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(54) **INKJET PRINTER**

(71) Applicant: **Roland DG Corporation**, Hamamatsu-shi (JP)

(72) Inventor: **Hideyuki HASEGAWA**, Hamamatsu-shi (JP)

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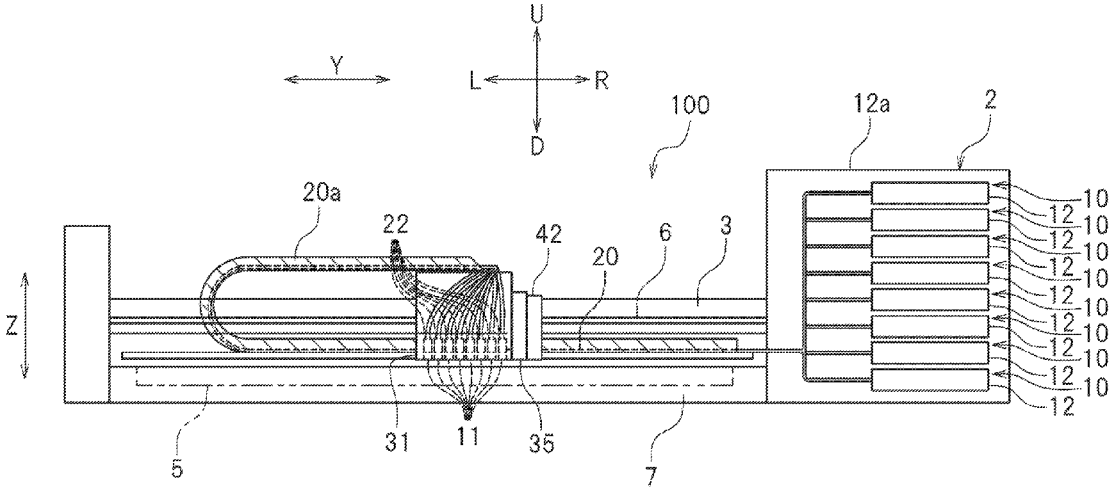
(57) **ABSTRACT**

An inkjet printer includes an ink tank in which an ink is stored, an ink head that ejects the ink onto a recording medium, an ink supply passage connected to the ink tank and the ink head, a light emitter that irradiates the ink ejected onto the recording medium with ultraviolet radiation, and a heat relay connected to the light emitter to transfer heat emitted by the light emitter to at least one of the ink supply passage and the ink head.



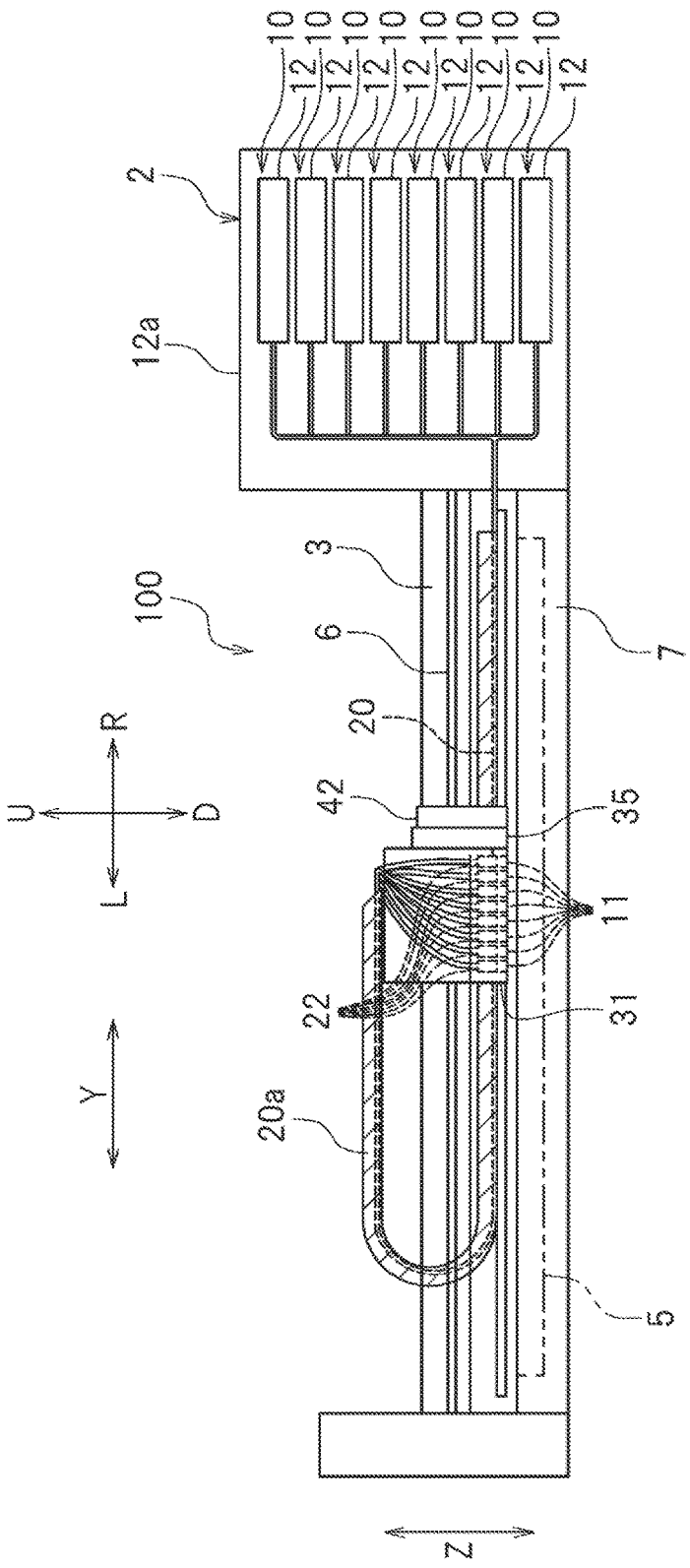


FIG. 1

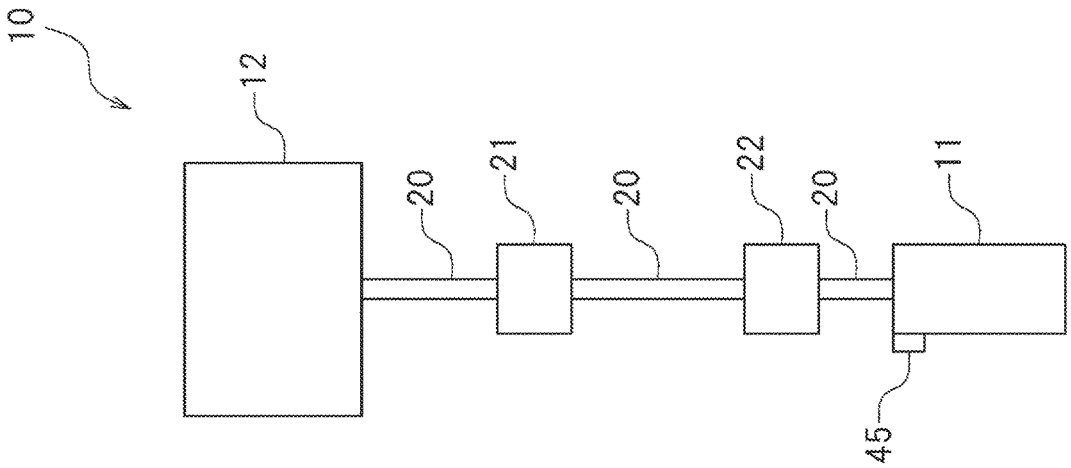


FIG. 2

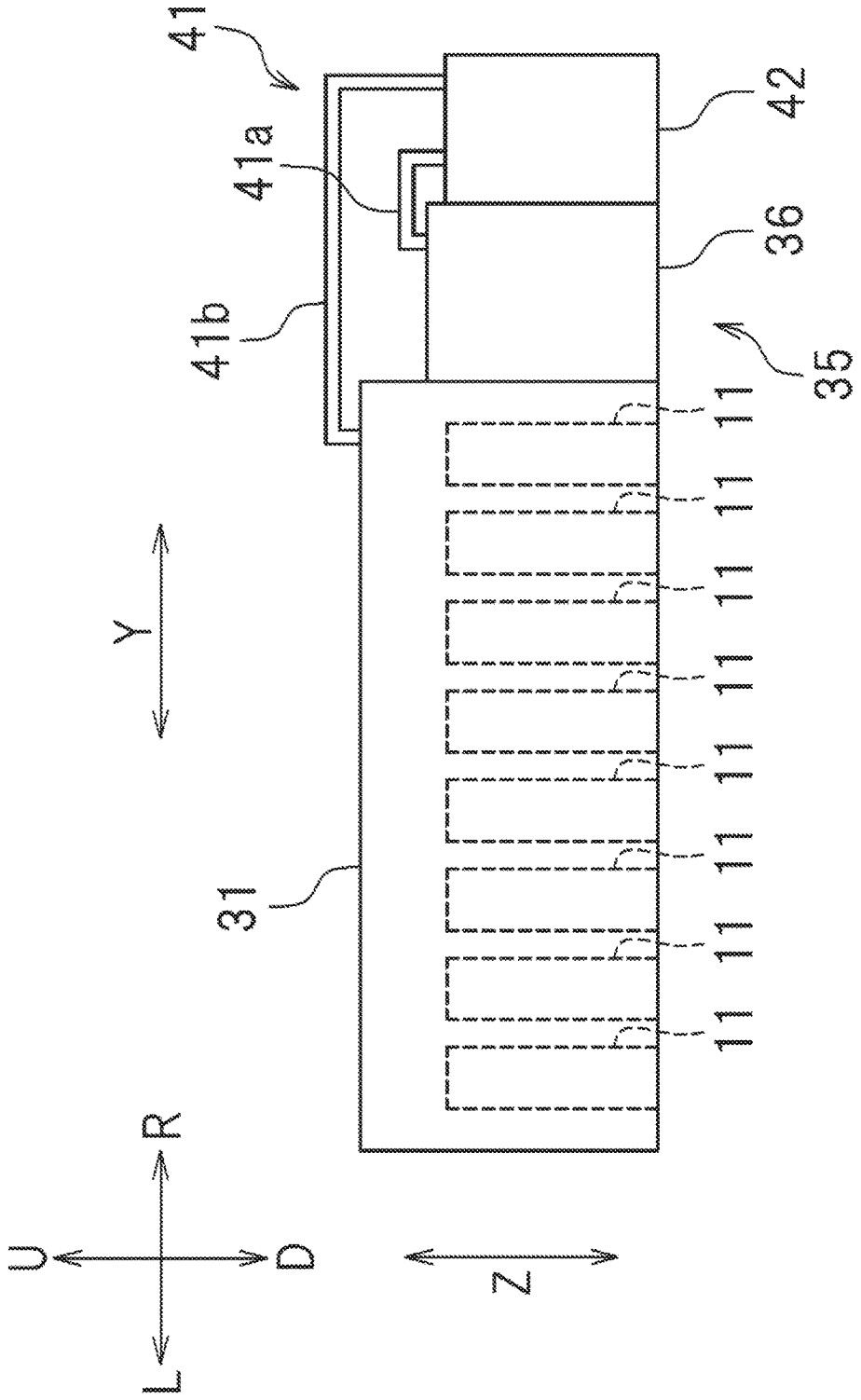
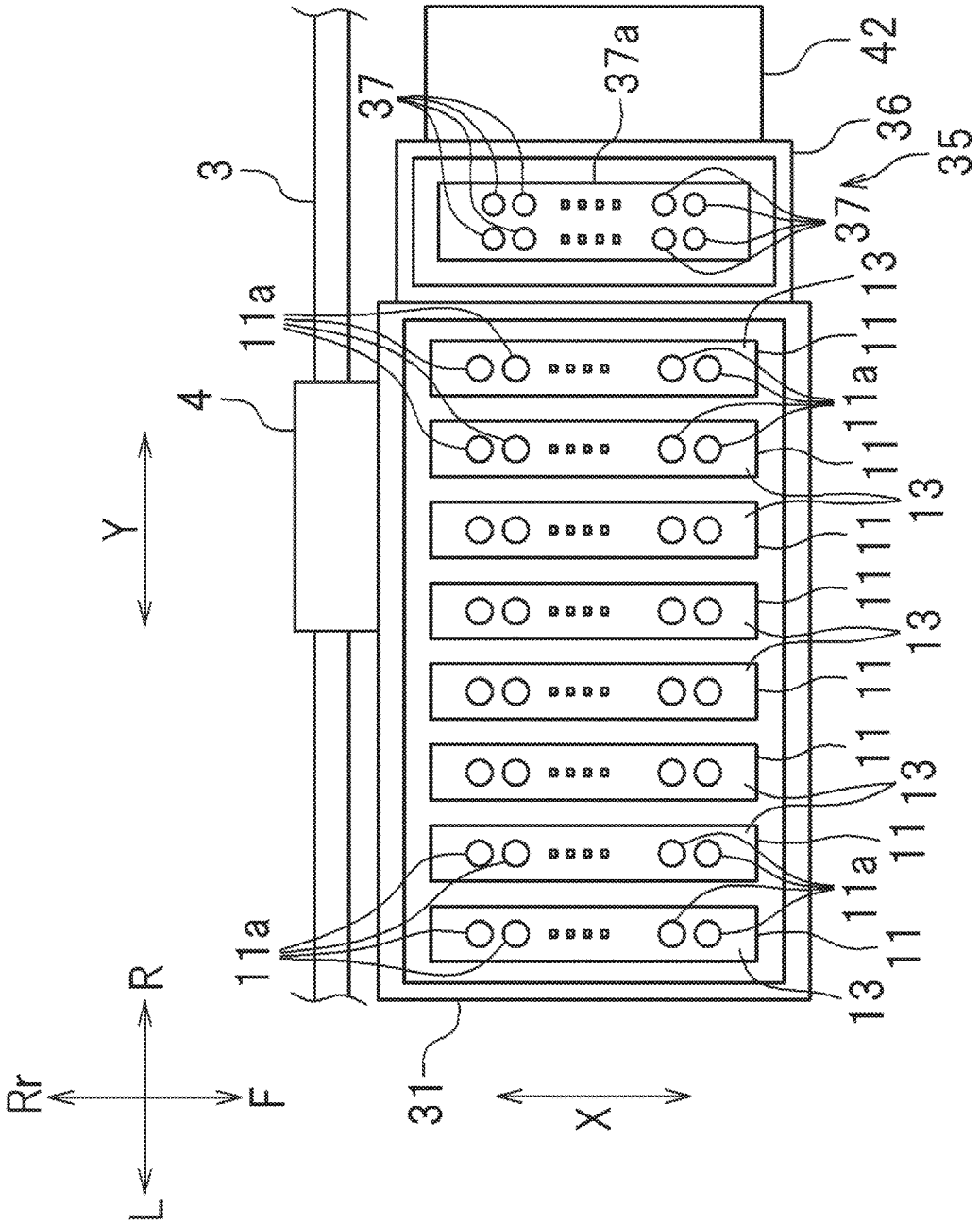


FIG. 3


42
37a
37
36
35
3
37
13
11a
11
4
11a
11
13
11
11
13
11
11
13
11
11
13
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13
11a
11
13
11a
11
R
Rr
F
L
31
X
Y

FIG. 4

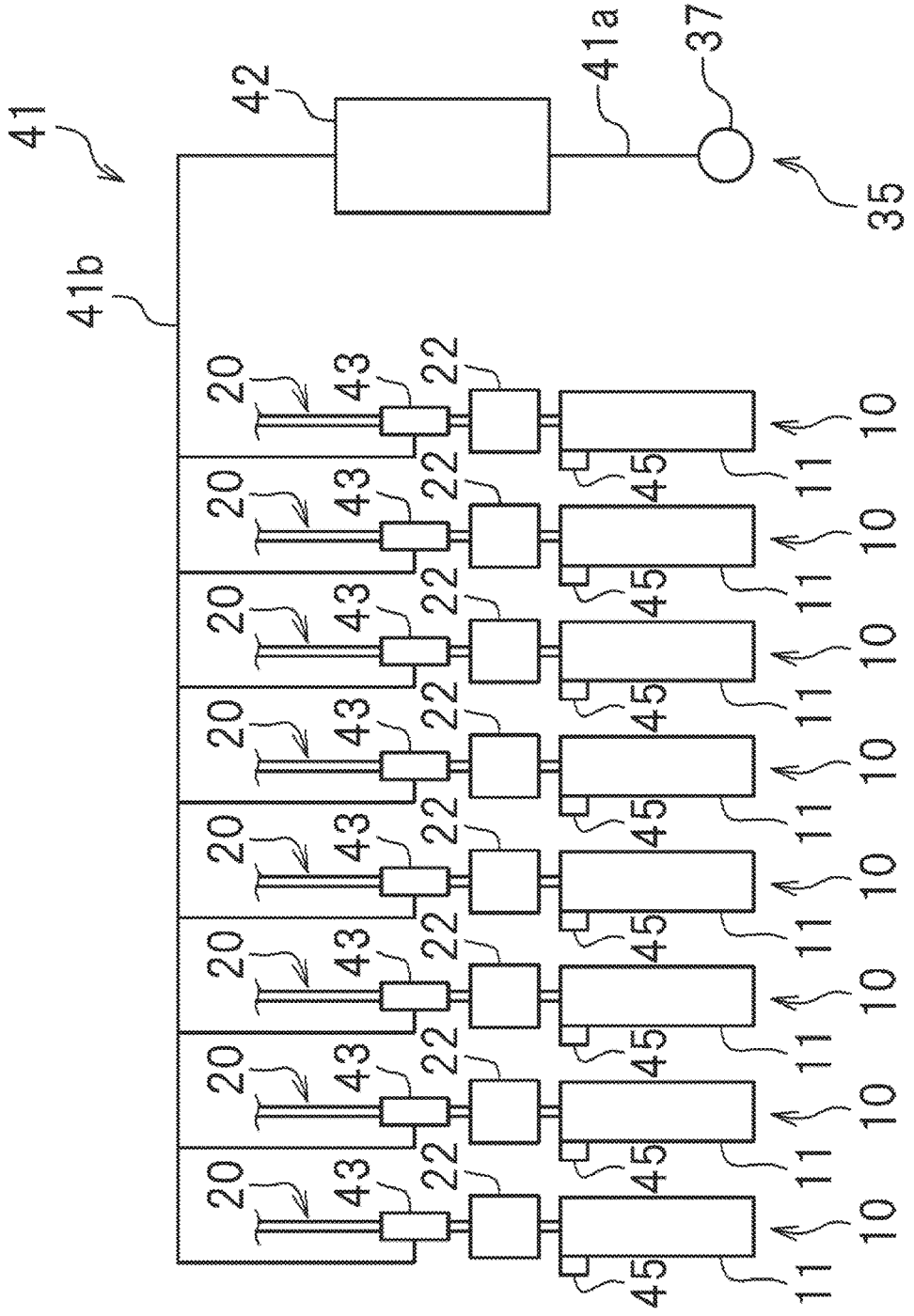

FIG. 5

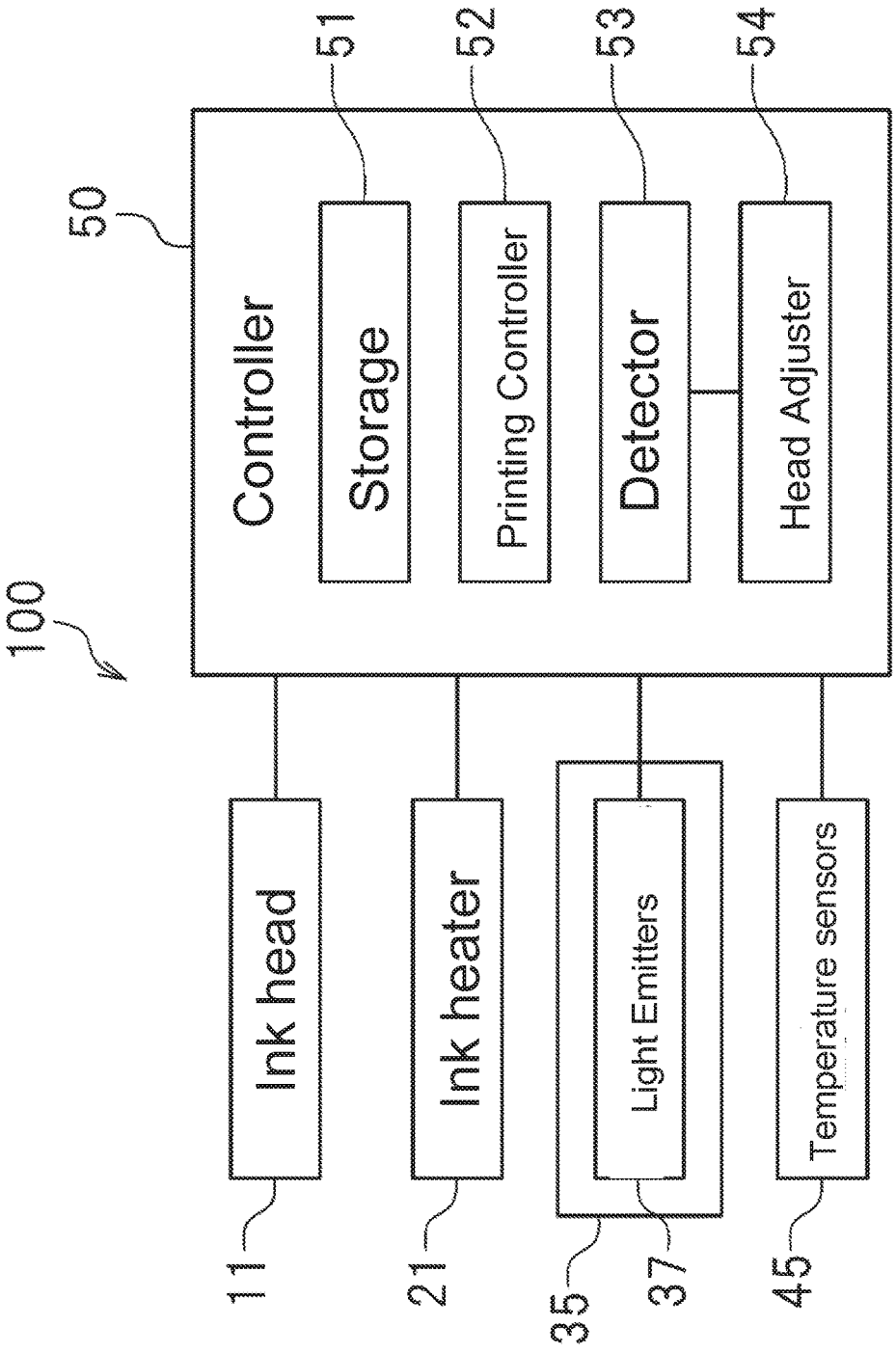
100
50
Controller
51
Storage
52
Printing Controller
53
Detector
54
Head Adjuster
Ink head
11
Ink heater
21
Light Emitters
35
37
Temperature sensors
45

FIG. 6

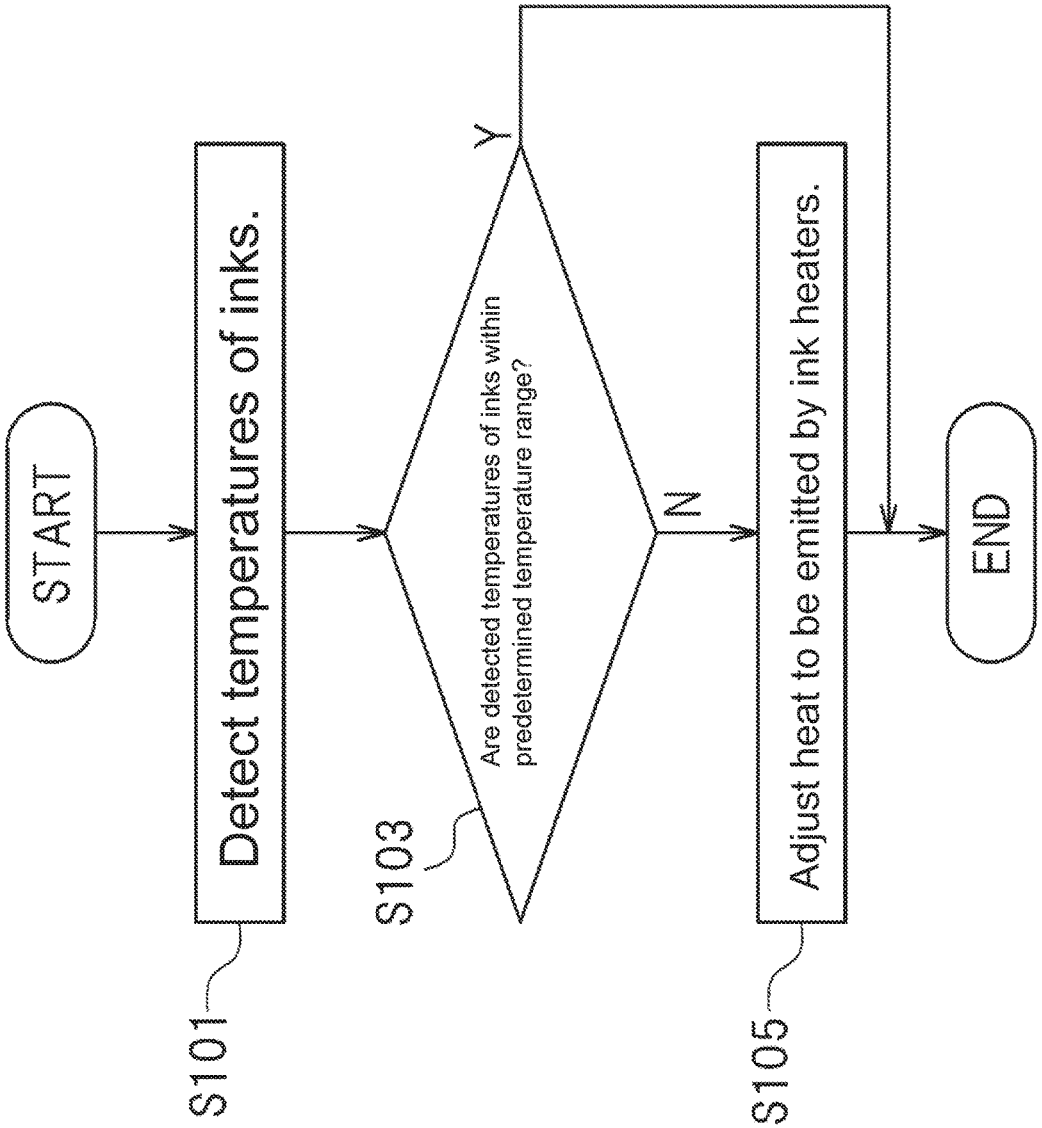
START
Detect temperatures of inks.
S101
Are detected temperatures of inks within predetermined temperature range?
S103
Y
N
Adjust heat to be emitted by ink heaters.
S105
END

FIG. 7

INKJET PRINTER

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of priority to Japanese Patent Application No. 2017-041704 filed on Mar. 6, 2017. The entire contents of this application are hereby incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to an inkjet printer.

2. Description of the Related Art

[0003] Conventionally, inkjet-type printers are known which perform printing using inks that cure when irradiated with ultraviolet radiation (which are hereinafter referred to as "ultraviolet-curable inks"). For example, an inkjet-type printer disclosed in Japanese Patent No. 5994259 includes inkjet heads that eject ultraviolet-curable inks onto a recording medium, and an ultraviolet irradiation part that irradiates the recording medium with ultraviolet radiation. The ultraviolet irradiation part has a light-emitting part that emits ultraviolet radiation, and the light-emitting part includes a plurality of light-emitting elements such as LED (Light Emitting Diode) elements.

[0004] In the printer disclosed in Japanese Patent No. 5994259, the ultraviolet-curable inks are first ejected from the inkjet heads onto the recording medium. Then, the light-emitting elements constituting the light-emitting part of the ultraviolet irradiation part irradiate the ultraviolet-curable inks ejected onto the recording medium with ultraviolet radiation. As a result, curing of the ultraviolet-curable inks ejected onto the recording medium is promoted.

[0005] In the printer disclosed in Japanese Patent No. 5994259, the light-emitting elements constituting the light-emitting part of the ultraviolet irradiation part also releases heat when emitting ultraviolet radiation. The heat emitted by the light-emitting elements is released to the outside of the printer. The heat release to the outside of the printer is not necessary. This means that energy is unnecessarily consumed.

SUMMARY OF THE INVENTION

[0006] Preferred embodiments of the present invention provide inkjet printers that reduce unnecessary heat that is emitted by light-emitting elements that emit ultraviolet radiation.

[0007] An inkjet printer according to a preferred embodiment of the present invention includes an ink tank, an ink head, an ink supply passage, a light emitter, and a heat relay. An ink is stored in the ink tank. The ink head ejects the ink onto a recording medium. The ink supply passage is connected to the ink tank and the ink head. The light emitter irradiates the ink ejected onto the recording medium with ultraviolet radiation. The heat relay is connected to the light emitter to transfer heat emitted by the light emitter to at least one of the ink supply passage and the ink head.

[0008] According to the above-mentioned inkjet printer, the ink to be ejected from the ink heads has been preferably warmed to some extent to prevent the ink head from being clogged by the ink to be ejected from the ink head. Thus, in the above inkjet printer, when the light emitter irradiates the ink ejected onto the recording medium with ultraviolet radiation, the heat emitted by the light emitter is transferred to the heat relay and then to at least one of the ink supply passage and the ink head. As a result, the ink in the ink supply passage and the ink in the ink head are warmed, and the warmed ink is ejected from the ink head. This configuration prevents the ink head from being clogged by ink. In this way, the heat emitted by the light emitter is utilized to warm the ink to be ejected from the ink head. This allows effective use of the heat emitted by the light emitter, and reduction of unnecessary heat that is emitted by the light emitter.

[0009] According to preferred embodiments of the present invention, it is possible to provide inkjet printers that reduce unnecessary heat that is emitted by light emitters that emit ultraviolet radiation.

[0010] The above and other elements, features, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of the preferred embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. **1** is a front view, illustrating a printer according to of a preferred embodiment of the present invention.

[0012] FIG. **2** is a schematic diagram, illustrating an ink supply system.

[0013] FIG. **3** is a front view of ink heads, an ultraviolet irradiator and a heat accumulator.

[0014] FIG. **4** is a bottom view of the ink heads, the ultraviolet irradiator and the heat accumulator.

[0015] FIG. **5** is a schematic diagram, illustrating the connection relationship between light emitters and ink supply passages.

[0016] FIG. **6** is a block diagram of the printer.

[0017] FIG. **7** is a flowchart, showing the procedure to adjust the temperature of inks to be ejected from the ink heads.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] Description is hereinafter made of inkjet printers according to preferred embodiments of the present invention (which may be hereinafter referred to as "printer") with reference to the drawings. It should be understood that the preferred embodiments described herein do not limit the present invention. In addition, members and elements that have the same functions are denoted by the same reference numerals or symbols and redundant description is omitted or simplified as appropriate.

[0019] FIG. **1** is a front view of a printer **100** according to a preferred embodiment of the present invention. In the following description, the reference symbols F, Rr, L, R, U and D in the drawings represent front, rear, left, right, up and down, respectively, with respect to the printer **100** viewed from front. The reference symbol Y in the drawings represents a main scanning direction. Here, the main scanning direction Y extends in a right-left direction. The reference symbol X (refer to FIG. **4**) represents a sub-scanning direction. Here, the sub-scanning direction X extends in a front-back direction and is perpendicular to the main scanning direction Y as viewed in a plan view. The reference symbol

Z represents a height direction, i.e., a vertical direction. Those directions are determined for convenience of description, and do not limit the installation mode of the printer **100** or the present invention.

[0020] As shown in FIG. **1**, the printer **100** is an inkjet printer. Here, the term "inkjet" refers to an inkjet using any of various continuous systems such as binary deflection systems or continuous deflection systems and various on-demand systems such as thermal systems or piezoelectric element systems. The printer **100** prints an image on a rolled recording medium **5** by moving the recording medium **5** sequentially forward (here, toward a downstream side in the sub-scanning direction X) and ejecting inks from ink heads **11** that moves in the main scanning direction Y. The recording medium **5** is an object on which an image is printed. The recording medium **5** may be any type of medium. The recording medium **5** may be paper such as plain paper or inkjet printing paper. Alternatively, the recording medium **5** may be a transparent sheet made from a resin, such as polyvinyl chloride (PVC) or polyester, or glass, or a sheet such as one made from a metal or rubber.

[0021] In this preferred embodiment, the printer **100** includes a printer main unit **2**, a guide rail **3**, and a carriage **4** (refer to FIG. **4**). The guide rail **3** is fixed to the printer main unit **2**. The guide rail **3** extends in the main scanning direction Y. As shown in FIG. **4**, the carriage **4** is in engagement with the guide rail **3**, and is slidably provided on the guide rail **3**. Although not shown, rollers are preferably provided at opposite right and left ends of the guide rail **3**. A carriage motor (not shown) is connected to one of the rollers. The roller connected to the carriage motor is rotated by the carriage motor. Here, as shown in FIG. **1**, an endless belt **6** is entrained around the rollers provided at opposite ends of the guide rail **3**. The carriage **4** (refer to FIG. **4**) is attached to the belt **6**. When the carriage motor is driven, the rollers are rotated and the belt **6** moves. Then, the carriage **4** moves in the main scanning direction Y. As described above, the carriage **4** is movable in the main scanning direction Y along the guide rail **3**.

[0022] In this preferred embodiment, as shown in FIG. **1**, the printer **100** includes a platen **7**. The platen **7** supports the recording medium **5** during printing on the recording medium **5**. The recording medium **5** is placed on the platen **7**. The printing on the recording medium **5** is carried out on the platen **7**. Although not shown, the platen **7** is provided with a pair of upper and lower, grid and pinch rollers. A feed motor (not shown) is connected to the grid roller. The grid roller is driven to rotate by the feed motor. When the grid roller is rotated with the recording medium pinched between the grid roller and the pinch roller, the recording medium **5** is transported in the sub-scanning direction X (refer to FIG. **4**).

[0023] In this preferred embodiment, the printer **100** includes a plurality of ink supply systems **10**. The ink supply systems **10** are systems that supply inks from ink tanks **12** to the ink heads **11**. The ink supply systems **10** are arranged in one-to-one correspondence with the ink heads **11**. The ink supply systems **10** are arranged in one-to-one correspondence with the ink tanks **12**. Here, because the number of the ink heads **11** is eight, the number of the ink supply systems **10** is eight, for example. However, the number of the ink heads **11** and the number of the ink supply systems **10** are not particularly limited to this value. The plurality of ink supply systems **10** has the same configuration. Thus, in the following, the configuration of one ink supply system **10** is described.

[0024] FIG. **2** is a schematic diagram, illustrating the ink supply system **10**. As shown in FIG. **2**, the ink supply system **10** includes the ink head **11**, the ink tank **12**, an ink supply passage **20**, an ink heater **21**, and a damper **22**. In the following description, the ink tank **12** side and the ink head **11** side of the ink supply passage **20** are referred to as an "upstream side" and a "downstream side," respectively.

[0025] FIG. **3** is a front view of the ink heads **11**, an ultraviolet irradiator **35**, and a heat accumulator **42**. FIG. **4** is a bottom view of the ink heads **11**, the ultraviolet irradiator **35** and the heat accumulator **42**. As shown in FIG. **3**, the ink head **11** of each ink supply system **10** ejects an ink onto the recording medium **5** (refer to FIG. **1**) placed on the platen **7**. In this preferred embodiment, as shown in FIG. **4**, each ink head **11** is provided in the carriage **4**, and is in engagement with the guide rail **3** via the carriage **4**. Each ink head **11** is movable in the main scanning direction Y along the guide rail **3**. In this preferred embodiment, a plurality of nozzles **11***a* aligned in the sub-scanning direction X are provided in a bottom surface of each ink head **11**. The ink is ejected from the plurality of nozzles **11***a*.

[0026] Each ink head **11** may be made from any material. For example, each ink head **11** preferably includes metal members. For example, each ink head **11** includes a nozzle plate **13** through which the nozzles **11***a* extend, and a cover (not shown) located above the nozzle plate **13** to cover the nozzle plate **13**. A space is provided between the nozzle plate **13** and the cover, and the ink is temporarily reserved in the space. Although not shown, the cover may have an outer peripheral member exposed to the outside, and an inner peripheral member that is located inside the outer peripheral member and contacts the ink in the space between the nozzle plate **13** and the cover. In this case, the nozzle plate **13**, and the outer peripheral member and the inner peripheral member of the cover may be made from a metal. However, the nozzle plate **13** and the outer peripheral member of the cover may be made from a metal, and the inner peripheral member of the cover may be made from a material other than a metal, such as a resin. Alternatively, the outer peripheral member of the cover may be made from a metal, and the nozzle plate **13** and the inner peripheral member of the cover may be made from a material other than a metal. In this preferred embodiment, at least the members that are exposed to the outside among the members of the ink head **11** are preferably partially made from a metal.

[0027] In this preferred embodiment, the printer **100** includes a carriage frame **31**. The carriage frame **31** is a hollow member including an internal space therein. Here, the carriage frame **31** preferably is a rectangular member, but the carriage frame **31** is not limited to a particular shape. The carriage frame **31** is provided on a front surface of the carriage **4**. In this preferred embodiment, the plurality of ink heads **11** is housed in the carriage frame **31**. Here, each ink head **11** is fixed to the carriage frame **31** by fixing elements (not shown) such as bolts. The ink heads **11** are surrounded by the carriage frame **31**. This configuration prevents entry of external dust or the like into the ink heads **11**. In this preferred embodiment, the ink heads **11** are provided in the carriage frame **31** in such a manner that the plurality of nozzles **11***a* provided in a bottom surface of each ink head **11** are exposed on the underside of the carriage frame **31**.

Each ink head **11** is provided in the carriage **4** via the carriage frame **31**. In this preferred embodiment, at least a portion of each ink head **11** is in contact with the carriage frame **31**.

[0028] In this preferred embodiment, the carriage frame **31** includes metal members. However, the material of the carriage frame **31** may be made from any material. For example, the carriage frame **31** may include non-metal members.

[0029] In this preferred embodiment, the ink ejected from the plurality of nozzles **11***a* of each ink head **11** is an ink that cures when irradiated with ultraviolet radiation, in other words, an ultraviolet-curable ink. Here, the number of the ink heads **11** is eight, for example, as described above. Different ink heads **11** eject inks with different color tones. However, some of the ink heads **11** of the plurality of ink head **11** may eject inks of the same color tone. Each ink heads **11** may eject an ink with any color tone. The ink ejected from each ink head **11** is either a process color ink, such as cyan, magenta, yellow, light cyan, light magenta or black ink, or a special color ink, such as white, metallic or clear ink.

[0030] As shown in FIG. **2**, each ink tank **12** stores an ink. In this preferred embodiment, the number of the ink tanks **12** is equal to the number of the ink heads **11**, i.e., eight herein, for example. One ink head **11** is connected to one ink tank **12**. The inks stored in the ink tanks **12** are supplied to the ink heads **11**. The ink tanks **12** may be installed at any location. In this preferred embodiment, as shown in FIG. **1**, the ink tanks **12** are detachably provided in the printer main unit **2**. For example, the printer main unit **2** is provided with a housing **12***a*, and the plurality of ink tanks **12** is housed in the housing **12***a*. However, the ink tanks **12** may be detachably provided on the carriage **4** (refer to FIG. **4**), for example.

[0031] As shown in FIG. **2**, the inks stored in the ink tanks **12** are supplied to the ink heads **11** through the ink supply passages **20**. Each ink supply passage **20** includes an upstream side end connected to an ink tank **12**. Each ink supply passage **20** includes a downstream side end connected to an ink head **11**. As shown in FIG. **1**, in this preferred embodiment, the ink supply passages **20** are at least partially covered with a cable protective guide **20***a*. The cable protective guide **20***a* is Cable Bare (trademark), for example.

[0032] As shown in FIG. **2**, the ink heaters **21** warm the inks flowing through the ink supply passages **20**. In other words, the ink heaters **21** heat the inks in the ink supply passages **20**. In this preferred embodiment, the ink heaters **21** warm the inks in the ink supply passages **20** to warm the inks in the ink heads **11** and the inks to be ejected from the nozzles **11***a* of the ink heads **11** (refer to FIG. **4**). The ink heaters **21** may be installed at any location. In this preferred embodiment, the ink heaters **21** are provided on intermediate portions of the ink supply passages **20**. Specifically, the ink heaters **21** are provided on upstream side portions of the ink supply passages **20**. For example, the ink heaters **21** are provided on the ink supply passages **20** between the ink tanks **12** and the dampers **22**. The ink heaters **21** may be any type of heaters. For example, the ink heaters **21** may be heating wires wound around the ink supply passages **20**. Alternatively, the ink heaters **21** may be heating wires provided in air traps (not shown) that trap air contained in the inks.

[0033] The dampers **22** mitigate the changes in ink pressure to stabilize the ejection operation of the ink heads **11**. In this preferred embodiment, the dampers **22** are provided in intermediate portions of the ink supply passages **20**. Specifically, the dampers are provided in downstream side portions of the ink supply passages **20**. For example, the dampers **22** are provided upstream of the ink heads **11** and downstream of the ink heaters **21**. However, the dampers **22** may be located in any position. For example, the damper **22** may be directly connected to the ink heads **11**.

[0034] In this preferred embodiment, as shown in FIG. **3**, the printer **100** includes the ultraviolet irradiator **35**. The ultraviolet irradiator **35** irradiates the inks ejected onto the recording medium **5** with ultraviolet radiation. This promotes curing of the inks ejected onto the recording medium **5**. In this preferred embodiment, as shown in FIG. **4**, the ultraviolet irradiator **35** is provided on the carriage **4**. More specifically, the ultraviolet irradiator **35** is provided on a right surface of the carriage frame **31**, in which the ink heads **11** are housed, and is provided on the carriage **4** via the carriage frame **31**. The printer **100** may include any number of ultraviolet irradiators **35**. For example, one ultraviolet irradiator **35** may be provided on the carriage frame **31** as in this preferred embodiment, or two ultraviolet irradiators **35** in total may be provided on both right and left sides (one on each side) of the carriage frame **31**. In this preferred embodiment, the ultraviolet irradiator **35** is movable via the carriage **4** in the main scanning direction Y along the guide rail **3**. The ultraviolet irradiator **35** moves in the main scanning direction Y together with the ink heads **11** when the carriage **4** moves in the main scanning direction Y.

[0035] The ultraviolet irradiator **35** may have any configuration. In this preferred embodiment, the ultraviolet irradiator **35** includes a UV frame **36**, and a plurality of light emitters **37**. The UV frame **36** is a hollow member having an internal space therein. Here, the UV frame **36** preferably is a rectangular member, but the UV frame **36** is not limited to a particular shape. In this preferred embodiment, the UV frame **36** is provided on the right surface of the carriage frame **31**. However, the UV frame **36** may be provided on a left surface of the carriage frame **31**. For example, the carriage frame **31** and the UV frame **36** may be fixed to each other by connectors such as bolts.

[0036] In this preferred embodiment, the UV frame **36** preferably includes metal members. However, the UV frame **36** may be made from any material. For example, the UV frame **36** may be made from a non-metal material. The UV frame **36** and the carriage frame **31** may be made from the same material or different materials.

[0037] The plurality of light emitters **37** is a light source that emits light (here, ultraviolet radiation). More specifically, the plurality of light emitters **37** irradiates the inks ejected onto the recording medium **5** (refer to FIG. **1**) on the platen **7** with ultraviolet radiation. The light emitters **37** may be any type of light emitters. In this preferred embodiment, the light emitters are light-emitting diodes (LEDs), for example. Here, the plurality of light emitters **37** is installed in the internal space in the UV frame **36**, and surrounded by the UV frame **36**. More specifically, the plurality of light emitters **37** is installed in a connector **37***a*, and the connector **37***a* is fixed to the UV frame **36** via connectors (not shown) such as bolts. While the light emitters are shown to be arranged in two rows in the sub-scanning direction X with each row having four light emitters **37** in FIG. **4** for

convenience of description, the number of light emitters **37** in one ultraviolet irradiator **35** and the number of rows in which the light emitters **37** are arranged in the sub-scanning direction X are not limited to particular values. In an actual ultraviolet irradiator **35**, the number of rows in which the light emitters **37** are arranged in the sub-scanning direction X is one to three, for example. The number of light emitters **37** in each row is eight, ten or twelve, for example. The number of light emitters **37** and the number of rows in which the light emitters **37** are arranged in the sub-scanning direction X are selected as appropriate based on the size of the printer **100**, the components of the inks and so on.

[0038] When the light emitters **37** of the ultraviolet irradiator **35** emit ultraviolet radiation, the light emitters **37** also release heat. Conventionally, the heat emitted by the light emitters **37** is released to the outside of the printer and unnecessary. Thus, the inventor of the present application considered whether there is an effective way to use the heat emitted by the light emitters **37**. The inventor of the present application focused attention on the inks that are ejected from the nozzles **11***a* of the ink heads **11**. For effective ejection of inks from the nozzles **11***a* of the ink heads **11**, it is preferable to maintain the viscosity of the inks to be ejected from the ink heads **11** within a predetermined range. To maintain the viscosity of the inks within a predetermined range, it is preferable to maintain the temperature of the inks to be ejected from the ink heads **11** within a predetermined temperature range. Thus, the inventor of the present application came up with the idea of using the heat emitted by the light emitters **37** to warm the inks to be ejected from the ink heads **11**.

[0039] Next, the configuration by which the heat emitted by the light emitters **37** is transferred to the inks to be ejected from the ink heads **11** is described. FIG. **5** is a schematic diagram, illustrating the connection relationship between the light emitters **37** and the ink supply passages **20**. In this preferred embodiment, as shown in FIG. **5**, the printer **100** includes a heat relay **41**, a heat accumulator **42**, and heat transmitters **43**. The heat emitted by the light emitters **37** is transferred to the heat relay **41**. The heat relay **41** is connected to the light emitters **37** and the ink supply passages **20**. In this preferred embodiment, the heat relay **41** transfers the heat emitted by the light emitters **37** to the ink supply passages **20** to warm the inks in the ink supply passages **20**. As a result, warmed inks are ejected from the ink heads **11**. In this preferred embodiment, as shown in FIG. **4**, the light emitters **37** are fixed to the UV frame **36** via the connector **37***a*. For example, the heat relay **41** is connected to the connector **37***a*, and the heat emitted by the light emitters **37** is transferred to the heat relay **41** via the connector **37***a*.

[0040] The heat relay **41** may have any configuration. For example, in this preferred embodiment, the heat relay **41** includes conductive wires. However, the entire portion of the heat relay **41** may not necessarily include conductive wires. For example, some portion of the heat relay **41** may include conductive wires and another portion of the heat relay **41** may include heat-radiating fins.

[0041] As shown in FIG. **4**, the heat accumulator **42** temporarily stores the heat emitted by the light emitters **37**. The heat accumulator **42** is provided on the carriage **4**. However, the heat accumulator **42** may be installed at any location. In this preferred embodiment, the heat accumulator **42** is installed on the right side of the UV frame **36** of the ultraviolet irradiator **35**, and provided on the carriage **4** via the UV frame **36** and the carriage frame **31**. However, the heat accumulator **42** may be installed on the left side of the carriage frame **31**. Also, the heat accumulator **42** may not be provided on the carriage **4** but may be provided at a position spaced away from the carriage **4**. In this preferred embodiment, as shown in FIG. **5**, the heat accumulator **42** is provided on an intermediate portion of the heat relay **41**. More specifically, the heat relay **41** includes a first heat relay **41***a* and a second heat relay **41***b*. The first heat relay **41***a* is connected to the light emitters **37** and the heat accumulator **42**, and the second heat relay **41***b* is connected to the heat accumulator **42** and the ink supply passages **20**.

[0042] The heat accumulator **42** may have any specific configuration. In this preferred embodiment, the heat accumulator **42** includes a block-shaped metal member. The inside of the metal member is preferably filled with a metal member. As shown in FIG. **4**, the heat accumulator **42** preferably has a predetermined size. The predetermined size is generally the same as the size of the UV frame **36** or slightly smaller than the size of the UV frame **36**.

[0043] In this preferred embodiment, as shown in FIG. **5**, the heat transmitters **43** apply heat to the ink supply passages **20**. However, the heat transmitters **43** may apply heat to the ink heads **11**. The heat transmitters **43** may have any specific configuration. Here, the heat transmitters **43** are metal members provided on the ink supply passages **20**, for example. For example, the heat transmitters **43** are made from aluminum. In this preferred embodiment, the second heat relay **41***b* of the heat relay **41** is connected to the heat transmitters **43**, and the heat relay **41** is connected to the ink supply passages **20** via the heat transmitters **43**.

[0044] In this preferred embodiment, the printer **100** includes temperature sensors **45**. The temperature sensors **45** detect temperatures of the inks. For example, the temperature sensors **45** are provided on the ink heads **11**. Here, the temperature sensors **45** detect temperatures of the inks in the ink heads **11**. However, the temperature sensors **45** may be installed at any locations. For example, the temperature sensors **45** may be installed on the ink supply passages **20** or on the members provided in the ink supply passages **20**. In this case, the temperature sensors **45** are preferably installed downstream of the positions where the heat transmitters **43** are provided on the ink supply passages **20**. In this case, the temperature sensors **45** detect temperatures of the inks in the ink supply passage **20**. The temperature sensors **45** may be any type of temperature sensors. For example, the temperature sensors **45** are thermistors.

[0045] FIG. **6** is a block diagram of the printer **100**. As shown in FIG. **6**, the printer **100** includes a controller **50**. The controller **50** adjusts the temperatures of the inks to be ejected from the ink heads **11**, and controls printing on the recording medium **5**. The controller **50** may have any configuration. In this preferred embodiment, the controller **50** is a microcomputer, for example. The microcomputer may have any hardware configuration, but it includes an interface (I/F) through which it receives print data and so on from an external device such as a host computer, a central processing unit (CPU) that executes instructions from control programs, a ROM (read only memory) in which programs that are executed by the CPU are stored, a RAM (random access memory) that is used as a working area in which the programs are developed, and a storage device, such as a memory, in which the program and various data are

stored. The controller **50** is provided in the printer main unit **2** (refer to FIG. **1**). However, the controller **50** is not necessarily provided in the printer main unit **2**, and may be a personal computer or the like that is installed outside the printer main unit **2**, for example. In this case, the controller **50** is communicably connected to the printer main unit **2** via a wired or wireless connection.

[0046] In this preferred embodiment, the controller **50** is electrically and communicably connected to the ink heads **11**, the ink heaters **21**, the ultraviolet irradiator **35** (more specifically, the light emitters **37** of the ultraviolet irradiator **35**) and the temperature sensors **45**, and controls the ink heads **11**, the ink heaters **21**, the ultraviolet irradiator **35** and the temperature sensors **45**. The controller **50** controls the timings of ejection of the inks from the ink heads **11**. The controller **50** controls the timing of irradiation of ultraviolet radiation from the light emitters **37** of the ultraviolet irradiator **35**. The controller **50** receives information about the temperatures of the inks detected by the temperature sensors **45**. Then, the controller **50** controls the heat generation rates of the ink heaters **21** based on the information about the temperatures of the inks.

[0047] In this preferred embodiment, the controller **50** is configured or programmed to include a storage **51**, a printing controller **52**, a detector **53**, and a heat adjuster **54**. Each of the above elements may be constituted of software or may be constituted of hardware. For example, each of the above elements may be implemented by a processor or incorporated in a circuit.

[0048] The printing controller **52** performs control operations necessary to print on the recording medium **5** placed on the platen **7**. Specifically, the printing controller **52** sequentially moves the recording medium **5** on the platen **7** forward (here, to the downstream side in the sub-scanning direction X), and causes the nozzles **11***a* of the ink heads **11** to eject the inks while moving the ink heads **11** in the main scanning direction Y. Here, the ink heads move in the main scanning direction Y and the ultraviolet irradiator **35** also moves in the main scanning direction Y. Thus, when the ultraviolet irradiator **35** moves in the main scanning direction Y, the light emitters **37** of the ultraviolet irradiator **35** irradiate the inks ejected onto the recording medium **5** with ultraviolet radiation. As a result, curing of the inks ejected onto the recording medium **5** is promoted.

[0049] The detector **53** and the heat adjuster **54** are used to adjust the temperatures of the inks to be ejected from the ink heads **11**. Next, referring to FIG. **7**, the procedure to adjust the temperatures of the inks to be ejected from the ink heads **11** is described with reference to the flowchart.

[0050] First, in step S**101** in FIG. **7**, the detector **53** detects temperatures of the inks while printing is in progress. In this preferred embodiment, the detector **53** causes the temperature sensors **45** to detect temperatures of the inks in the ink heads **11**. Then, the detector **53** estimates the temperatures of the inks to be ejected from the ink heads **11** based on the temperatures of the inks detected by the temperature sensors **45**. The ink temperature detection in step S**101** is performed at predetermined time intervals. The predetermined time intervals are set as appropriate by the printer **100**. The predetermined time intervals are preliminarily stored in the storage **51**.

[0051] Next, in step S**103** in FIG. **7**, the heat adjuster **54** determines whether the temperatures of the inks detected by the temperature sensors **45** are within a predetermined temperature range. Here, the predetermined temperature range is a range in which the inks are ejected properly from the nozzles **11***a* of the ink heads **11** without clogging the nozzles **11***a*. The predetermined temperature range is set as appropriate based on the printer **100** and the components of the inks. The predetermined temperature range is preliminarily stored in the storage **51**. If it is determined that the temperatures of the inks detected by the temperature sensors **45** are within the predetermined temperature range, the sequential flow in FIG. **7** is terminated. If it is determined that the temperatures of the inks detected by the temperature sensors **45** are not within the predetermined temperature range, the procedure advances to step S**103** in FIG. **7**.

[0052] In step S**103**, the heat adjuster **54** adjusts the heat to be emitted by the ink heaters **21**. Here, if the temperatures of the inks detected by the temperature sensors **45** are lower than the predetermined temperature range, the heat adjuster **54** controls the ink heaters **21** so that the inks in the ink supply passages **20** are warmed. If the temperatures of the inks detected by the temperature sensors **45** are higher than the predetermined temperature range, the heat adjuster **54** controls the ink heaters **21** so that the temperatures of the inks in the ink supply passages **20** are lower. In this case, the heat adjuster **54** may control the ink heaters **21** so that the ink heaters **21** emit no heat. As a result of this control in step S**103**, the temperatures of the inks are able to be brought closer to the predetermined temperature range.

[0053] As described above, in this preferred embodiment, the inks to be ejected from the ink heads **11** have been preferably warmed to some extent to prevent the nozzles **11***a* of the ink heads **11** from being clogged by the inks to be ejected from the ink heads **11**. Thus, here, when the light emitters **37** irradiate the inks ejected onto the recording medium **5** with ultraviolet radiation, the heat emitted by the light emitters **37** is, as shown in FIG. **5**, transferred to the heat relay **41** and then to the ink supply passages **20**. As a result, the inks in the ink supply passages **20** are warmed, and the warmed inks are ejected from the ink heads **11**. This configuration prevents the nozzles **11***a* of the ink heads **11** from being clogged by ink. In this way, in this preferred embodiment, the heat emitted by the light emitters **37** is utilized to warm the inks to be ejected from the ink heads **11**. This allows effective use of the heat emitted by the light emitters **37** and reduction of unnecessary heat that is emitted by the light emitters **37**.

[0054] In this preferred embodiment, the heat relay **41** preferably includes metal members. This facilitates transfer of the heat emitted by the light emitters **37** to the heat relay **41** and, consequently, facilitates warming of the inks to be ejected from the ink heads **11**.

[0055] In this preferred embodiment, the heat transmitters **43** are connected to the heat relay **41** to apply heat to the ink supply passages **20**. Here, the heat transmitters **43** preferably include metal members. This facilitates transfer of the heat transferred to the heat relay **41** to the ink supply passages **20** via the heat transmitters **43**. This allows efficient warming of the inks in the ink supply passages **20** and, consequently, facilitates warming of the inks to be ejected from the ink heads **11**.

[0056] In this preferred embodiment, the heat accumulator **42** is provided on an intermediate portion of the heat relay **41** to accumulate the heat emitted by the light emitters **37**. Here, as shown in FIG. **3**, the heat accumulator **42** is a block-shaped metal member installed between the first heat

relay **41***a* and the second heat relay **41***b* of the heat relay **41**. Thus, the heat emitted by the light emitters **37** is temporarily accumulated in the heat accumulator **42** via the first heat relay **41***a*. Thus, even when the light emitters **37** are not emitting ultraviolet radiation and are therefore emitting no heat, the heat accumulated in the heat accumulator **42** is transferred to the ink supply passages **20** via the second heat relay **41***b*. Thus, even when the light emitters **37** are emitting no heat, the inks to be ejected from the ink heads **11** are warmed with the heat from the heat accumulator **42** when some heat has been accumulated in the heat accumulator **42**.

[0057] In this preferred embodiment, as shown in FIG. **2**, the ink heaters **21** are provided on the ink supply passages **20** to heat the inks flowing through the ink supply passages **20**. Thus, in this preferred embodiment, the inks in the ink supply passages **20** are warmed not only with heat from the light emitters **37** but also with heat emitted by the ink heaters **21**. This allows efficient warming of the inks in the ink supply passages **20** and, consequently, allows efficient warming of the inks to be ejected from the ink heads **11**.

[0058] In this preferred embodiment, the detector **53** of the controller **50** detects temperatures of the inks to be ejected from the ink heads **11** with the temperature sensors **45** as shown in step S**101** in FIG. **7**. As shown in step S**103** and step S**105** in FIG. **7**, the heat adjuster **54** adjusts the heat to be emitted by the ink heaters **21** so that the temperatures of the inks detected by the detector **53** are able to be within a predetermined temperature range. Here, the inks ejected from the ink heads **11** are ultraviolet-curable inks, i.e., inks that cures when irradiated with ultraviolet radiation. When such ultraviolet-curable inks are warmed too much, the inks may cure and cause clogging of the nozzles **11***a* of the ink heads **11**. Thus, in this preferred embodiment, the heat from the ink heaters **21** is controlled so that the ink temperatures are able to be within a predetermined temperature range to prevent the inks from being warmed too much and cured. This prevents the inks from being cured to cause clogging of the nozzles **11***a* of the ink heads **11**.

[0059] In this preferred embodiment, as shown in FIG. **4**, the ink heads **11** and the ultraviolet irradiator **35** including the light emitters **37** are provided on the carriage **4**. Here, the heat relay **41** and the heat accumulator **42** are also provided on the carriage **4**. Thus, the ink heads **11**, the ultraviolet irradiator **35**, the heat relay **41** and the heat accumulator **42** move in the main scanning direction Y together with the movement of the carriage **4** in the main scanning direction Y. Thus, the relative distance between the ink heads **11** and the light emitters **37** of the ultraviolet irradiator **35** does not change. This allows stable application of heat emitted by the light emitters **37** to the inks.

[0060] A preferred embodiment of the present invention has been described in the foregoing. However, the above preferred embodiment is provided for illustrative purposes only, and the present invention can be implemented in various other forms.

[0061] In the above preferred embodiment, as shown in FIG. **5**, the heat transmitters **43** preferably are provided on the ink supply passages **20**. The heat relay **41** is connected to the ink supply passages **20** via the heat transmitters **43** so that heat is able to be applied to the inks in the ink supply passages **20**. However, the heat transmitters **43** may be provided one each on the plurality of ink heads **11**, for example. In this case, the heat transmitters **43** are preferably provided on connectors (not shown) that fix the ink heads **11** to the carriage frame **31**, for example. The heat relay **41** may be connected to the ink heads **11** via the heat transmitters **43** so that the heat emitted by the light emitters **37** is able to be applied to the inks in the ink heads **11**. Even in this case, the heat emitted by the light emitters **37** is able to be utilized to warm the inks to be ejected from the ink heads **11**. Alternatively, a configuration is possible in which the heat transmitters **43** are provided on both the ink supply passages **20** and the ink heads **11**.

[0062] In the above preferred embodiment, the heat relay **41** preferably includes conductive wires, and the heat accumulator **42** is a block-shaped metal member, for example. The heat transmitters are metal members provided on the ink supply passages **20**. However, the carriage frame **31**, the UV frame **36** or the like may serve as the heat relay **41**, the heat accumulator **42** and the heat transmitters **43**, for example. For example, the portion of the carriage frame **31** that extends from the portion connected to the UV frame **36** to the portions connected to the ink heads **11**, the portion of the UV frame **36** that is connected to the carriage frame **31**, and connectors (not shown), such as bolts, used to fix the UV frame **36** to the carriage frame **31** may serve as the heat relay **41** and the heat accumulator **42**. The heat accumulator **42** may be omitted. Fixing portions (not shown) where the ink heads **11** are fixed to the carriage frame **31** or contact portions where the ink heads **11** are in contact with the carriage frame **31** may serve as the heat transmitters **43**. In this case, the carriage frame **31** and the UV frame **36** preferably include metal members. Then, the heat emitted by the light emitters **37** is transferred to the ink heads **11** via the UV frame **36** and the carriage frame **31** as the heat relay **41** and the heat accumulator **42**. Thus, the heat emitted by the light emitter **37** is able to be utilized to warm the inks in the ink heads **11**.

[0063] In the above preferred embodiment, the ink heaters **21** are preferably provided on the ink supply passages **20**, and the inks to be ejected from the ink heads **11** are preferably warmed with the heat emitted by the ink heaters **21** as well as the heat emitted by the light emitters **37**, for example. However, the ink heaters **21** may be omitted. In this case, a configuration is possible in which the inks to be ejected from the ink heads **11** are warmed only with the heat emitted by the light emitters **37**.

[0064] In addition, the techniques disclosed herein can be applicable to various types of inkjet printers. In addition to so-called roll-to-roll printers in which a rolled recording medium **5** is transported, such as the printer **100** shown in the above preferred embodiment, the techniques can be also applicable to flat-bed type inkjet printers, for example. In addition, the printer **100** is not limited to a printer that is used alone as an independent printer and may be combined with other devices. For example, the printer **100** may be incorporated in another apparatus.

[0065] As described above, the storage **51**, the printing controller **52**, the detector **53**, and the heat adjuster **54** of the controller **50** may be defined by software. In other words, a computer may be caused to implement each of the above elements and their functions by loading a computer program into it. A preferred embodiment of the present invention includes a computer program that causes a computer to function as each of the above elements. The present invention also includes a non-transitory computer readable medium in which the computer program is recorded. Each of the above elements and functions may be implemented by

one processor or a plurality of processors included in the controller **50**. A preferred embodiment of the present invention further includes a circuit by which the same functions as those executed by the above elements are accomplished.

[0066] While preferred embodiments of the present invention have been described above, it is to be understood that variations and modifications will be apparent to those skilled in the art without departing from the scope and spirit of the present invention. The scope of the present invention, therefore, is to be determined solely by the following claims.

What is claimed is:

1. An inkjet printer, comprising:
an ink tank in which an ink that is curable by ultraviolet radiation is stored;
an ink head that ejects the ink onto a recording medium;
an ink supply passage connected to the ink tank and the ink head;
a light emitter that irradiates the ink ejected onto the recording medium with ultraviolet radiation; and
a heat relay connected to the light emitter and directly physically connected to the ink head to transfer heat emitted by the light emitter to the ink head.

2. The inkjet printer according to claim **1**, wherein the heat relay includes a metal block and a conductive wire.

3. The inkjet printer according to claim **2**, wherein the conductive wire includes one end that is directly physically attached to a surface of the ink head.

4. The inkjet printer according to claim **2**, wherein the conductive wire includes one end that is directly physically attached to the light emitter.

5. The inkjet printer according to claim **1**, wherein the heat relay includes a metal block, a first conductive wire and a second conductive wire, the first conductive wire being directly physically attached to a surface of the ink head and the second conductive wire being directly physically attached to the light emitter.

6. The inkjet printer according to claim **1**, wherein the heat relay is not connected to the ink supply passage.

7. The inkjet printer according to claim **1**, further comprising an ink heater provided on the ink supply passage to heat the ink flowing through the ink supply passage.

8. The inkjet printer according to claim **7**, further comprising:
a temperature sensor that detects a temperature of the ink in the ink head; and
a controller that controls the ink heater and the temperature sensor to adjust the heat to be emitted by the ink heater so that the temperature of the ink detected by the sensor is within a predetermined temperature range.

9. The inkjet printer according to claim **1**, further comprising:
a carriage slidably provided on a guide rail that extends a main scanning direction; wherein
the ink head and the light emitter are provided on the carriage.

10. The inkjet printer according claim **9**, wherein the heat relay is provided on the carriage.

11. An inkjet printer, comprising:
an ink tank in which an ink that is curable by ultraviolet radiation is stored;
an ink head that ejects the ink onto a recording medium;
an ink supply passage connected to the ink tank and the ink head; and
a light emitter that irradiates the ink ejected onto the recording medium with ultraviolet radiation; wherein
heat emitted by the light emitter is applied to the ink head to heat the ink in the ink head.

12. The inkjet printer according to claim **11**, wherein the heat emitted by the light emitter is directly applied to the ink head by a direct physical connection.

13. The inkjet printer according to claim **11**, further comprising a heat relay connected to the light emitter and directly physically connected to the ink head.

14. The inkjet printer according to claim **13**, wherein the heat relay includes a metal block and a conductive wire.

15. The inkjet printer according to claim **14**, wherein the conductive wire includes one end that is directly physically attached to a surface of the ink head.

16. The inkjet printer according to claim **14**, wherein the conductive wire includes one end that is directly physically attached to the light emitter.

17. The inkjet printer according to claim **13**, wherein the heat relay includes a metal block, a first conductive wire and a second conductive wire, the first conductive wire being directly physically attached to a surface of the ink head and the second conductive wire being directly physically attached to the light emitter.

18. The inkjet printer according to claim **13**, wherein the heat relay is not connected to the ink supply passage.

19. The inkjet printer according to claim **11**, further comprising an ink heater provided on the ink supply passage to heat the ink flowing through the ink supply passage.

20. The inkjet printer according to claim **19**, further comprising:
a temperature sensor that detects a temperature of the ink in the ink head; and
a controller that controls the ink heater and the temperature sensor to adjust the heat to be emitted by the ink heater so that the temperature of the ink detected by the sensor is within a predetermined temperature range.

21. The inkjet printer according to claim **11**, further comprising:
a carriage slidably provided on a guide rail that extends a main scanning direction; wherein
the ink head and the light emitter are provided on the carriage.

22. The inkjet printer according claim **21**, wherein the heat relay is provided on the carriage.

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