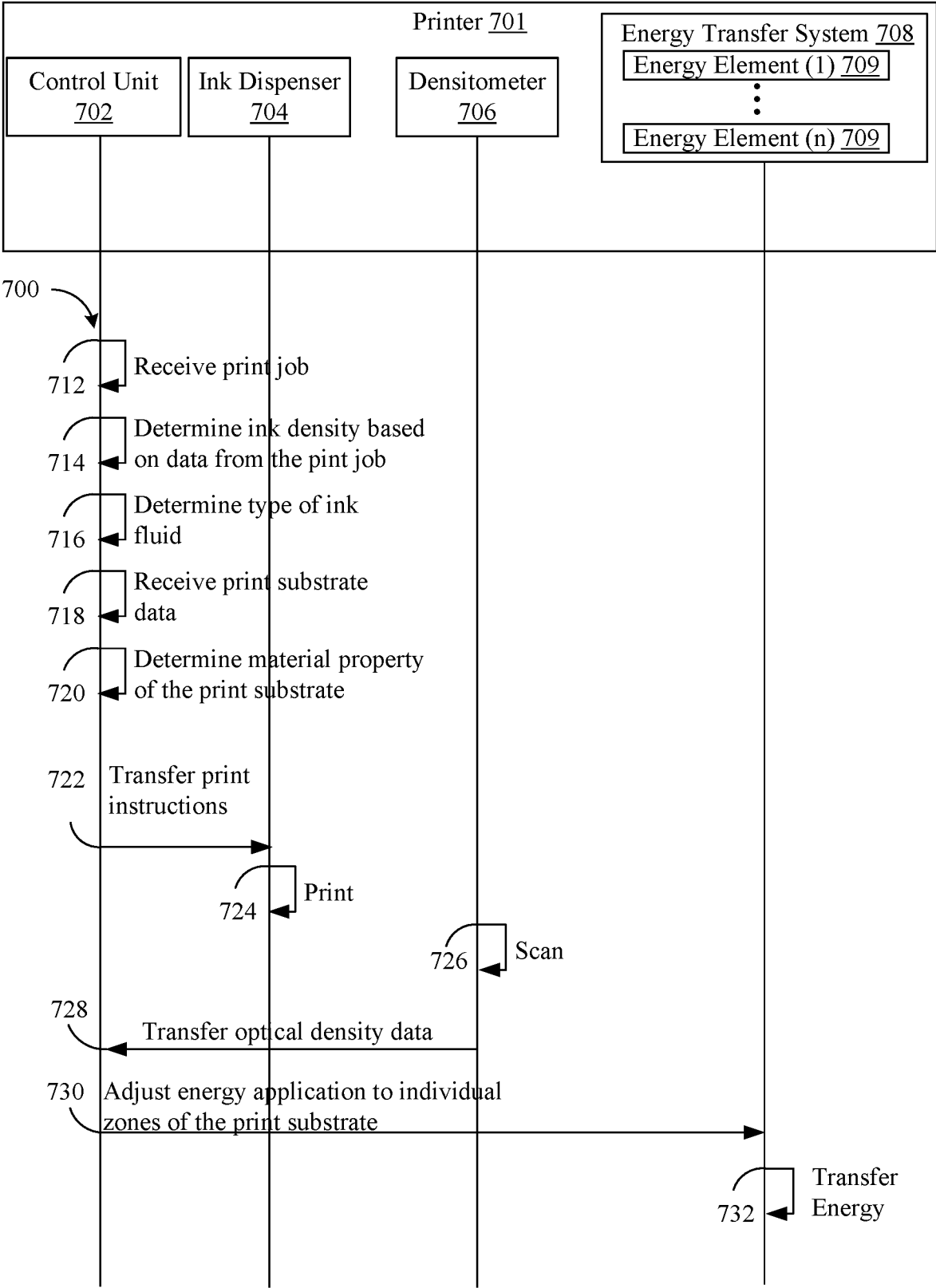
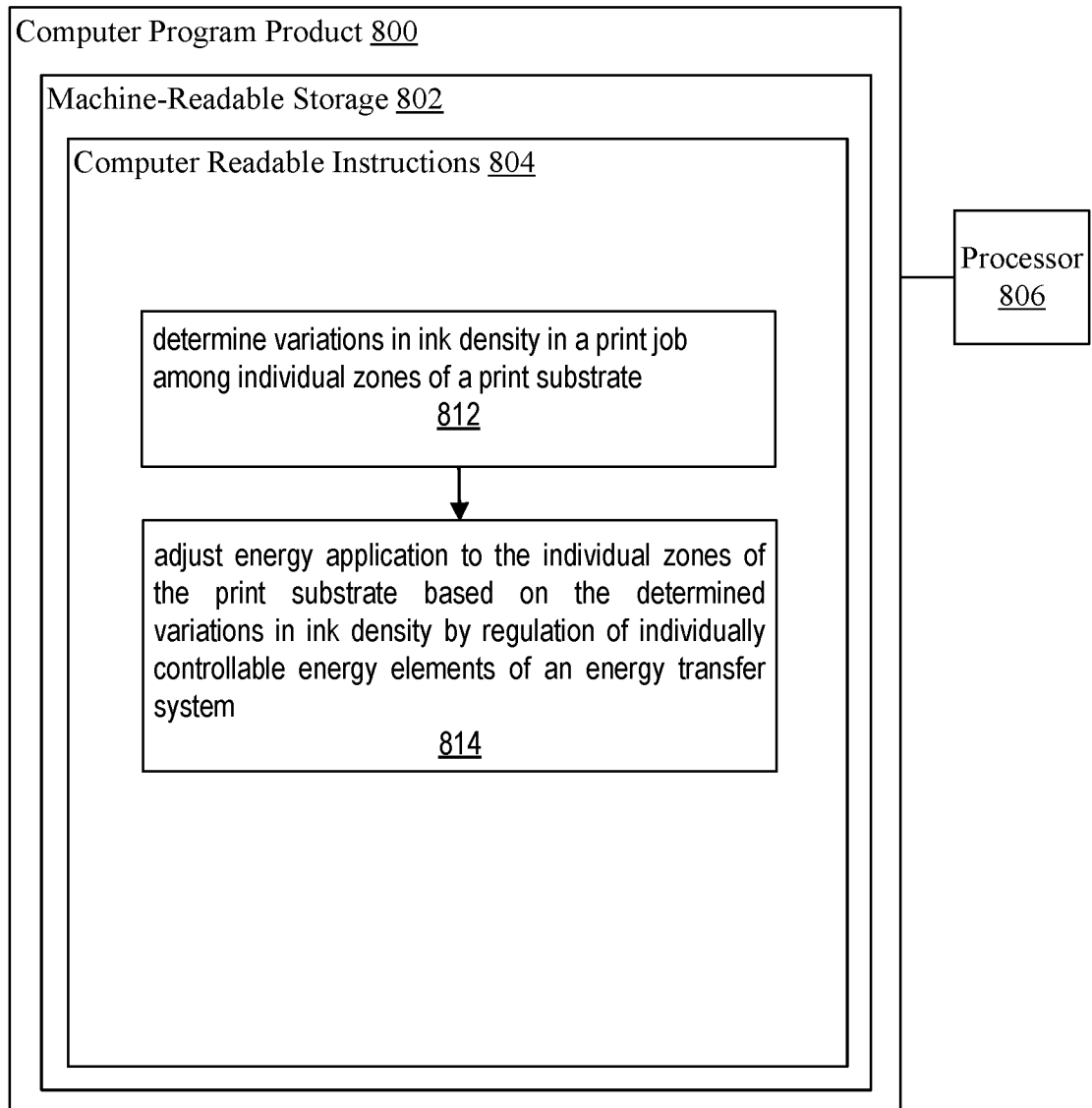
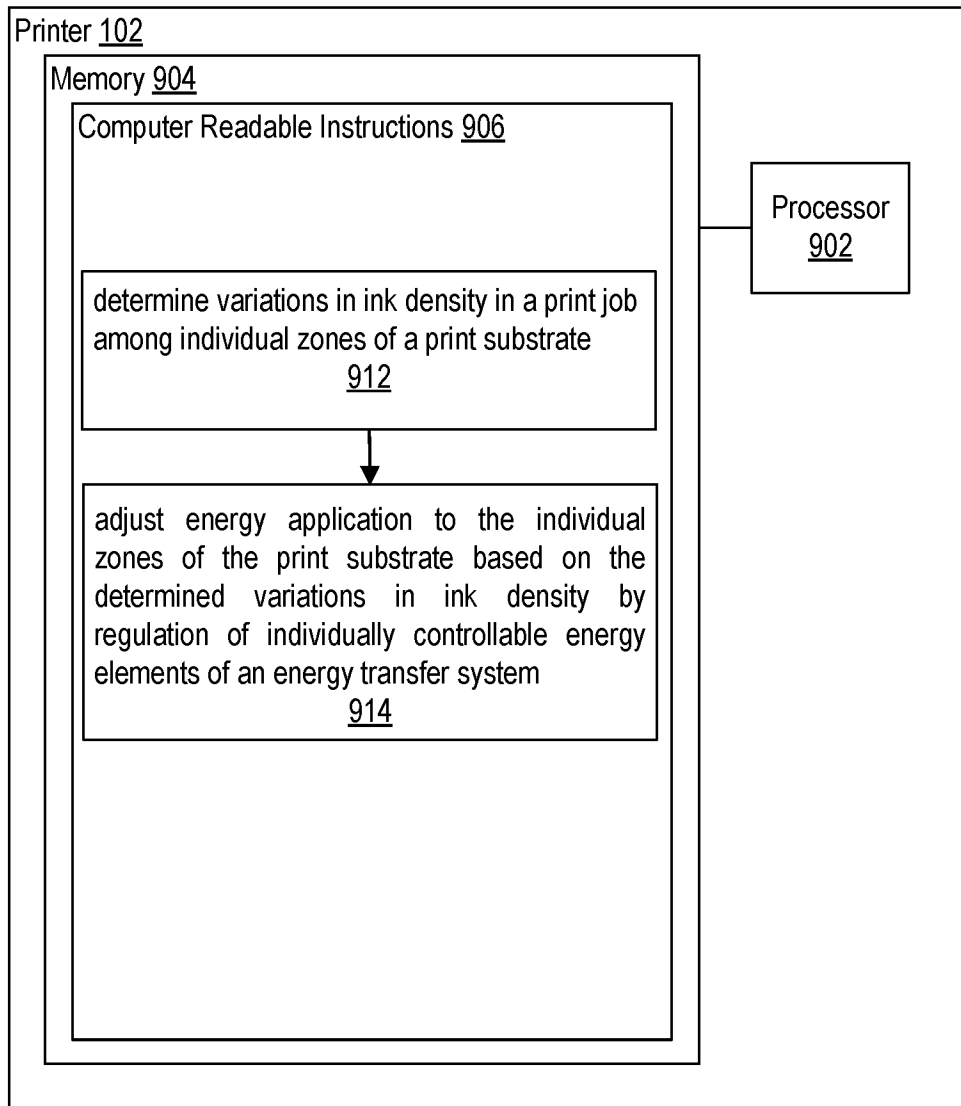


FIG. 7

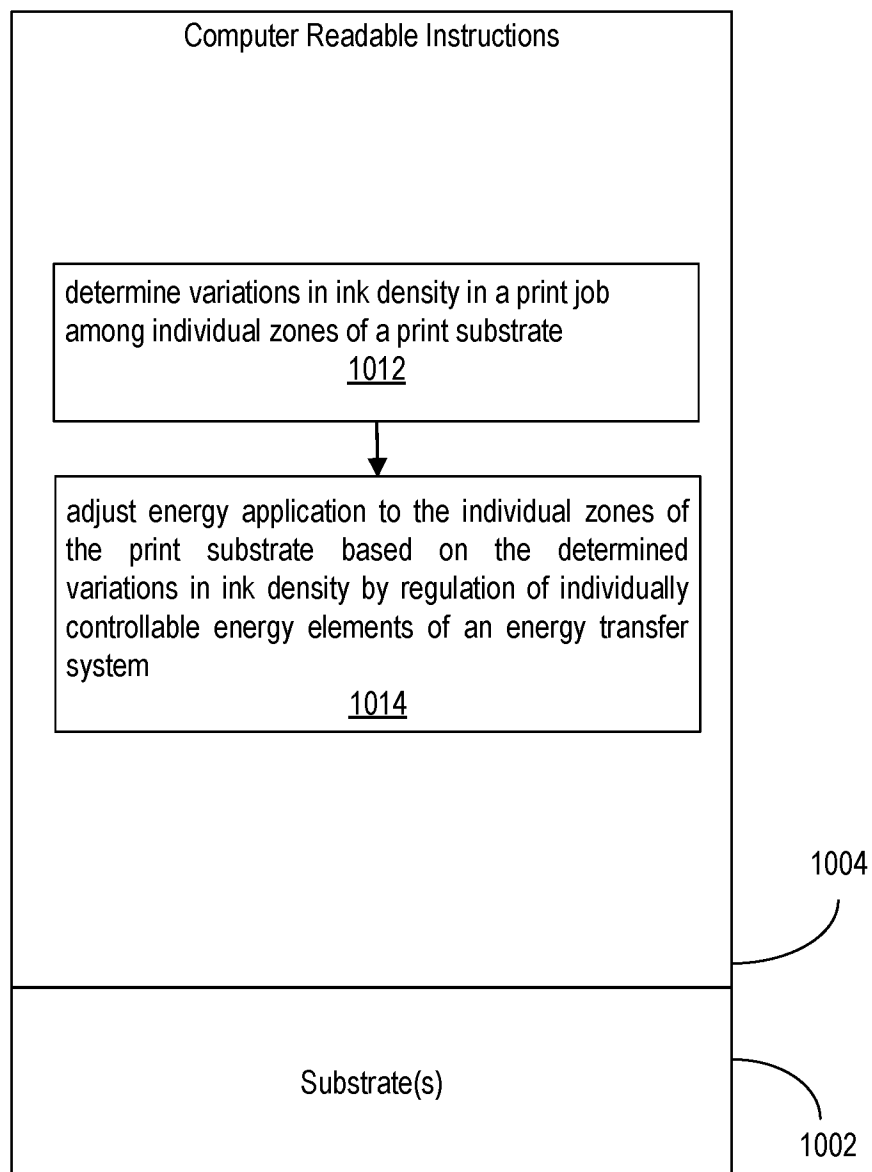
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**FIG. 8**

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**FIG. 9**

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1000**FIG. 10**

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2023/020572

A. CLASSIFICATION OF SUBJECT MATTER

INV. B41J11/00 B41J19/20 B41J2/205
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B41J

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2019/358965 A1 (PRAHARAJ SEEMIT [US] ET AL) 28 November 2019 (2019-11-28) the whole document -----	1, 5, 7-10, 12-14
X	JP 2012 011563 A (KONICA MINOLTA HOLDINGS INC) 19 January 2012 (2012-01-19) the whole document -----	1, 6, 9, 11, 14
X	JP 2011 110922 A (SEIKO EPSON CORP) 9 June 2011 (2011-06-09) the whole document -----	1, 9, 14
X	US 2006/061625 A1 (KONNO MASAOKI [JP] ET AL) 23 March 2006 (2006-03-23) the whole document ----- -/-	1-4, 9, 14, 15



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

19 October 2023

Date of mailing of the international search report

09/11/2023

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Authorized officer

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INTERNATIONAL SEARCH REPORT

International application No

PCT/US2023/020572

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 2018/086108 A1 (HOJO HIROAKI [JP]) 29 March 2018 (2018-03-29) the whole document -----	1, 9, 14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2023/020572

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