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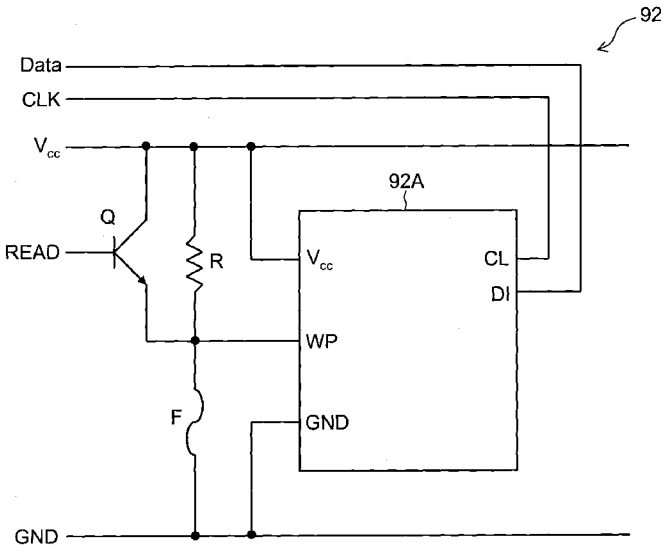
(54) **Title**: RECORDING HEAD ASSEMBLY, IMAGE RECORDING APPARATUS AND RECORDING HEAD ADJUSTMENT METHOD

FIG.6



(57) **Abstract**: A recording head assembly includes: a plurality of head modules; and a head module information storage device including: a storage element, in which head module information is stored and information can be written in a state in which the storage element is mounted on an electrical wiring board, and which includes an input terminal; a first voltage generator generating a first voltage for bringing the storage element into a write enable state; a fuse provided between the first voltage generator and the input terminal; a second voltage generator generating a second voltage for bringing the storage element into a write inhibit state; a resistor provided between the second voltage generator and the input terminal; a switch element selecting whether to apply, to the fuse, a current for blowing the fuse; and a switching signal input unit to which a switching signal for switching the switch element is input.

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DESCRIPTION

Title of Invention

RECORDING HEAD ASSEMBLY, IMAGE RECORDING APPARATUS AND RECORDING HEAD ADJUSTMENT METHOD

Technical Field

The present invention relates to a recording head assembly, an image recording apparatus, and a recording head adjustment method. Particularly, the present invention relates to technology for adjusting a long recording head configured by combining a plurality of head modules.

Background Art

An inkjet recording apparatus for recording a desired image onto a recording medium by ejecting color inks from an inkjet head onto the recording medium is known as a general-purpose image recording apparatus. In the single-pass image recording with a line head having a plurality of nozzles disposed over a length corresponding to the entire width of a recording medium, an image is formed on the entire surface of a recording medium by causing the recording medium and the inkjet head to move relative to each other once. In this single-pass image recording, image recording in a main scanning direction is performed by moving the head in the main scanning direction. The single-pass image recording, therefore, can be realized at higher speeds than a serial image recording that performs image recording in a main scanning direction repeatedly while sending a predetermined length of a recording medium.

As a form of a line-type recording inkjet head, there is proposed a form in which a plurality of head modules are connected to each other. The advantages of this type of inkjet head are that it can be manufactured in units of modules, hence a high yield ratio, and that the modules can be replaced in units of a module in the event of a failure in the inkjet head.

However, when connecting the plurality of head modules, the position of each module needs to be adjusted precisely. In so doing, alignment information and the like of each module are stored in a predetermined memory and managed within the apparatus equipped with this inkjet head.

Moreover, in order to optimize the recording operation of each head module in

accordance with the output characteristics (recording characteristics) thereof, the recording operation of each head module is controlled in response to the previously stored information on each head module.

PTL 1 discloses a recording apparatus which records recording characteristics data unique to a recording head in a memory in the recording head. Thereby, the recording apparatus in the PTL 1 can prevent recording characteristics data of a recording head other than a recording head being used, from being inadvertently applied to the recording head being used. Further, the recording apparatus in the PTL 1 can improve recording density spots.

PTL 2 discloses a recording apparatus in which identification numbers for individually identifying recording heads are provided to the recording heads, and characteristics data for controlling a specific identification number is stored in a nonvolatile memory of a main body of the recording apparatus. The recording apparatus of PTL 2 can detect whether a recording head is installed or not. In this recording apparatus, when it is detected that a recording head is installed, the specific identification number and a identification number of the installed recording head are displayed so as to be compared with each other, a scanning operation according to whether the two identification numbers are identical or not is performed, and the characteristics data is changed depending on a result of the operation.

PTL 3 discloses an inkjet recording apparatus that is configured to inhibit rewriting of a memory in which ink information is stored, in accordance with a depth at which an ink tank is inserted.

PTL 4 discloses a container and a management system. According to this disclosure, an IC chip in which identification information and information on the ink residual amount are stored is provided to a consumable part container such as a cartridge, and a coupling coil that enables communication with the IC chip is provided to the apparatus. The main body is configured to be able to recognize a normal consumable product by acquiring the identification information or information on the previous residual amount. Deterioration of the apparatus, degradation of the performance thereof, malfunction and the like caused by an abnormal product can be prevented by operating the main body apparatus by the recognition that the normal consumable product is placed.

Citation List

Patent Literature

PTL 1: Japanese Patent Application Publication No. 2003-231245

PTL 2: Japanese Patent Application Publication No. 2002-347225

PTL 3: Japanese Patent Application Publication No. 2005-014397

PTL 4: Japanese Patent Application Publication No. 2000-246921

Summary of Invention

Technical Problem

Some of those memories for storing head module information and the like are configured that the data stored therein can be stored or updated in the state that the memories are mounted and fixed onto an electric circuit board. Such memories enabling on-board writing can switch, using signals, between a state in which the data can be erased or written (updated) and a state in which erasure or writing of the data is inhibited.

A concern about such memories is that the data can be erased or rewritten due to an incorrect operation caused by noise or the like.

None of PTLs 1 to 4 discloses the problem where data stored in the memories can be accidentally erased or rewritten or describes a configuration for solving such a problem.

The present invention was made in view of such circumstances, and an object thereof is to provide a recording head assembly, an image recording apparatus, and a recording head adjustment method, which, in a configuration having a line-type inkjet head equipped with a plurality of head modules, prevent information of each head module from being accidentally erased or rewritten.

Solution to Problem

In order to achieve the above described object, an aspect of a recording head assembly includes: a plurality of head modules; a head module information acquiring device configured to acquire head module information on each of the plurality of head modules; and a head module information storage device configured to store the acquired head module information on each of the head modules, wherein the head module information storage device includes: a storage element, in which the head module information is stored and information can be written in a state in which the storage element is mounted on an electrical wiring board, and which includes an input terminal to which is applied a voltage for switching between a write enable state of enabling writing of information and a write inhibit state of inhibiting writing of information; a first voltage generator configured to generate a first voltage for bringing the storage element into the write enable state; a fuse provided between

the first voltage generator and the input terminal; a second voltage generator configured to generate a second voltage for bringing the storage element into the write inhibit state; a resistor provided between the second voltage generator and the input terminal; a switch element configured to select whether to apply, to the fuse, a current for blowing the fuse; and a switching signal input unit to which a switching signal for switching the switch element is input.

Advantageous Effects of Invention

According to the present invention, once the information on each head module is stored in the storage element provided in the head module information storage device, the fuse is melted so that the storage device can be fixed to the write inhibit state in terms of hardware. Therefore, the information on each head module stored in the storage element can be prevented from being lost or rewritten.

Brief Description of Drawings

{Figure 1} Figure 1 is an entire configuration diagram of an inkjet recording apparatus according to an embodiment of the present invention.

{Figure 2} Figure 2 is a plan view illustrating a schematic configuration of an inkjet head illustrated in Figure 1.

{Figure 3} Figure 3 is an explanatory diagram illustrating a nozzle arrangement in an inkjet head provided in an inkjet recording apparatus according to a first embodiment.

{Figure 4} Figure 4 is a cross-sectional diagram illustrating a three-dimensional structure of the inkjet head illustrated in Figure 3.

{Figure 5} Figure 5 is an explanatory diagram schematically illustrating an example of a connection between the inkjet head illustrated in Figure 3 and a drive voltage supply unit.

{Figure 6} Figure 6 is an electric circuit diagram illustrating a schematic configuration of a head module information storage unit.

{Figure 7} Figure 7 is an electric circuit diagram illustrating another configuration example of the head module information storage unit illustrated in Figure 6.

{Figure 8} Figure 8 is a block diagram illustrating a schematic configuration of a control system of the inkjet recording apparatus illustrated in Figure 1.

{Figure 9} Figure 9 is a block diagram illustrating a configuration example of a head drive unit illustrated in Figure 8.

{Figure 10} Figure 10 is a flowchart illustrating a flow of storing information of a

head module.

{Figure 11} Figure 11 is a flowchart illustrating a flow of storing the information upon replacement of a head module.

{Figure 12} Figure 12 is a plan view illustrating a schematic configuration of an inkjet head provided in an inkjet recording apparatus according to a second embodiment.

{Figure 13} Figure 13 is an explanatory diagram schematically illustrating a relationship in arrangement between the inkjet head illustrated in Figure 12 and a magnetic sensor.

{Figure 14} Figure 14 is a block diagram illustrating a schematic configuration of a control system of the inkjet recording apparatus according to the second embodiment.

{Figure 15} Figure 15 is a flowchart illustrating a flow of storing sensor information.

Description of Embodiments

The nature of this invention, as well as other objects and advantages thereof, will be explained in the following with reference to the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures.

[Entire Configuration of Inkjet Recording Apparatus]

Figure 1 is a general schematic drawing illustrating a schematic configuration of an inkjet recording apparatus (an image recording apparatus) according to an embodiment of the present invention. The inkjet recording apparatus 10 illustrated in this diagram adopts an impression cylinder conveyance system in which a recording medium 14 is held on an outer circumferential surface of an impression cylinder and conveyed.

Inkjet heads 48K, 48C, 48M, 48Y (recording heads) that eject inks to the recording medium 14 are disposed at an inclination with respect to a horizontal plane in such a manner that nozzle surfaces of the inkjet heads become orthogonal to a normal line of an outer circumferential surface of an impression cylinder (a rendering drum 44).

The inkjet recording apparatus 10 illustrated in Figure 1 includes: a recording medium accommodating unit 20 configured to accommodate the recording medium 14 prior to image formation; a treatment liquid application unit 30 configured to apply a treatment liquid to the recording medium 14 sent from the recording medium accommodating unit 20; a rendering unit 40 configured to eject a color ink to the recording medium 14 applied with the treatment liquid, to form a desired color image; a drying process unit 50 configured to dry the recording medium 14 on which the color image has been formed; a fixing process unit 60 configured to perform a fixing process on the dried recording medium 14; and an output unit

70 configured to output the recording medium 14 obtained after the fixing process.

A leading end portion of the recording medium 14 delivered to a transfer drum 32 via a paper supply tray 12 is gripped by grippers 80A, 80B of a treatment liquid drum 34. The recording medium 14 is supported by the treatment liquid drum 34 and conveyed along an outer circumferential surface of the treatment liquid drum 34 as the treatment liquid drum 34 rotates.

When the recording medium 14 that is rotary conveyed by the treatment liquid drum 34 reaches a process region of a treatment liquid application apparatus 36 disposed facing the outer circumferential surface of the treatment liquid drum 34, the treatment liquid is applied to a surface of the recording medium 14 on which the image is formed. The treatment liquid applied by the treatment liquid application apparatus 36 functions to react with color inks ejected from the inkjet heads 48K, 48C, 48M, 48Y and aggregate or insolubilize colorants contained in the color inks.

The recording medium 14 applied with the treatment liquid is delivered to the rendering drum 44 via a transfer drum 42, held on the outer circumferential surface of the rendering drum 44, and rotary conveyed along the outer circumferential surface of the rendering drum 44.

A paper pressing roller 46 is disposed immediately before the upstream side of a recording medium conveyance direction at the inkjet heads 48K, 48C, 48M, 48Y. The paper pressing roller 46 causes the recording medium 14 to adhere tightly to the outer circumferential surface of the rendering drum 44 immediately before entering a space immediately below the inkjet heads 48K, 48C, 48M, 48Y.

The color inks are ejected from the inkjet heads 48K, 48C, 48M, 48Y to the recording medium 14 that is rotary conveyed by the rendering drum 44, and thereby a color image is formed on an image formation surface (a liquid adhesion surface) of the recording medium 14 to which the treatment liquid is applied.

The recording medium 14 on which the color image is formed is delivered to a drying drum 54 via a transfer drum 52, is supported on an outer circumferential surface of the drying drum 54, and is rotary conveyed along the outer circumferential surface of the drying drum 54 as the drying drum 54 rotates.

The recording medium 14 that is rotary conveyed by the drying drum 54 is subjected to a drying process by a drying process apparatus 56. The drying process uses a heater to heat the recording medium 14, uses a fan to blow dry air or heating air, or uses both the heater and the fan.

After the drying process is performed on the recording medium 14, the recording medium 14 is delivered to a fixing drum 64 via a transfer drum 62. The recording medium 14 delivered to the fixing drum 64 is held on the outer circumferential surface of the fixing drum 64 and rotary conveyed along the outer circumferential surface of the fixing drum 64 as the fixing drum 64 rotates.

The image that is formed on the recording medium 14 that is rotary conveyed by the fixing drum 64 is subjected to a heating process by a heater 66 and a pressurizing process by a fixing roller 68. An in-line sensor 82 that is provided on the downstream side of the recording medium conveyance direction at the fixing roller 68 is a device for imaging the recording medium 14 (image) on which the fixing process using heat and pressure is performed. Ejection abnormalities of the inkjet heads 48K, 48C, 48M, 48Y are determined based on the imaging result obtained from the in-line sensor 82.

After passing through an imaging region where imaging is performed by the in-line sensor 82, the recording medium 14 is sent to the output unit 70. The output unit 70 is configured to convey the recording medium 14 to a stocker 76 by means of a chain 74 wrapped around tension rollers 72A, 72B.

[Configuration of Rendering Unit]

Figure 2 is a plan view illustrating a schematic configuration of the inkjet head 48 (48K, 48C, 48M, 48Y) illustrated in Figure 1. Because the inkjet heads 48K, 48C, 48M, 48Y of the present embodiment include the same or similar structure, the inkjet heads are illustrated without the alphabets (KCMY) representing the respective colors, unless the inkjet heads of the respective colors need to be distinguished from each other.

As illustrated in Figure 2, the inkjet head 48 is configured by connecting a plurality of head modules 48A in a longitudinal direction (a direction denoted with M).

Note that a flow channel, electrical wiring and the like are configured in each head module 48A so that each head module 48A alone can function as a recording head of an inkjet printing system (inkjet head).

The inkjet heads 48K, 48C, 48M, 48Y provided in the rendering unit 40 are full-line inkjet heads, in each of which a plurality of nozzles (not illustrated in Figure 2 but denoted with reference numeral 150 in Figure 3) are disposed over the length exceeding the entire width of the recording medium 14 (at least the entire length of an image formation region of the recording medium 14).

The inkjet heads 48K, 48C, 48M, 48Y illustrated in Figure 2 are disposed in this order from the upstream side in terms of the recording medium conveyance direction S (see

Figure 1). With the single-pass image recording system where the full-line inkjet heads 48K, 48C, 48M, 48Y and the recording medium 14 are moved relative to each other once, a recorded image can be recorded over the entire region of the recording medium 14.

Note that the configuration of the rendering unit 40 is not limited to the one described above. For instance, an inkjet head 48 corresponding to LC (light cyan) or LM (light magenta) may be provided in the rendering unit 40. Also, the order of disposing the inkjet heads 48K, 48C, 48M, 48Y can be changed appropriately.

[Structure of Inkjet Head: First Embodiment]

Next is described a structure of the inkjet head 48 provided in an inkjet recording apparatus according to a first embodiment of the present invention. Figure 3 is a perspective plan view illustrating a nozzle arrangement in the inkjet head 48 (head modules 48A).

The head module 48A illustrated in this diagram has a matrix arrangement of a plurality of ejection elements (recording elements) 154 each of which includes a nozzle 150 and a pressure chamber 152. The ejection elements 154 are arranged in rows along a direction (a main scanning direction) orthogonal to a conveyance direction for conveying the recording medium 14 (a sub-scanning direction denoted with reference numeral S), as well as an oblique column direction that is not orthogonal to the conveyance direction of the recording medium 14.

The matrix arrangement of the nozzles 150 (ejection elements 154) illustrated in Figure 3 can achieve a high density of substantial nozzle arrangement in the direction orthogonal to the conveyance direction of the recording medium 14. Note that the nozzle arrangement in the inkjet head that can be applied to the present invention is not limited to the matrix arrangement illustrated in Figure 3.

Applicable examples of the nozzle arrangement include an aspect in which the plurality of nozzles 150 are arranged in a single line along the direction orthogonal to the conveyance direction of the recording medium, and an aspect in which the plurality of nozzles 150 are arranged in a staggered manner in two lines in the same direction.

Figure 4 is a cross-sectional diagram illustrating a three-dimensional structure of one ejection element of the inkjet head 48 (head module 48A). As illustrated in this diagram, the inkjet head 48 (head module 48A) includes a nozzle 150 configured to eject ink, a pressure chamber 152 communicated with the nozzle 150, a diaphragm 156 configuring a ceiling surface of the pressure chamber 152, and a piezoelectric element 158 provided in the diaphragm 156.

The pressure chamber 152 is communicated with a common flow channel 162 via a

supply port (supply aperture) 160. The common flow channel 162 is communicated with an ink tank disposed outside the inkjet head 48, via a flow channel that is not illustrated.

The piezoelectric element 158 has a structure in which a piezoelectric body 168 is sandwiched between an upper electrode 164 and a lower electrode 166. The piezoelectric element 158 is distorted by application of a drive voltage between the upper electrode 164 and the lower electrode 166, and the pressure chamber 152 is deformed by the distortion of the piezoelectric element 158. Thereby, the ink stored in the pressure chamber 152 is ejected from the nozzle 150.

When the distorted piezoelectric element 158 is restored to its original state, ink is supplied from the common flow channel 162 to the pressure chamber 152 via the supply port 160. When the diaphragm 156 is made by a metallic material, the diaphragm 156 may double as the lower electrode 166.

The inkjet head 48 illustrated in Figure 4 has a structure in which a plurality of cavity plates are stacked. For example, a nozzle plate in which an opening portion of the nozzle 150 (an ink ejection surface 150A) is formed, a flow channel plate in which the pressure chamber 152, the supply port 160, the common flow channel 162 and the like are formed, the diaphragm, and the piezoelectric element can be stacked in this order. Note that each of the plates described above can further be configured by a plurality of plates.

The present embodiment illustrates the piezoelectric system as an ink ejection system in which a distortion of the piezoelectric element is used. However, the present embodiment can adopt a thermal system including a heater in a liquid chamber that operates the heater of the liquid chamber to heat the ink stored in the liquid chamber and then ejects the ink by means of a film boiling phenomenon.

[Explanation of Drive Voltage Supply Unit]

Figure 5 is an explanatory diagram schematically illustrating an example of a connection between the inkjet head 48 illustrated in Figure 1 and a drive voltage supply unit (a drive voltage supply device) that supplies a drive voltage to the inkjet head 48.

As illustrated in Figure 5, the head module 48A is attached to a head attachment plate 48B corresponding to the head modules 48A. The head module 48A is provided with a drive voltage supply unit 90 which supplies a drive voltage to each of the head module 48A.

The drive voltage supply unit 90 includes a drive voltage generating circuit and a drive voltage output circuit (both not illustrated) mounted on an electrical wiring board (a drive circuit board) 91. A drive voltage output unit of the drive voltage output circuit is connected to an electrical wiring pattern of the inkjet head 48 by a flexible board 90A.

There are also mounted on the drive circuit board 91 a head module information storage unit 92 (a head module information storage device) in which is stored information on the head module 48A to which a drive voltage is supplied, a connector 93 to which the flexible board 90A is connected, and a data input unit 94 (a head module information acquiring device) that acquires the information on the head module 48A or image data (dot data).

The data input unit 94 can also include a plurality of interfaces corresponding to different data communication formats. For example, the data input unit 94 can include a serial communication interface, a parallel communication interface, and a wireless communication interface.

When the data input unit 94 is provided with a communication interface other than the serial communication interface, a data converter that converts data to the serial communication format is provided.

The information on the head module 48A includes an identification number of each head module 48A, information on each nozzle, such as the nozzle arrangement and ejection characteristics of each nozzle, information on each ejection element (recording element), such as drive characteristics of each recording element (piezoelectric element, heater), and information on the drive voltage, such as an adjusted value of a drive waveform (voltage).

For example, the drive voltage can be adjusted based on the information on each nozzle and the information on each ejection element, to secure uniform recording characteristics of the entire inkjet head 48.

In addition, information on an attachment error occurring when attaching the head module 48A to the head attachment plate 48B may be included in the information on the head module 48A. Adjusting the drive of the head module 48A or correcting the image data based on the attachment error information of the head module 48A can prevent deterioration of image quality caused by the attachment error of the head module 48A.

The head module information storage unit 92 includes a memory, data of which can be erased or written in a state in which the memory is mounted and fixed onto the drive circuit board 91 (e.g., an EEPROM (Electrically Erasable Programmable Read-Only Memory, denoted with reference numeral 92A in Figure 6).

The description, "a state in which the memory is mounted and fixed onto the drive circuit board 91 (on-board)," means a state in which a terminal (lead) of the memory and a pad of the drive circuit board are bonded to each other by a conductive adhesive agent such as solder.

After the head module 48A is attached to the head attachment plate 48B (attachment member), the information of the head module 48A needs to be stored in the head module information storage unit 92. Furthermore, when the head module 48A is replaced, the information of the head module 48A obtained after the replacement needs to be stored. Therefore, a one-time memory in which data are written at once beforehand cannot be used as the memory for storing the information on the head module 48A.

Therefore, a memory in which data can be erased and written on-board is applied as the memory for storing the information on the head module 48A.

The information on the head module 48A may be acquired from an information storage body (an IC tag, etc.) attached to the head module 48A by means of wireless data communication or acquired from a storage medium in which the information of the head module 48A is stored (a memory card, etc.), through a predetermined communication interface (a card slot).

The information on the head module 48A to be used may be read from a database in which the information on this head module 48A is stored beforehand, based on the identification number provided to the head module 48A.

[Explanation of Head Module Information Storage Unit]

Figure 6 is an electric circuit diagram illustrating a schematic configuration of the head module information storage unit 92. An EEPROM 92A (a storage element) illustrated in this diagram is a storage element with a built-in serial interface. The EEPROM 92A has a write-protect terminal WP (an input terminal) to which is input a state switching signal for switching between a data write enable state and a data write inhibit state (read-only state).

A clock input terminal CL of the EEPROM 92A receives an input of a clock signal based on which an operation cycle of the EEPROM 92A is determined. The EEPROM 92A performs a division process on an input clock signal to generate an operation clock.

A data input terminal DI receives an input of data of serial format. Note that the present embodiment illustrates the storage element of serial data communication format; however, a storage element of a parallel communication system in which data communication is carried out using a bus line can also be adopted.

The data input terminal DI is electrically connected to the data input unit 94 illustrated in Figure 5 via a wiring pattern formed in the drive circuit board 91 illustrated in Figure 5.

When a switching signal (voltage) of an H level is input to the write-protect terminal WP, the EEPROM 92A illustrated in Figure 6 enters a protect mode, the state in which data

writing is disabled (the write inhibit state). When a switching signal of an L level is input to the write-protect terminal, the protect mode is canceled, realizing the state in which data writing is enabled (the write enable state).

A pull-up resistor R and an NPN transistor Q (a switch element) are inserted between the write-protect terminal WP and a power-supply voltage V_{cc} (a second voltage generator), and a fuse F is inserted between the write-protect terminal WP and a ground voltage GND (a first voltage generator).

While a collector terminal of the transistor Q is connected to the power-supply voltage V_{cc}, an emitter terminal of the same is connected to the write-protect terminal WP, and a base terminal of the same receives an input of a read signal (READ). The read signal is generated by a read signal generator (not illustrated), and is supplied to the transistor Q under control of a control system (to be described hereinafter in detail).

When the read signal is of an L level, the transistor Q is turned off, and a voltage of an H level is input to the write-protect terminal WP, allowing data to be written to the EEPROM 92A.

When, on the other hand, the transistor Q is turned on by a read signal of an H level, current flows from the power-supply voltage V_{cc} to the ground voltage GND, not via the pull-up resistor R but via the transistor Q. As a result, the fuse F is melted and cut. After the fuse F is melted and cut, a read signal of an L level is applied to the base terminal of the transistor Q, turning the transistor Q off.

The level of the voltage input to the write-protect terminal WP is fixed at H level after the fuse F is melted and cut. Therefore, the EEPROM 92A is fixed, in terms of hardware, to the state of disabling data writing.

According to this configuration, once the information of the head module 48A is written to the EEPROM 92A, the level of the write-protect terminal WP of the EEPROM 92A is fixed at the H level, and the EEPROM 92A is fixed to the write inhibit state in terms of hardware, without having its level switched to the L level, and the EEPROM 92A functions as a read-only memory. This can prevent the information of the head module 48A from being lost or rewritten.

Note that a fuse resistance may be adopted in place of the fuse F. Moreover, a bipolar transistor or an FET (Field Effect Transistor) may be adopted as the transistor Q.

Figure 7 is an electric circuit diagram illustrating another form of schematic configuration of the head module information storage unit 92 illustrated in Figure 6. In Figure 7, parts which are the same as or similar to the parts illustrated in Figure 6 are denoted

with the same reference numerals and further explanations thereof are omitted.

In an EEPROM 92A' illustrated in Figure 7, the write-protect terminal WP thereof is low-active. When a switching signal of an L level is input to this write-protect terminal WP, the EEPROM 92A' enters the data write enable state. However, when a switching signal of an H level is input to this write-protect terminal WP, the EEPROM 92A' enters the data write inhibit state.

In a head module information storage unit 92' illustrated in Figure 7, a pull-down resistor R' is inserted between the write-protect terminal WP and the ground voltage GND (the second voltage generator). Also, a fuse F and a resistor R_A ($R' >> R_A$) are inserted between the write-protect terminal WP and the power-supply voltage V_{cc} (the first voltage generator). The fuse F and the resistor R_A are connected in series.

In addition, a transistor Q' is inserted between the connection between the fuse F and the resistor R_A and the ground voltage GND. A collector terminal of the transistor Q' is connected to the connection between the fuse F and the resistor R_A, and an emitter terminal of the same is connected to the ground voltage GND. The base terminal of the same receives an input of a read signal (READ).

When the read signal is of an L level, the transistor Q' is turned off, and a voltage of an H level (a voltage obtained by resistively dividing the power-supply voltage V_{cc} by the resistor R_A and the pull-down resistor R') is input to the write-protect terminal WP, allowing data to be written to the EEPROM 92A'.

When, on the other hand, the transistor Q' is turned on by a read signal of an H level, current flows from the power-supply voltage V_{cc} to the ground voltage GND, not via the pull-down resistor R' and the resistor R_A but via the transistor Q'. As a result, the fuse F is melted. After the fuse F is melted, a read signal of an L level is applied to the base terminal of the transistor Q', turning the transistor Q' off.

The level of the voltage input to the write-protect terminal WP is fixed at L level in terms of hardware after the fuse F is melted. Therefore, the EEPROM 92A' is fixed, in terms of hardware, to the state of disabling data writing, and consequently functions as a read-only memory.

According to this configuration, as with the head module information recording unit 92 illustrated in Figure 6, once the information of the head module 48A is written to the EEPROM 92A' the level of the write-protect WP of the EEPROM 92A' is fixed at the L level, and the EEPROM 92A' is fixed to the write inhibit state without having its state switched to the H level, and functions as a read-only memory. This can prevent the information of the

head module 48A from being lost or rewritten.

[Configuration of Control System]

Figure 8 is a block diagram illustrating a schematic configuration of a control system of the inkjet recording apparatus 10. As illustrated in this diagram, the inkjet recording apparatus 10 has a communication interface 170, a system control unit 172, a conveyance control unit 174, an image process unit 176, a head drive unit 178, an image memory 180, a ROM 182 and the like.

The communication interface 170 is an interface unit for receiving raster image data sent from a host computer 184. A serial interface such as USB (Universal Serial Bus) or a parallel interface such as a Centronics interface may be used as the communication interface 170. A buffer memory (not illustrated) may be mounted in the communication interface 170 in order to increase the communication speed.

The system control unit 172 is constituted of a central processing unit (CPU) and peripheral circuits thereof, and functions as a control device for controlling the entire inkjet recording apparatus 10 in accordance with a predetermined program, as well as a calculation device for performing various calculations. The system control unit 172 further functions as a memory controller for controlling the image memory 180 and the ROM 182.

In other words, the system control unit 172 controls the communication interface 170, the conveyance control unit 174 and other units to control communication between these units and a host computer 184, controls reading/writing of data to/from the image memory 180 and the ROM 182, and generates control signals for controlling the units described above.

Image data sent from the host computer 184 is imported to the inkjet recording apparatus 10 via the communication interface 170 and subjected to a predetermined image process by the image processing unit 176.

The image process unit 176 is a control unit that has a signal (image) processing function for performing various treatment processes/corrections in order to generate a print control signal from the image data, and supplies thus generated print data (dot data) to the head drive unit 178.

When the image processing unit 176 carries out a required signal process, an ejection droplet amount (deposited droplet amount) or ejection timing of droplets ejected by the inkjet head 48 is controlled by the head drive unit 178 based on the print data (halftone image data). Note that the head drive unit 178 may be configured by a plurality of blocks with respect to each head unit 12.

As a result, a desired dot size or dot arrangement is realized. Note that the head

drive unit 178 illustrated in Figure 8 may include a feedback control system of maintaining constant drive conditions of the inkjet head 48.

The conveyance control unit 174 controls conveyance timing and conveyance speed for conveying the recording medium (see Figure 1) based on print data generated by the image processing unit 176. The conveyance drive unit 186 illustrated in Figure 8 includes a motor for driving the impression cylinders 34, 44, 54, 64 and the transfer drums 32, 42, 52, 62 that convey the recording medium 14 illustrated in Figure 1, and the conveyance control unit 174 functions as a driver for driving the motor.

The image memory (temporary storage memory) 180 functions as a temporary storage device for temporarily storing the image data input through the communication interface 170, and functions as an expansion area for various programs stored in the ROM 182 and a calculation work area of the CPU (e.g., a work area of the image processing unit 176). A volatile memory (RAM) from/to which data can be read/written sequentially is used as the image memory 180.

Programs executed by the CPU of the system control unit 172, various types of data required for controlling each of the units of the apparatus, control parameters, and the like are stored in the ROM 182. Data are read/written from/to the ROM 182 through the system control unit 172. The ROM 182 is not limited to a memory composed of semiconductor elements, and a magnetic medium such as a hard disk may be used. The ROM 182 may also have an external interface and use a detachable recording medium.

Various control parameters that are required in the operations of the inkjet recording apparatus 10 are stored in a parameter storage unit 190. The system control unit 172 appropriately reads the parameters required for control processing and updates (rewrites) the various parameters according to need.

A program storage unit 192 is a storage device in which control programs for operating the inkjet recording apparatus 10 are stored. The system control unit 172 (or each of the units of the apparatus) reads a required control program from the program storage unit 192 in order to control each of the units of the apparatus and appropriately executes the control program.

The information of the head module 48A that is acquired through the data input unit 94 is written to the head module information storage unit 92 (92') via the system control unit 172.

Further, the head module information storage unit 92 (92') switches its mode from a write enable mode that enables writing of the information (data) of the head module 48A, to a

write inhibit mode that inhibits writing of the information of the head module 48A, based on a read signal sent from the system control unit 172.

The head module information storage unit 92 (92'), the data input unit 94, and the head drive unit 178 are provided on the drive circuit board 91. Note that the drive circuit board 91 may be provided with a control unit (not illustrated), and this control unit of the drive circuit board 91 may be caused to execute some functions of the system control unit 172.

Various types of information such as the operation status of the apparatus and an alarm are displayed on a display unit 171. A monitor such as a liquid crystal display is used as the display unit 171. A monitor with a touch panel can be adopted as the display unit 171 to serve as an input apparatus used by an operator.

[Detailed Explanation of Head Drive Unit]

Figure 9 is a block diagram illustrating a configuration example of the head drive unit 178 illustrated in Figure 8. The configuration example illustrated in this diagram is provided with a drive waveform generator 202 that generates an analog waveform signal (drive waveform) based on a digital waveform signal transmitted from a head controller 200, and an amplifier (AMP) 204 that voltage-amplifies and current-amplifies the drive waveform.

Print data in a serial format, which is transmitted from the head controller 200, is transmitted to a shift register 206 together with a clock signal, in synchronization with the clock signal. A drive waveform generated by the drive waveform generator 202 includes a plurality of waveform elements. The amount of ink ejected can be changed gradually by selecting one or more of the waveform elements.

The print data stored in the shift register 206 is latched in a latch circuit 208 based on a latch signal. A signal latched in the latch circuit 208 is converted into a predetermined voltage at which a switch element 214 configuring a switch IC 212 in a level conversion circuit 210 can be driven.

ON/OFF-controlling the switch element 214 based on an output signal of the level conversion circuit 210 can select at least one of the plurality of waveform elements and determine the ejection amount, and accordingly the piezoelectric element 158 that is driven by a select signal and enable signal sent from the head controller 200 is selected.

The head drive unit 178 adjusts the drive voltage supplied to each head module 48A based on the information on the head module 48A (the recording characteristics, the attachment error information, etc.) stored in the head module information storage unit 92 illustrated in Figure 8, such that uniform recording characteristics of the entire inkjet head 48

can be obtained.

In order to adjust the drive voltage, the maximum amplitude, the ejection amount (dot size) and the like, for example, are adjusted.

Note that the drive system of the inkjet head 48 is not limited to the system of selectively applying a common drive voltage (drive waveform); thus, a system of generating a drive waveform for each nozzle can be adopted in an inkjet head having a relatively low number of nozzles.

The head controller 200 illustrated in Figure 9 can be used as the system control unit 172 of Figure 8 as well.

[Explanation about Storing Head Module Information]

Figure 10 is a flowchart illustrating a flow of storing the information on the head module 48A in the EEPROM 92A.

Once storing of the information on the head module 48A is started (step S10), the head module 48A is recognized (step S12). To recognize the head module 48A, the operator may input the identification number of the target head module 48A or automatically recognize the head module 48A by a barcode or the like attached thereto.

Once the head module 48A is recognized, head module information complying with the head module 48A is acquired (step S14). The head module information is stored in the EEPROM 92A (step S16). When head module information items of all head modules 48A configuring the inkjet head 48 are stored, the process proceeds to step S18.

In step S18 an operation test is executed on the inkjet head 48. In this operation test, the inkjet head 48 is operated to form a test pattern, which is then analyzed, to determine whether the inkjet head 48 is operated properly or not.

When the inkjet head 48 fails the operation test in step S18 (NO), the inkjet head 48 is adjusted (step S20). Then, the process returns to step S18, to execute the operation test on the inkjet head 48 again.

However, when the inkjet head 48 passes the operation test in step S18 (YES), the EEPROM 92A is fixed to the data write inhibit state (step S22, a write inhibit process), and storing of the information on the head module 48A is ended (step S24).

When the inkjet head 48 consecutively fails the operation tests in step S18, the fact that the inkjet head 48 has consecutively failed the operation tests is displayed in the form of character information on the display unit illustrated in Figure 8. Then, the process proceeds to step S24 to end this control.

[Explanation about Replacing Head Module]

In the inkjet recording apparatus 10 illustrated in the present embodiment, the inkjet head 48 is configured by combining the plurality of head modules 48A. Thus, the head modules 48A can be replaced in units of head modules.

Because the head modules 48A can be replaced in units of head modules, it is not necessary to replace the whole inkjet head 48 even when some of the nozzles of the inkjet head 48 become unusable. That way, the time required for the replacement or the time required for the adjustment involved in the replacement can be reduced significantly.

Figure 11 is a flowchart illustrating a flow of replacing one of the head modules 48A. In Figure 11, parts which are the same as or similar to the parts illustrated in Figure 10 are denoted with the same reference numerals and further explanations thereof are omitted.

When replacing the head module 48A as illustrated in Figure 11, a head module attachment step (step S1) of attaching a head module 48A to the inkjet head 48 and a fuse replacement step (step S2) of replacing a blown fuse F after the information on the head module 48A to be replaced is written, are executed prior to the step of recognizing the head module 48A (step S12).

After the execution of steps S12 to S24, replacing the head module 48A is ended.

[Effects of First Embodiment]

According to the inkjet recording apparatus 10 having the configuration described above, the information on each head module 48A, which is used for adjusting the drive voltage or attachment error of each head module 48A, is stored in the EEPROM 92A, and consequently the EEPROM 92A is fixed, in terms of hardware, to the state of inhibiting erasing or writing of data. This can prevent the information on each head module 48A stored in the EEPROM 92A from being lost or rewritten during the operation of the inkjet recording apparatus.

In addition, when replacing any of the head modules, the fuse F mounted on the drive circuit board 91 is replaced, and then a head module 48A is attached to the inkjet head 48. Subsequently, the information on this replaced head module 48A is stored, and then the EEPROM 92A is fixed to the data write inhibit state in terms of hardware. As a result, the inkjet head 48 can be operated based on the information on the replaced head module 48A, and the information on the replaced head module 48A stored in the EEPROM 92A can be prevented from being lost or rewritten during the operation of the inkjet recording apparatus.

[Explanation of Inkjet Head: Second Embodiment]

An inkjet recording apparatus according to a second embodiment of the present invention is described next. In the following description, parts which are the same as or

similar to the parts described previously in the first embodiment are denoted with the same reference numerals and further explanations thereof are omitted.

Figure 12 is a plan view illustrating a schematic structure of an inkjet head 348 according to the second embodiment, wherein the inkjet head 348 is viewed from the outside of a head attachment plate 348B to which a head module 348A is attached.

Figure 13 is an explanatory diagram schematically illustrating a relationship in arrangement between the head module 348A (a magnet 302) and a magnetic sensor 304, wherein the inkjet head 348 of Figure 12 is viewed from the side.

The inkjet head 348 illustrated in Figure 12 has the magnet 302 attached to the head module 348A. As illustrated in Figure 13, the position of the magnet 302 in the head module 348A corresponds to the position of the magnetic sensor 304 attached to the head attachment plate 348B.

In the inkjet recording apparatus illustrated in the present embodiment, the positions of the head module 348A and the head attachment plate 348B are adjusted based on an output signal of the magnetic sensor 304. In other words, since the greater the distance between the magnetic sensor 304 and the magnet 302, the greater the value of a detection signal output from the magnetic sensor 304, an error in adjusted position between the head module 348A and the head attachment plate 348B is obtained from the value of the detection signal.

Further, the distance in which the head module 348A moves and the detection characteristics of the sensor (the value of the detection signal) vary depending on the magnet used. For this reason, in order to accurately align the head module 348A and the head attachment plate 348B, the position of the magnetic sensor 304 needs to match the position of the magnet 302.

While the head module 348A is attached to the head attachment plate 348B, the magnetic sensor 304 is fixed, and then the relationship between the position of the magnet 302 attached to the head module 348A and the detection characteristics of the magnetic sensor 304 is stored as sensor information in a sensor information storage unit 306.

A storage element, data of which can be written and erased in a state in which the storage element is mounted on the sensor board 308, is adopted as the sensor information storage unit 306. Examples of such storage element include an EEPROM.

The sensor information storage unit 306 is configured such that, after the sensor information is stored in the sensor information storage unit 306 (EEPROM), the sensor information storage unit 306 (EEPROM) is fixed to the data write inhibit state in terms of hardware and caused to function as a read-only memory. The configurations illustrated in

Figures 6 and 7 can be applied to such configuration.

The sensor board 308 illustrated in Figure 13 has a sensor information input unit 310 for acquiring the sensor information. The sensor information input unit 310 is connected to a control system (illustrated in Figure 14) or the drive voltage supply unit 90 (the drive circuit board 91) by a predetermined data communication cable 312.

Figures 12 and 13 illustrate the aspect in which the head module 348A has the magnet (detected body) 302 and the head attachment plate 348B has the magnetic sensor 304; however, an aspect in which the head module 348A has the magnetic sensor 304 and the head attachment plate 348B has the magnet 302 can also be adopted.

Figure 14 is a block diagram illustrating a schematic configuration of the control system of an inkjet recording apparatus 300 according to the second embodiment. In Figure 14, parts which are the same as or similar to the parts illustrated in Figure 8 are denoted with the same reference numerals and further explanations thereof are omitted.

The inkjet recording apparatus 300 illustrated in Figure 14 is provided with the magnetic sensor 304, the sensor information storage unit 306, and the sensor information input unit 310, which are mounted on the sensor board 308.

The sensor information stored in the sensor information storage unit 306 is calculated, and the degree of displacement between the head module 348A (see Figure 13) and the head attachment plate 348B is calculated based on the detection signal obtained from the magnetic sensor 304. It is preferred that the degree of displacement be displayed by the display unit 171.

Because the detection characteristics of the magnetic sensor 304 vary depending on the magnet 302 as described above, the sensor information cannot be acquired until after the head module 348A is attached to the head attachment plate 348B (until after the combination of the magnet 302 and the magnetic sensor 304 is determined).

Therefore, after the head module 348A is attached to the head attachment plate 348B, the sensor information corresponding to the head module 348A (the magnet 302) is acquired and stored.

Note that the information of the magnet 302 may be acquired from an information storage body (an IC tag, etc.) attached to the head module 348A, by means of wireless data communication or may be acquired from a storage medium in which the information of the magnet 302 is stored is stored (a memory card, etc.), through a predetermined communication interface (a card slot).

In addition, the information of the magnet 302 attached to a relevant head module

348A may be read from a database in which the information items of a plurality of magnets 302 are stored beforehand.

[Explanation about Controlling Storing of Sensor Information]

Figure 15 is a flowchart illustrating a flow of storing the sensor information in the sensor information storage unit 306 (EEPROM).

Once storing of the sensor information is started (step S100), the head module 348A (the magnet 302) is recognized (step S102). To recognize the head module 348A, the operator may input the identification number of the target head module 48A or automatically recognize the head module 348A by a barcode or the like attached thereto.

Once the head module 48A is recognized, the sensor information corresponding to the magnet 302 attached to this head module 348A is acquired (step S104), and the sensor information is then stored in the sensor information storage unit 306 (EEPROM) (step S106).

When the sensor information items of all head modules 348A configuring the inkjet head 348 are stored, the sensor information storage unit 306 (EEPROM) is fixed to the data write inhibit state (step S108, a write inhibit process), and storing of the sensor information is ended (step S110).

Once the corresponding sensor information of each head module 348A is stored in the sensor information storage unit 306, alignment can be performed for each of the head modules 348A based on the detection signal obtained from the magnetic sensor 304 corresponding to each head module 348A. Note that, when replacing any of the head modules 348A, steps S1 and S2 illustrated in Figure 11 are executed prior to step S102 illustrated in Figure 15.

[Effects of Second Embodiment]

According to the inkjet recording apparatus 300 having the configuration described above, the detection characteristics of the magnetic sensor 304 are stored as the sensor information for each head module, and the sensor information is stored in the sensor information storage unit 306. Thereafter, the sensor information storage unit 306 is fixed to the data write inhibit state in terms of hardware. This can prevent the sensor information from being lost or rewritten during the operation of the inkjet recording apparatus.

Note that, when any of the head modules 348A is replaced, the fuse F illustrated in Figures 6 and 7 is replaced, and the sensor information is acquired and stored again. Subsequently, the sensor information storage unit 306 is fixed to the data write inhibit state in terms of hardware.

The inkjet recording apparatus according to the second embodiment described above

can appropriately be combined with the configuration of the inkjet recording apparatus according to the first embodiment.

The present specification illustrates, as an example of an image recording apparatus, the inkjet recording apparatuses that form color images on recording media; however, the scope of application of the present invention is not limited to the inkjet recording apparatuses.

The present invention can be applied widely to, for example, a liquid ejection apparatus with an inkjet head, such as a pattern forming apparatus for forming a predetermined pattern (a mask pattern, a wiring pattern) by using a functional liquid containing resin particles or metal particles, and an electrophotographic image recording apparatus that has a recording head provided with a plurality of LED elements as recording elements.

The components of the inkjet recording apparatuses according to the first and second embodiments described above can appropriately be changed, deleted, or have additional components, without departing from the gist of the present invention.

[Invention Disclosed in Present Specification]

As has become evident from the detailed description of the embodiments of the invention provided above, the present specification includes at least disclosure of various technical ideas as follows.

(First aspect): A recording head assembly includes: a plurality of head modules; a head module information acquiring device configured to acquire head module information on each of the plurality of head modules; and a head module information storage device configured to store the acquired head module information on each of the head modules, wherein the head module information storage device includes: a storage element, in which the head module information is stored and information can be written in a state in which the storage element is mounted on an electrical wiring board, and which includes an input terminal to which is applied a voltage for switching between a write enable state of enabling writing of information and a write inhibit state of inhibiting writing of information; a first voltage generator configured to generate a first voltage for bringing the storage element into the write enable state; a fuse provided between the first voltage generator and the input terminal; a second voltage generator configured to generate a second voltage for bringing the storage element into the write inhibit state; a resistor provided between the second voltage generator and the input terminal; a switch element configured to select whether to apply, to the fuse, a current for blowing the fuse; and a switching signal input unit to which a switching signal for switching the switch element is input.

According to this aspect, once the head module information is stored in the storage element of the head module information storage device, the fuse is blown and the storage device can be fixed to the write inhibit state in terms of hardware. This can prevent the head module information stored in the storage element from being lost or rewritten.

(Second Aspect): The recording head assembly in which the head module information includes recording characteristic information on the head module.

According to this aspect, it is preferred that a control parameter of a recording head be changed based on the recording characteristic information on the head module.

(Third Aspect): The recording head assembly in which the head module information includes information on a position detection element used for aligning an attachment member to which the head module is attached, and the head module.

According to this aspect, the head module and the attachment member can be aligned using the position detection information.

(Fourth Aspect): The recording head assembly in which the position detection element includes a magnetic sensor attached to either one of the head module and the attachment member, and a magnet attached to the other of the head module and the attachment member, and the information on the position detection element is output characteristics of the magnetic sensor corresponding to the magnet.

According to this aspect, positional alignment of the head module and the attachment member, which is performed using the magnetic sensor and the magnet, can be performed accurately by using the detection characteristics of the magnetic sensor, the position of which matches the position of the magnet.

(Fifth Aspect): The recording head assembly in which the storage element includes a semiconductor element in which data can be erased and written electrically, in a state in which the semiconductor element is mounted on the electrical wiring board.

According to this aspect, examples of the semiconductor element include an EEPROM.

(Sixth Aspect): An image recording apparatus including the recording head assembly described in any of the first to fifth aspects, wherein the switching signal input unit receives an input of a switching signal for switching the switch element so as to apply, to the fuse, a current for blowing the fuse in order to fix the storage element to the write inhibit state after the head module information is stored in the storage element.

(Seventh Aspect): The image recording apparatus further including a signal generator configured to generate a switching signal for switching the switch element, and a switch

control unit configured to supply the generated switching signal to the signal input unit so as to blow the fuse and fix the storage element to the write inhibit state.

According to this aspect, switching the switch element by means of the switching signal can blow the fuse and fix the storage element to the write inhibit state.

(Eighth Aspect): The image recording apparatus including a drive voltage supply device configured to supply a drive voltage to the recording head, wherein the drive voltage supply device adjusts the drive voltage for each of the head modules based on the recording characteristic information of the head module.

According to this aspect, the recording head can be controlled in accordance with the recording characteristics of each head module.

(Ninth Aspect): The image recording apparatus, wherein the switch element is a transistor that is connected to the fuse in series, and the switch control unit supplies the generated switching signal to the signal input unit so as to fix the transistor to an OFF state, after blowing the fuse by turning the transistor on and applying, to the fuse, a current for blowing the fuse.

According to this aspect, after the storage element enters the write inhibit state, the write inhibit state can securely be maintained.

(Tenth Aspect): A recording head adjustment method for a recording head assembly which includes: a plurality of head modules; a head module information acquiring device configured to acquire head module information on each of the plurality of head modules; and a head module information storage device configured to store the acquired head module information on each of the head modules, the head module information storage device including: a storage element, in which the head module information is stored and information can be written in a state in which the storage element is mounted on an electrical wiring board, and which includes an input terminal to which is applied a voltage for switching between a write enable state of enabling writing of information and a write inhibit state of inhibiting writing of information; a first voltage generator configured to generate a first voltage for bringing the storage element into the write enable state; a fuse provided between the first voltage generator and the input terminal; a second voltage generator configured to generate a second voltage for bringing the storage element into the write inhibit state; a resistor provided between the second voltage generator and the input terminal; a switch element configured to select whether to apply, to the fuse, a current for blowing the fuse; a signal input unit configured to receive an input of a signal for operating the switch element so as to apply, to the fuse, the current for blowing the fuse in order to fix the storage element to the write inhibit

state after the head module information is stored in the storage element; and a switching signal input unit to which is input a switching signal for switching the switch element, the method comprising: a storing step of storing the head module information in the storage element; and a fixing step of fixing the storage element to the write inhibit state after the switching signal for switching the switch element is input so that the current for blowing the fuse is applied to the fuse, the fixing step being executed after the storing step of storing the head module information.

(Eleventh aspect): The recording head adjustment method according to the above described aspect, further includes: a fuse replacement step of replacing the fuse of the head module information storage device when replacing any of the head modules; a re-storing step of storing information on the replaced head module in the storage element after the execution of the fuse replacement step; and a re-fixing step of blowing the replaced fuse and fixing the storage element to the write inhibit state after the execution of the re-storing step.

According to this aspect, as a head module is replaced. The information on the replaced head module is stored, preventing the information on the replaced head module from being lost or replaced.

(Twelfth aspect): The recording head adjustment method according to the above described aspect, further includes a test step of executing an operation test on the recording head after the execution of the storing step and the re-storing step, wherein in the fixing step and the re-fixing step, the fuse is blown to fix the storage element to the write inhibit state after the recording head passes the operation test in the test step.

According to this aspect, the storage element is fixed to the write inhibit state after the recording head passes the operation test. Therefore, this aspect can prevent the information on the recording head that passes the operation test from being lost or replaced.

It should be understood, however, that there is no intention to limit the invention to the specific forms disclosed, but on the contrary, the invention is to cover all modifications, alternate constructions and equivalents falling within the spirit and scope of the invention as expressed in the appended claims.

Reference Signs List

10, 300 Inkjet recording apparatus

48, 348 Inkjet head

48A, 348A Head module

92, 92' Head module information storage unit

94 Data input unit

302 Magnet

304 Magnetic sensor

306 Sensor information storage unit

CLAIMS

1. A recording head assembly, comprising:

a plurality of head modules;

a head module information acquiring device configured to acquire head module information on each of the plurality of head modules; and

a head module information storage device configured to store the acquired head module information on each of the head modules,

wherein the head module information storage device includes:

a storage element, in which the head module information is stored and information can be written in a state in which the storage element is mounted on an electrical wiring board, and which includes an input terminal to which is applied a voltage for switching between a write enable state of enabling writing of information and a write inhibit state of inhibiting writing of information;

a first voltage generator configured to generate a first voltage for bringing the storage element into the write enable state;

a fuse provided between the first voltage generator and the input terminal;

a second voltage generator configured to generate a second voltage for bringing the storage element into the write inhibit state;

a resistor provided between the second voltage generator and the input terminal;

a switch element configured to select whether to apply, to the fuse, a current for blowing the fuse; and

a switching signal input unit to which a switching signal for switching the switch element is input.

2. The recording head assembly according to claim 1,

wherein the head module information includes recording characteristic information on the head module.

3. The recording head assembly according to claim 1 or 2,

wherein the head module information includes information on a position detection element used for aligning an attachment member to which the head module is attached, and the head module.

4. The recording head assembly according to claim 3,

wherein the position detection element includes a magnetic sensor attached to either one of the head module and the attachment member, and a magnet attached to the other of the head module and the attachment member, and

the information on the position detection element is output characteristics of the magnetic sensor corresponding to the magnet.

5. The recording head assembly according to any one of claims 1 to 4,

wherein the storage element includes a semiconductor element in which data can be erased and written electrically, in a state in which the semiconductor element is mounted on the electrical wiring board.

6. An image recording apparatus comprising

the recording head assembly according to any one of claims 1 to 5,

wherein the switching signal input unit receives an input of a switching signal for switching the switch element so as to apply, to the fuse, a current for blowing the fuse in order to fix the storage element to the write inhibit state after the head module information is stored in the storage element.

7. The image recording apparatus according to claim 6, further comprising:

a signal generator configured to generate a switching signal for switching the switch element; and

a switch control unit configured to supply the generated switching signal to the signal input unit so as to blow the fuse and fix the storage element to the write inhibit state.

8. The image recording apparatus according to claim 6 or 7, further comprising:

a drive voltage supply device configured to supply a drive voltage to the recording head,

wherein the drive voltage supply device adjusts the drive voltage for each of the head modules based on the recording characteristic information of the head module.

9. The image recording apparatus according to any one of claims 6 to 8,

wherein the switch element is a transistor which is connected to the fuse in series, and

the switch control unit supplies the generated switching signal to the signal input unit so as to fix the transistor to an OFF state, after blowing the fuse by turning the transistor on and applying, to the fuse, a current for blowing the fuse.

10. A recording head adjustment method for a recording head assembly which includes:

a plurality of head modules;

a head module information acquiring device configured to acquire head module information on each of the plurality of head modules; and

a head module information storage device configured to store the acquired head module information on each of the head modules,

the head module information storage device including:

a storage element, in which the head module information is stored and information can be written in a state in which the storage element is mounted on an electrical wiring board, and which includes an input terminal to which is applied a voltage for switching between a write enable state of enabling writing of information and a write inhibit state of inhibiting writing of information;

a first voltage generator configured to generate a first voltage for bringing the storage element into the write enable state;

a fuse provided between the first voltage generator and the input terminal;

a second voltage generator configured to generate a second voltage for bringing the storage element into the write inhibit state;

a resistor provided between the second voltage generator and the input terminal;

a switch element configured to select whether to apply, to the fuse, a current for blowing the fuse;

a signal input unit configured to receive an input of a signal for operating the switch element so as to apply, to the fuse, the current for blowing the fuse in order to fix the storage element to the write inhibit state after the head module information is stored in the storage element; and

a switching signal input unit to which is input a switching signal for switching the switch element ,

the method comprising:

a storing step of storing the head module information in the storage element; and

a fixing step of fixing the storage element to the write inhibit state after the switching signal for switching the switch element is input so that the current for blowing the fuse is

applied to the fuse, the fixing step being executed after the storing step of storing the head module information.

11. The recording head adjustment method according to claim 10, further comprising:

a fuse replacement step of replacing the fuse of the head module information storage device when replacing any of the head modules;

a re-storing step of storing information on the replaced head module in the storage element after the execution of the fuse replacement step; and

a re-fixing step of blowing the replaced fuse and fixing the storage element to the write inhibit state after the execution of the re-storing step.

12. The recording head adjustment method according to claim 11, further comprising

a test step of executing an operation test on the recording head after the execution of the storing step and the re-storing step,

wherein in the fixing step and the re-fixing step, the fuse is blown to fix the storage element to the write inhibit state after the recording head passes the operation test in the test step.

FIG.1

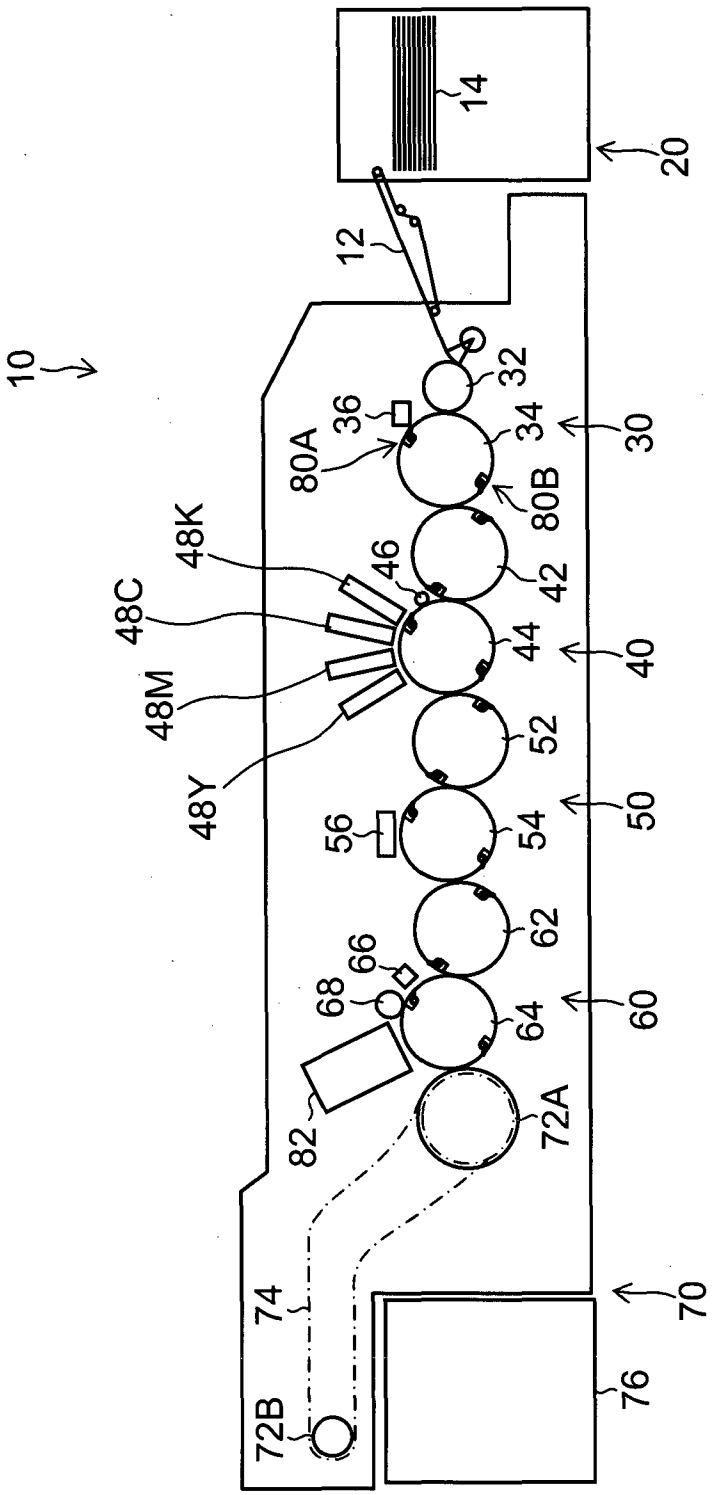

10
12
14
20
30
32
34
36
40
42
44
46
48C
48K
48M
48Y
50
52
54
56
60
62
64
66
68
70
72A
72B
74
76
80A
80B
82

FIG.2

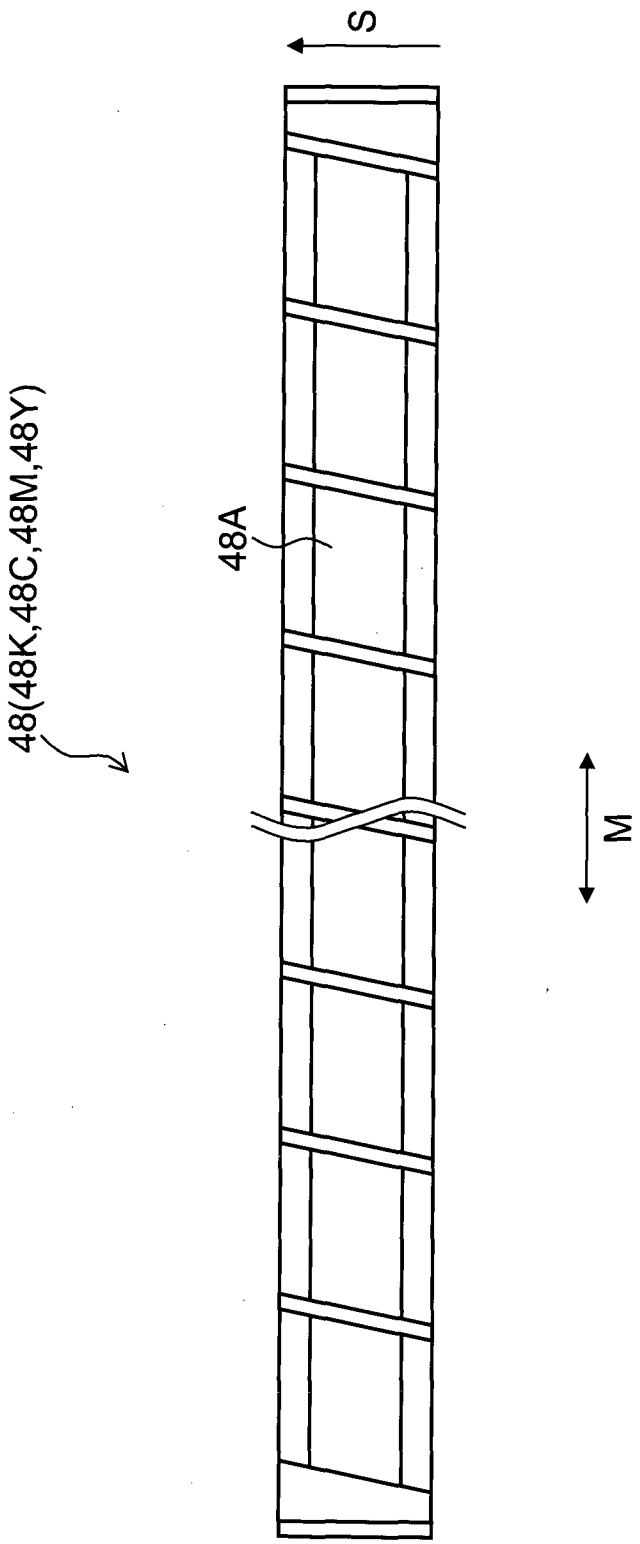


FIG.3

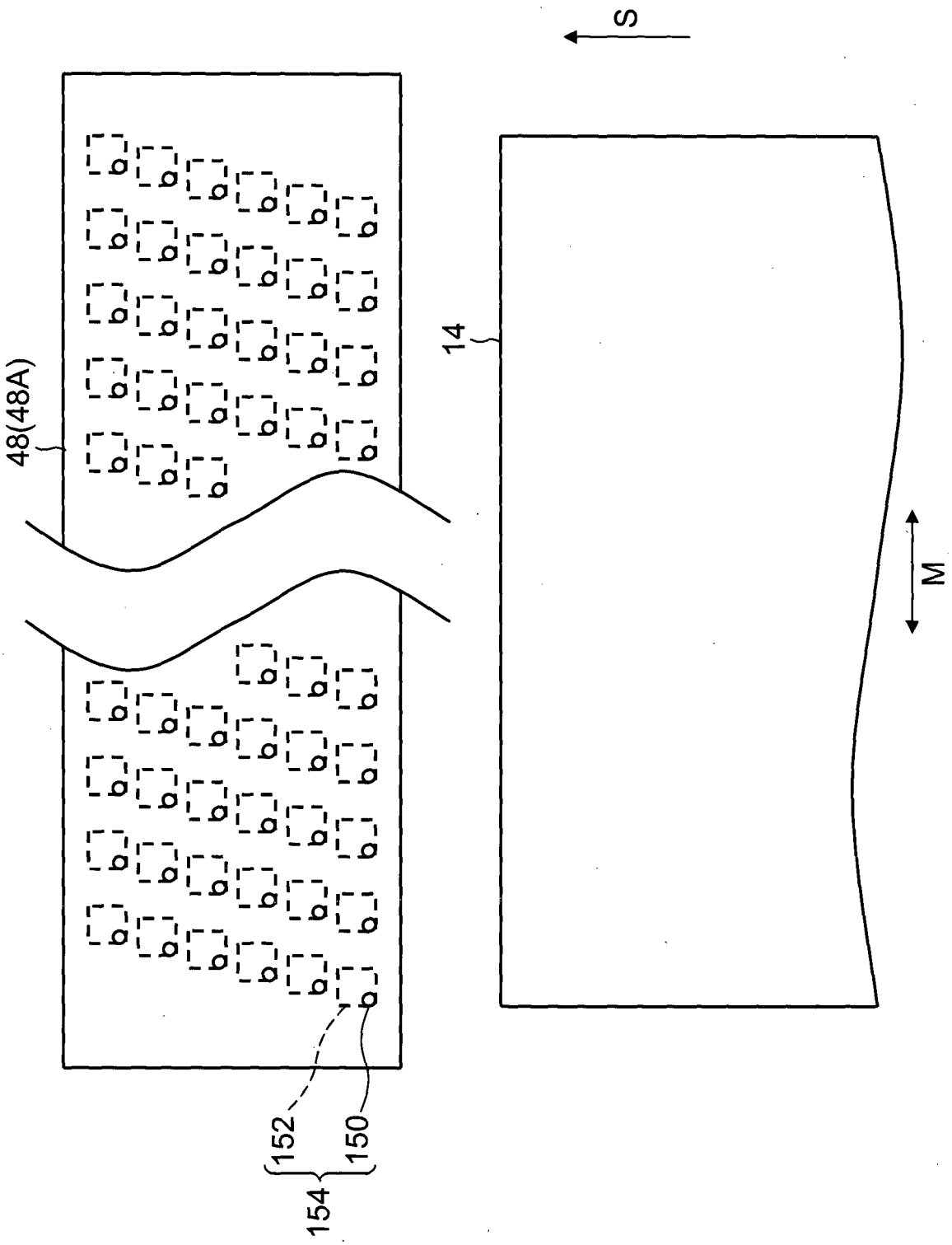


FIG.4

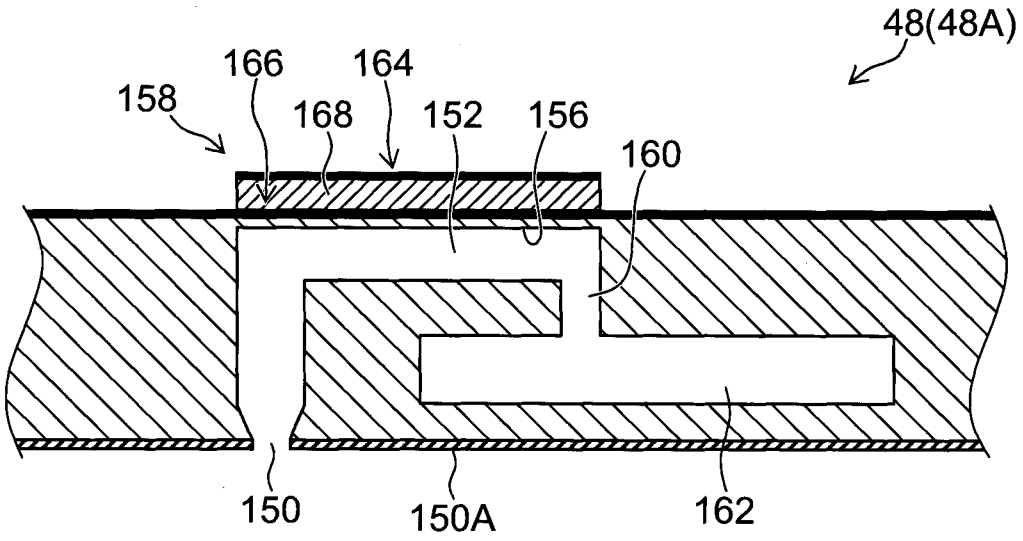


FIG.5

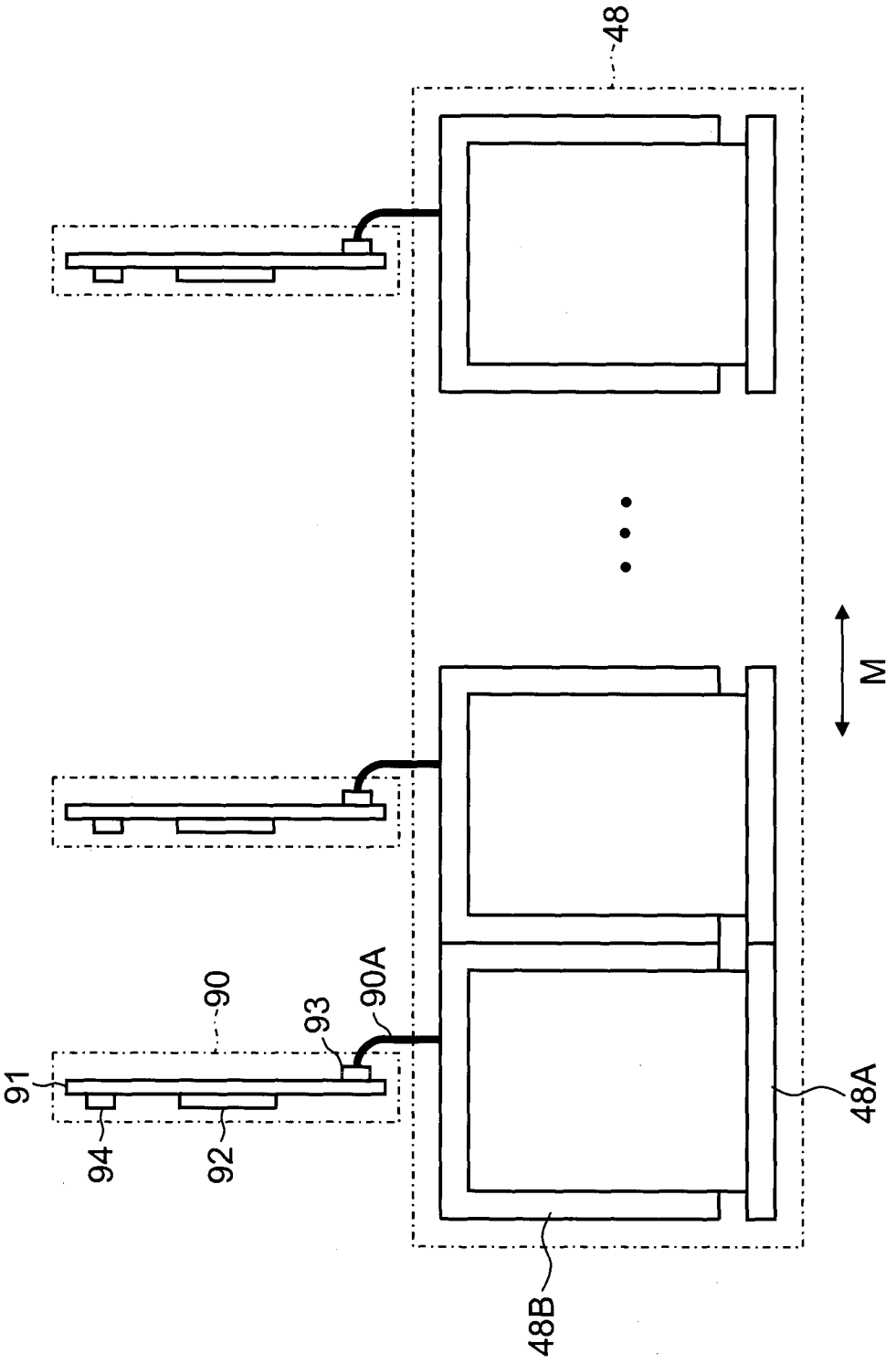


FIG.6

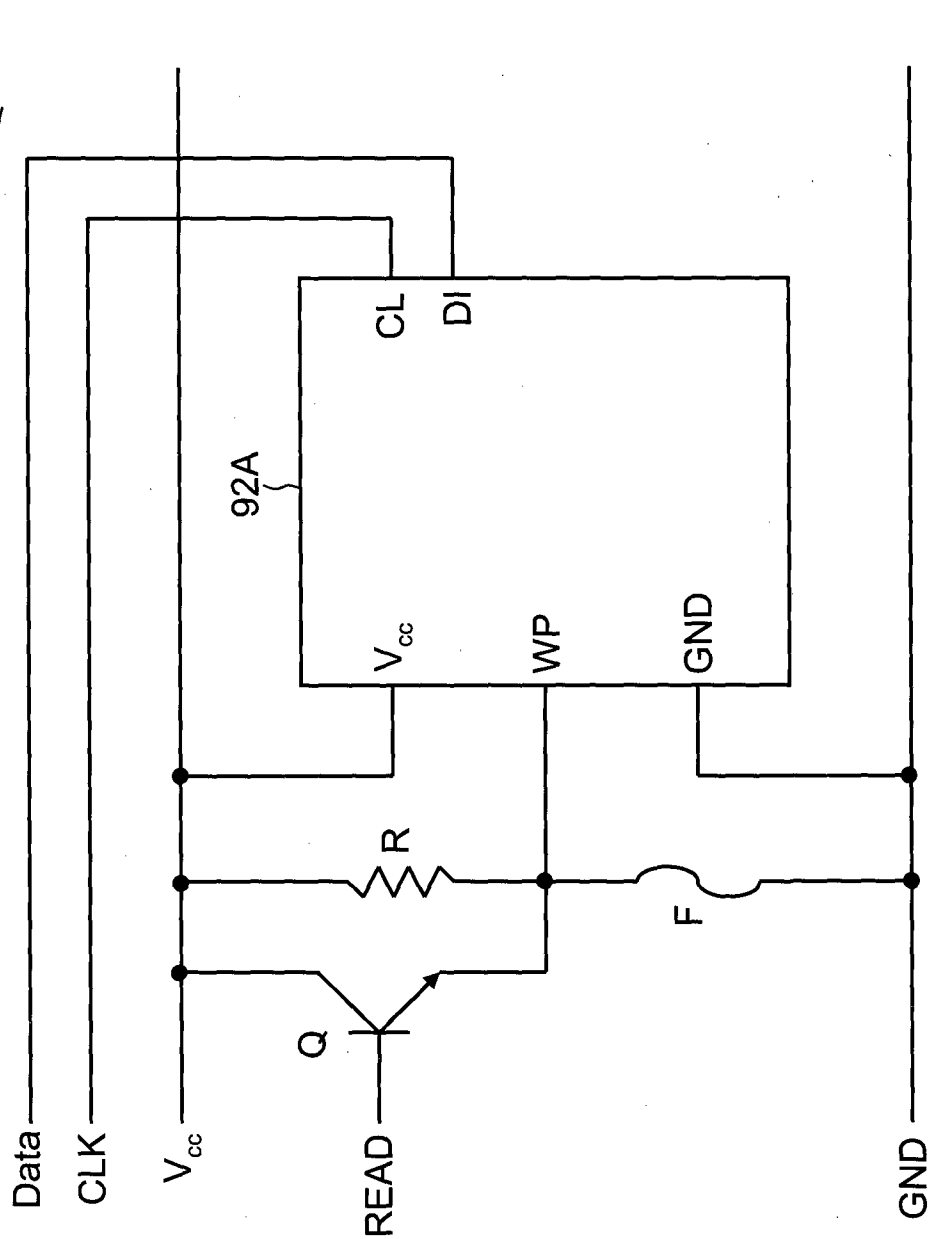


FIG.7

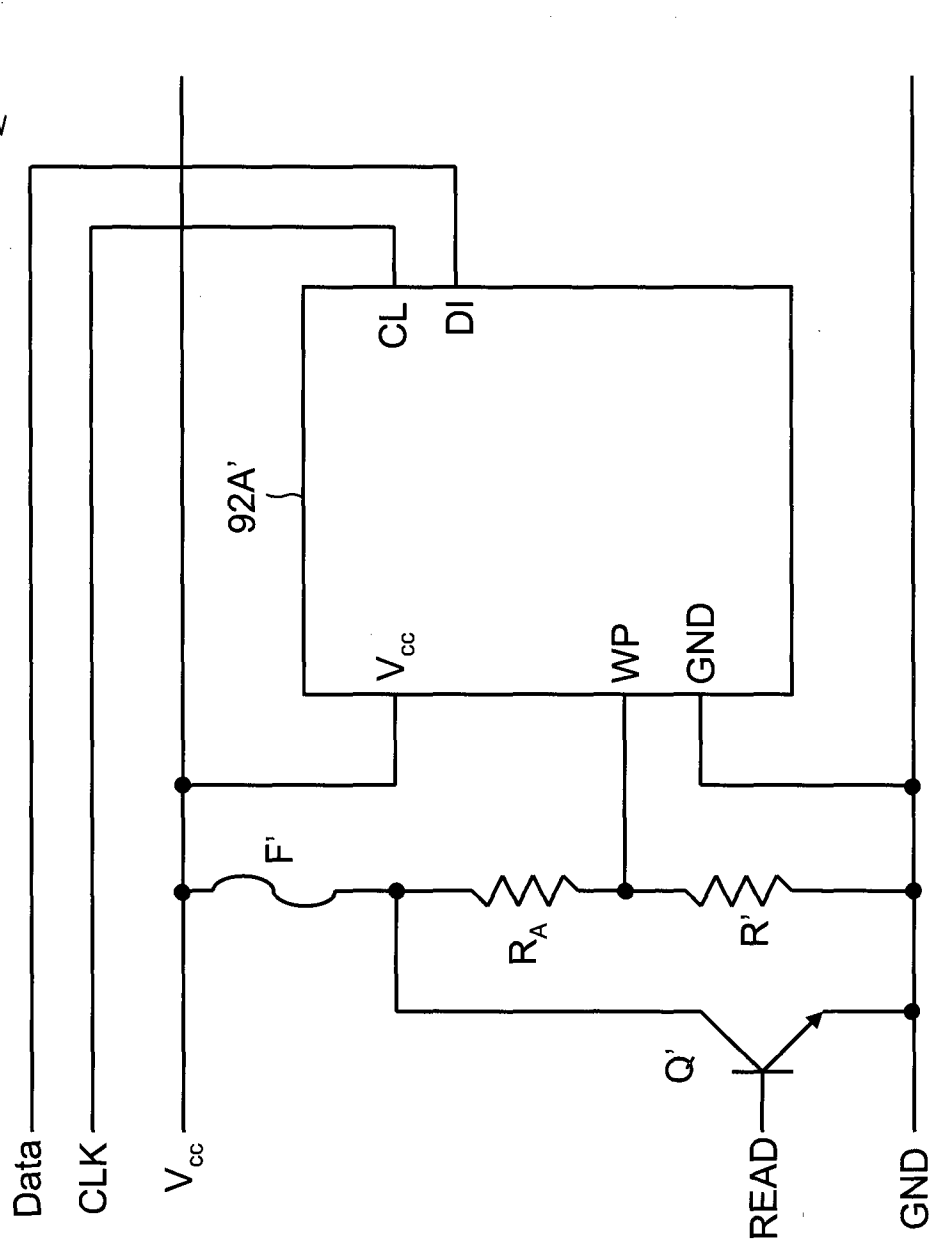


FIG.8

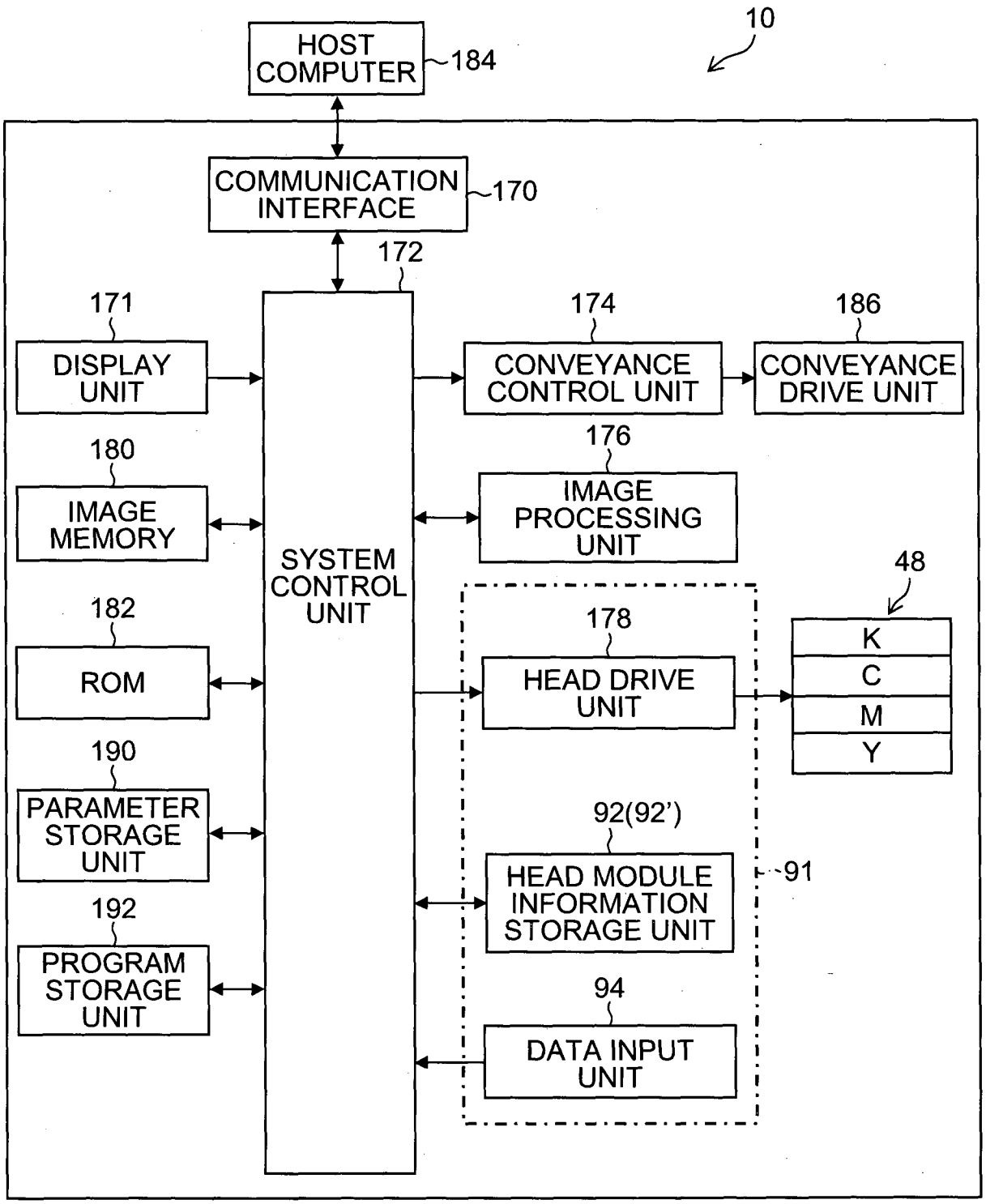

10
HOST COMPUTER
184
COMMUNICATION INTERFACE
170
172
171
DISPLAY UNIT
174
CONVEYANCE CONTROL UNIT
186
CONVEYANCE DRIVE UNIT
180
IMAGE MEMORY
176
IMAGE PROCESSING UNIT
SYSTEM CONTROL UNIT
48
182
ROM
178
HEAD DRIVE UNIT
K
C
M
Y
190
PARAMETER STORAGE UNIT
92(92')
HEAD MODULE INFORMATION STORAGE UNIT
91
192
PROGRAM STORAGE UNIT
94
DATA INPUT UNIT

FIG.9

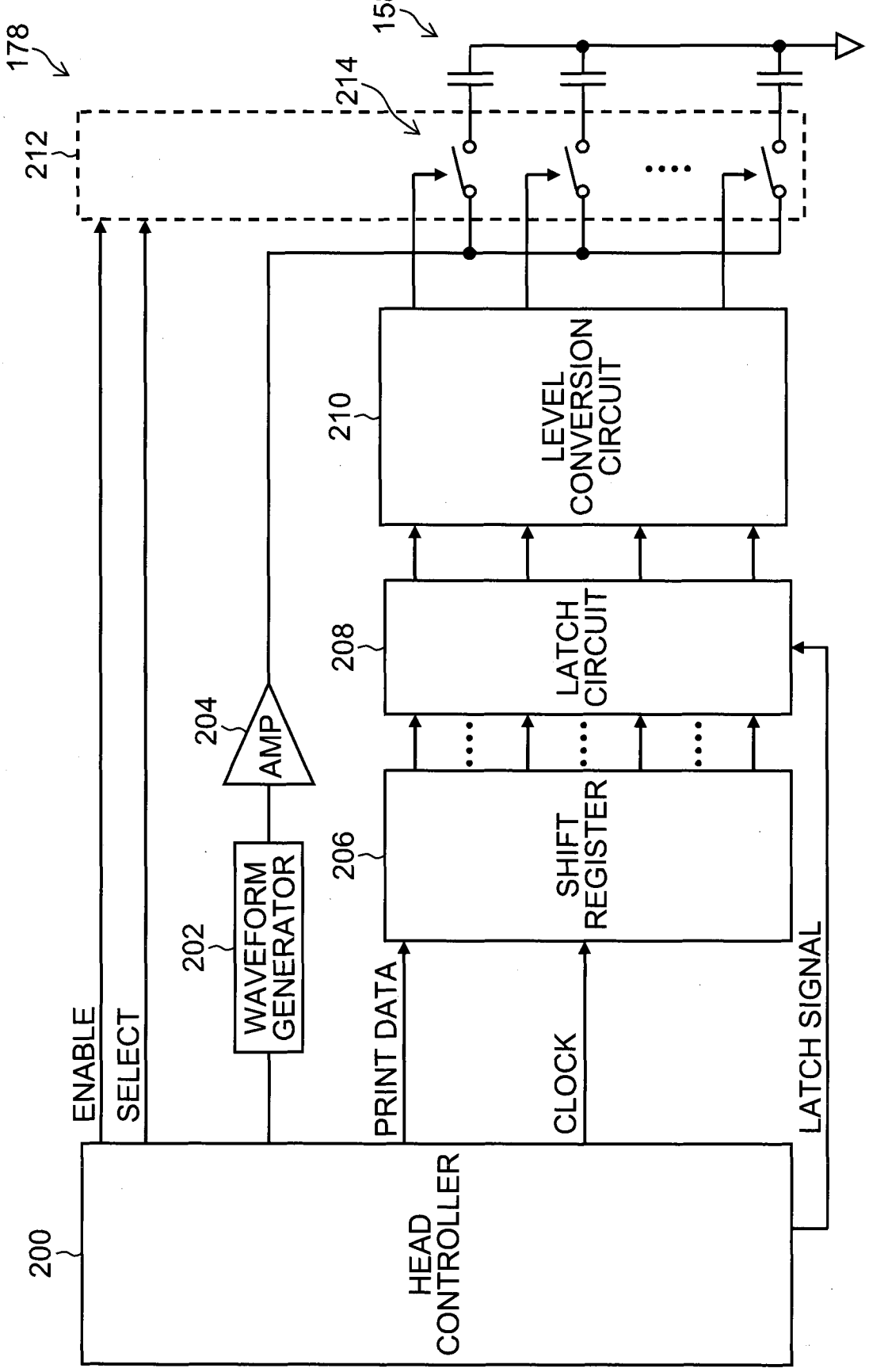

178
158
214
212
LEVEL CONVERSION CIRCUIT
210
LATCH CIRCUIT
208
SHIFT REGISTER
206
AMP
204
WAVEFORM GENERATOR
202
ENABLE
SELECT
PRINT DATA
CLOCK
LATCH SIGNAL
HEAD CONTROLLER
200

FIG.10

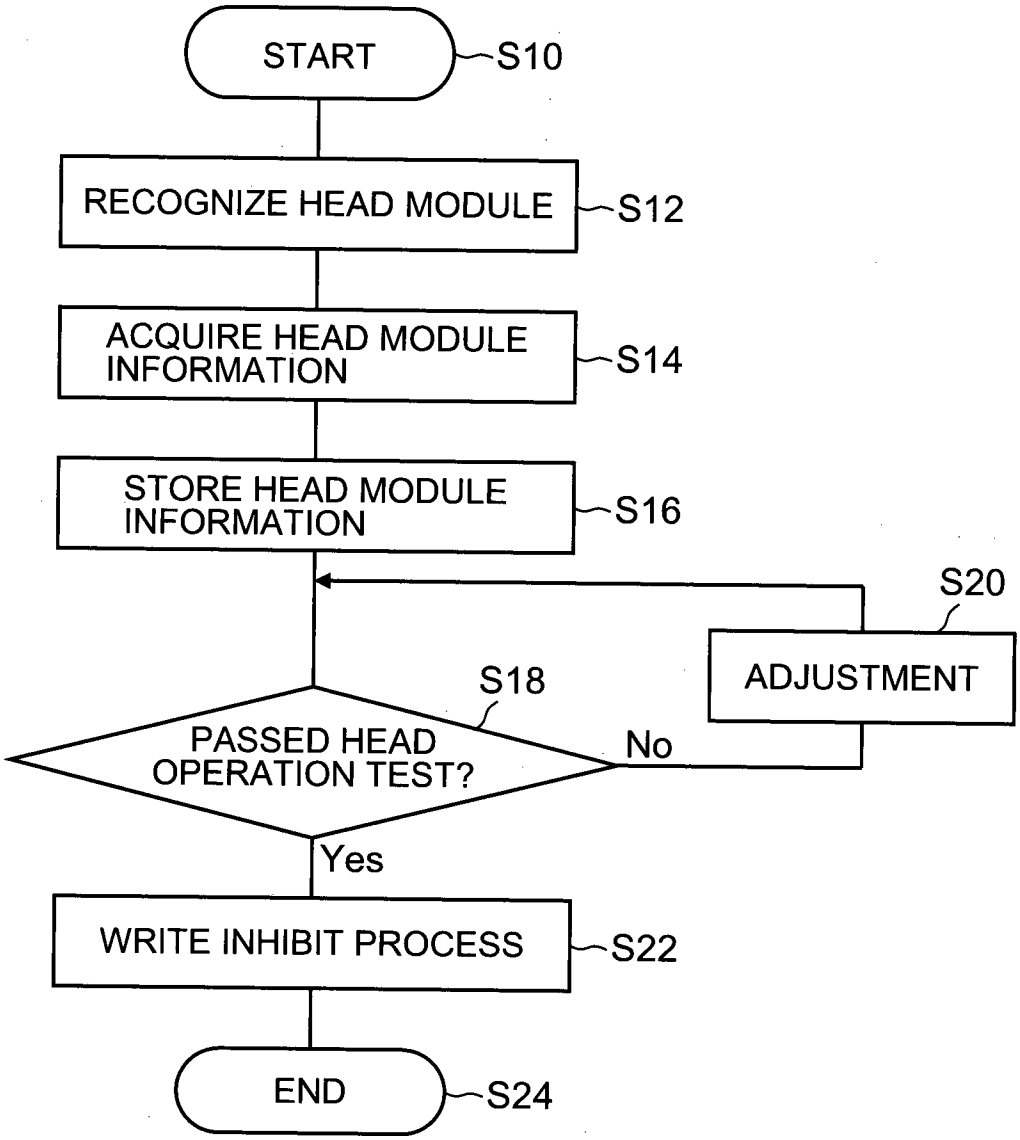

START
S10
RECOGNIZE HEAD MODULE
S12
ACQUIRE HEAD MODULE INFORMATION
S14
STORE HEAD MODULE INFORMATION
S16
S20
ADJUSTMENT
S18
PASSED HEAD OPERATION TEST?
No
Yes
WRITE INHIBIT PROCESS
S22
END
S24

FIG.11

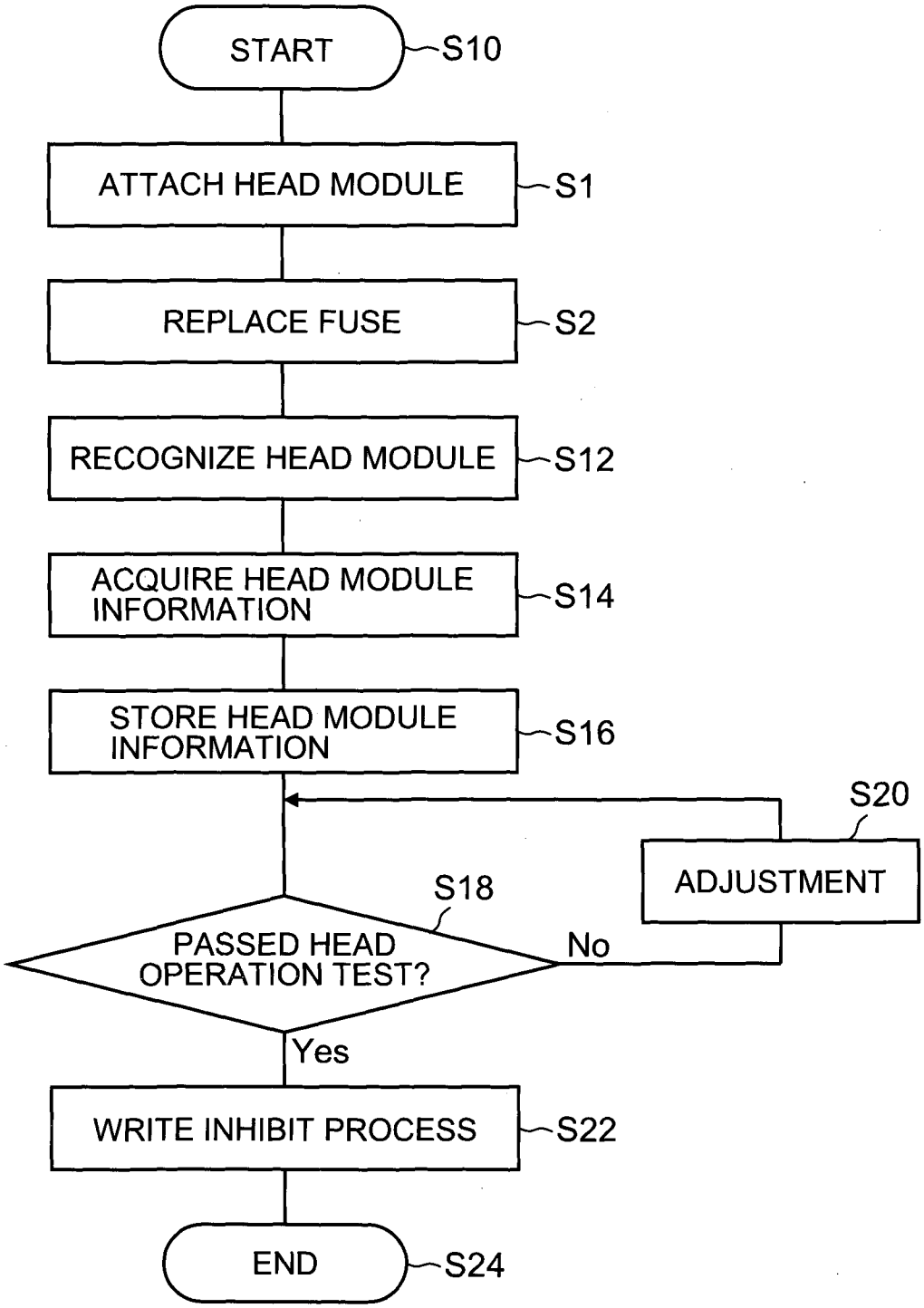

START
S10
ATTACH HEAD MODULE
S1
REPLACE FUSE
S2
RECOGNIZE HEAD MODULE
S12
ACQUIRE HEAD MODULE INFORMATION
S14
STORE HEAD MODULE INFORMATION
S16
S20
ADJUSTMENT
S18
PASSED HEAD OPERATION TEST?
No
Yes
WRITE INHIBIT PROCESS
S22
END
S24

FIG.12

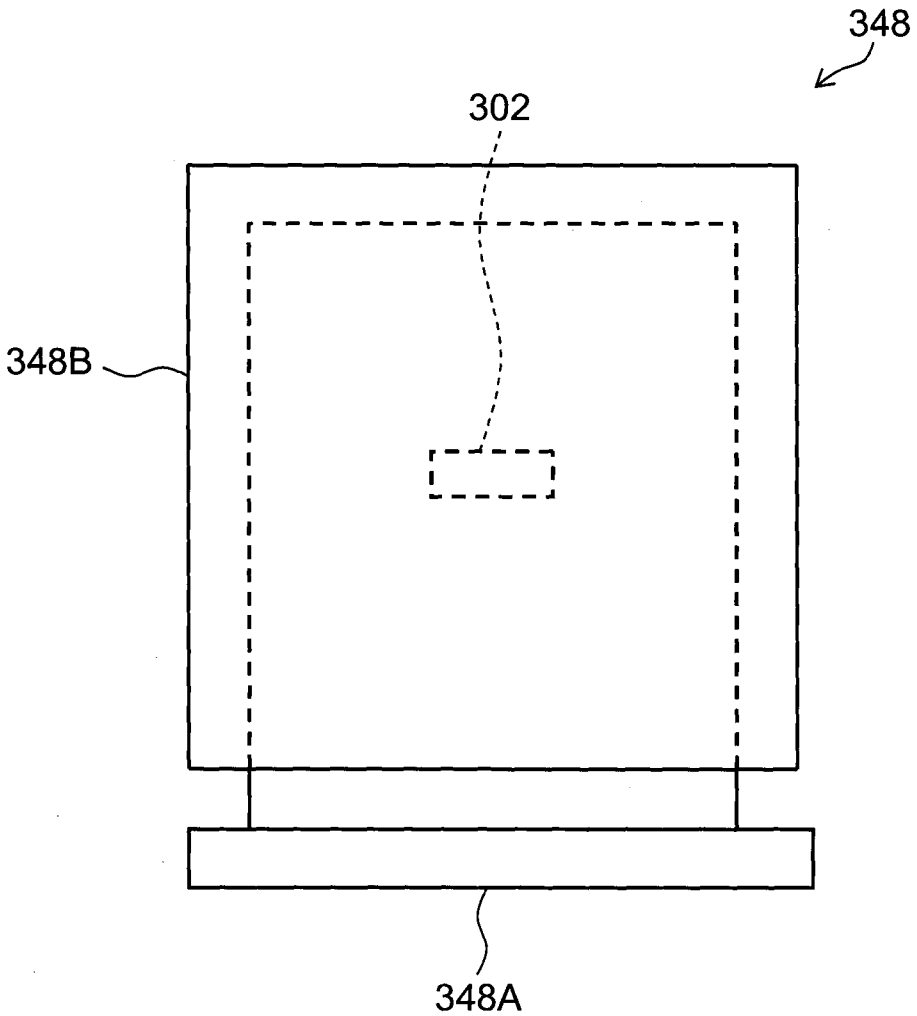


FIG.13

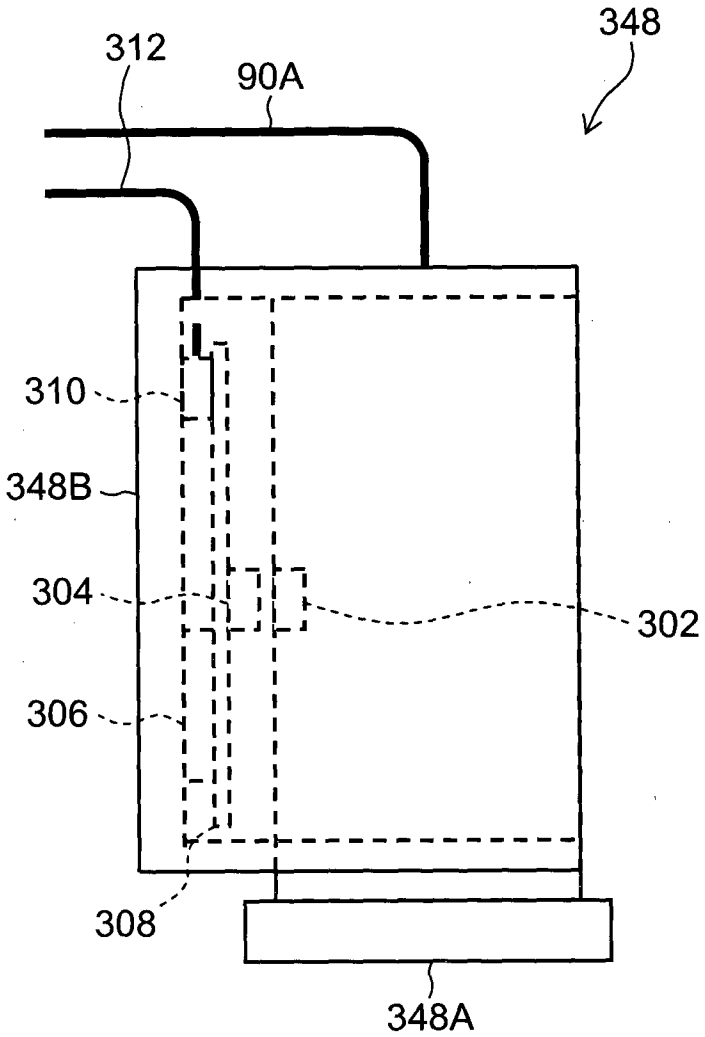


FIG.14

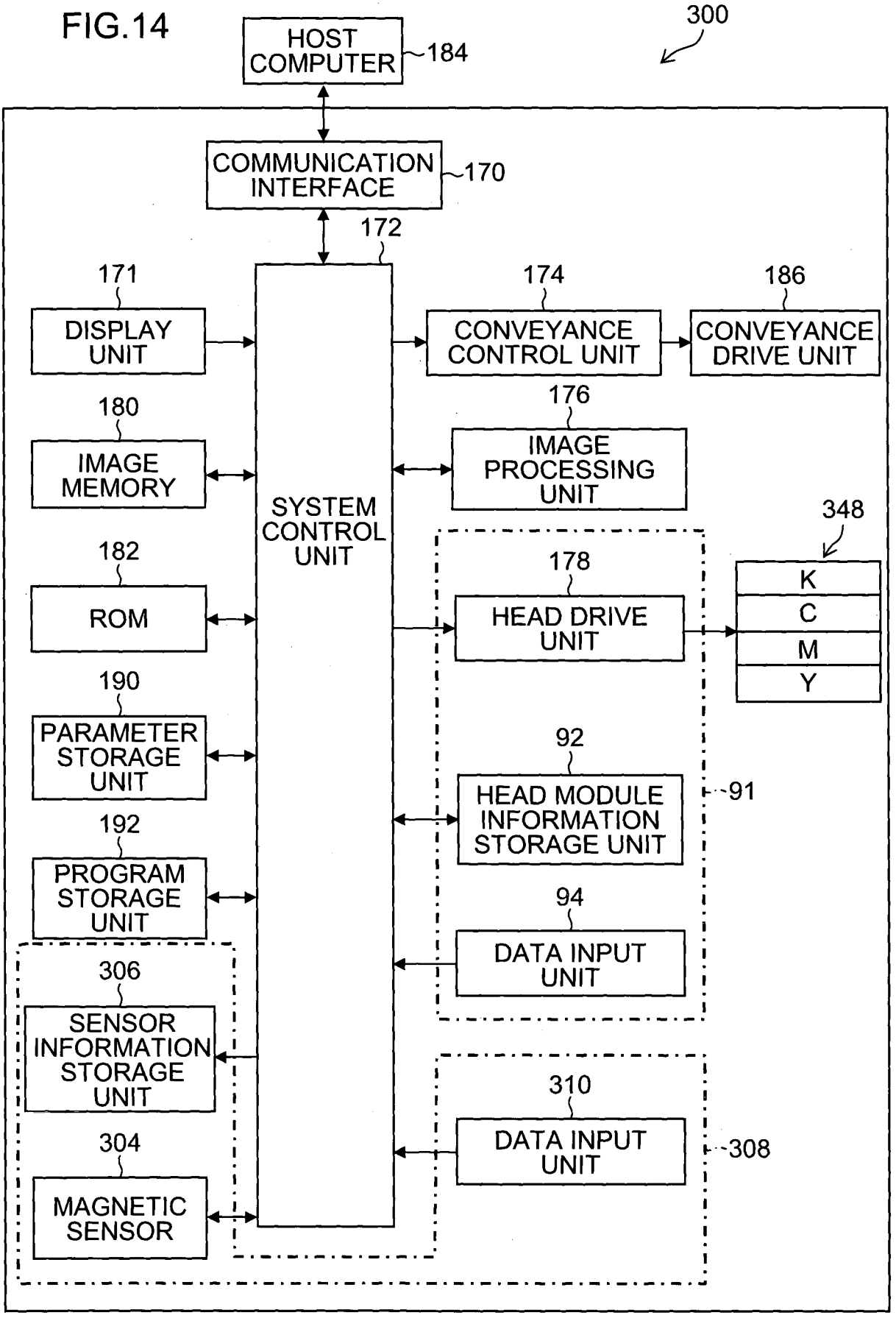
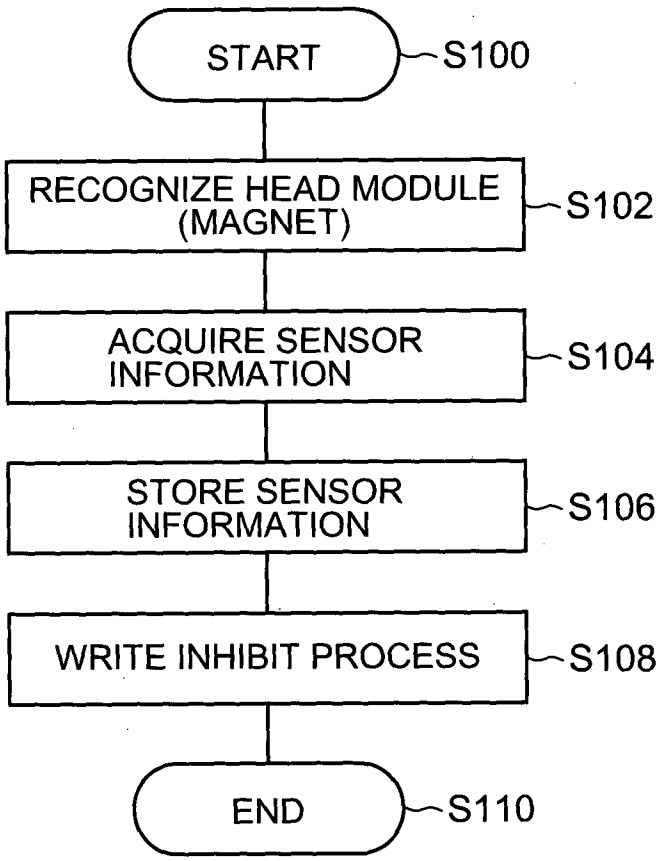

300
HOST COMPUTER
184
COMMUNICATION INTERFACE
170
172
171
DISPLAY UNIT
174
CONVEYANCE CONTROL UNIT
186
CONVEYANCE DRIVE UNIT
180
IMAGE MEMORY
176
IMAGE PROCESSING UNIT
SYSTEM CONTROL UNIT
348
K
C
M
Y
182
ROM
178
HEAD DRIVE UNIT
190
PARAMETER STORAGE UNIT
92
HEAD MODULE INFORMATION STORAGE UNIT
91
192
PROGRAM STORAGE UNIT
94
DATA INPUT UNIT
306
SENSOR INFORMATION STORAGE UNIT
310
DATA INPUT UNIT
308
304
MAGNETIC SENSOR

FIG.15


START
S100
RECOGNIZE HEAD MODULE (MAGNET)
S102
ACQUIRE SENSOR INFORMATION
S104
STORE SENSOR INFORMATION
S106
WRITE INHIBIT PROCESS
S108
END
S110

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/060259

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. B41J2/045(2006.01)i, B41J2/01(2006.01)i, B41J2/055(2006.01)i, B41J29/38(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl. B41J2/045, B41J2/01, B41J2/055, B41J29/38

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2013
Registered utility model specifications of Japan 1996-2013
Published registered utility model applications of Japan 1994-2013

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	US 6271928 B1 (Hewlett-Packard Company) 2001.08.07, claim 1, col. 5 lin. 38-50, col. 9 lin. 23-27, fig. 3, 4, 6 & JP 11-314377 A & EP 940254 A2 & EP 1745933 A2 & KR 10-2000-0034813 A & CN 1233560 A	1, 2, 5-12 3, 4
Y A	JP 2008-140018 A (DENSO Co., Ltd.) 2008.06.19, abstract, fig. 2 (no family)	1, 2, 5-12 3, 4
Y A	EP 1866815 A1 (Canon Finetech Inc.) 2008.02.13, paragraph 227-230, fig. 42-50 & JP 2007-160916 A & US 2009/0091779 A1 & WO 2006/129732 A1 & KR 10-2008-0011683 A & CN 101189129 A	1, 2, 5-12 3, 4

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
28.06.2013	09.07.2013

Name and mailing address of the ISA/JP	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	NAKAMURA, Shinsuke 2P 3705 Telephone No. +81-3-3581-1101 Ext. 3261

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/060259

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2010-115783 A (SEIKO EPSON CORPORATION) 2010.05.27, abstract, fig. 3 (no family)	1, 2, 5-12 3, 4
Y	JP 2003-231245 A (Canon Finetech Inc.) 2003.08.19, claim 1, 2 (no family)	2, 8
A	JP 2011-126082 A (SEIKO EPSON CORPORATION) 2011.06.30, the whole documents and figures (no family)	3, 4
A	JP 2009-241536 A (FUJIFILM Corporation) 2009.10.22, claim 1 (no family)	1-12
A	US 7029081 B1 (Canon Kabushiki Kaisha) 2006.08.18, Col. 1 lin. 28-lin. 52 & JP 2000-198202 A & EP 997280 A2	1-12