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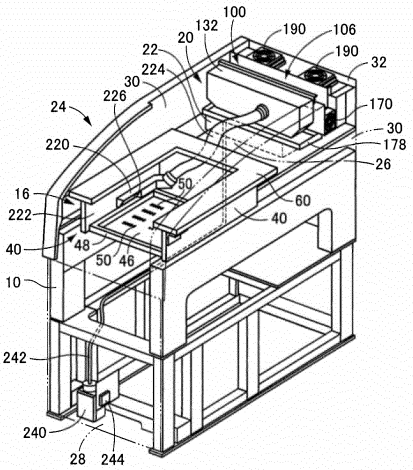
(54) SCREEN PRINTER

(57) To provide an improved temperature control device in an inner space of a screen printer. A temperature control device 20 is disposed in the inner space of a printer covered with a cover 24. A heating/cooling unit 100 thereof is disposed by being fixed to a printer main body 10 behind a mask holding device 16 within an upper section of the inner space. Four heating/cooling units 100 which heat and cool air by using a Peltier device assembly are disposed side by side in a width direction of the printer. A heat exchanger and a fan on a temperature control side are surrounded by a common housing 132. The air whose temperature is controlled inside the housing 132 is supplied to a blower 220 disposed adjacent to a mask 46 by using a hose 224, and is caused to blow to a squeegee moving region so as to control the temperature. Heat is radiated and absorbed by the heat exchanger and the fan on a side opposite to the temperature control side of the Peltier device assembly. Furthermore, a fan 190 promotes exhausting of air, thereby efficiently controlling the temperature.

[FIG. 1]



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Description

Technical Field

[0001] The present invention relates to a screen printer, and particularly relates to temperature control inside a screen printer.

Background Art

[0002] PTL 1 described below discloses a screen printer which controls a temperature inside a surrounding cover by covering a squeegee using the surrounding cover. The surrounding cover and temperature control device for controlling the temperature inside the surrounding cover are disposed on a moving plate which holds and moves the squeegee along a mask, and are moved together with the squeegee and solder moved on the mask by the squeegee. This enables the solder to be printed on a board in an atmosphere where the temperature is always controlled so as to be suitable for printing.

Citation List

Patent Literature

[0003] PTL 1: JP-A-7-323516

Summary of Invention

Technical Problem

[0004] However, a screen printer in the related art has points to be improved. For example, it is necessary to supply power or a signal to temperature control device which is moved together with a squeegee. Since a configuration of a printer becomes complicated, there is room for improvement.

[0005] The invention is made in view of the above-described circumstances, and an object thereof is to improve a temperature control device which controls a temperature inside a screen printer.

Solution to Problem

[0006] The above-described object is achieved in such a way that a heating/cooling unit of a temperature control device for controlling temperature inside a screen printer is disposed by fixing a position thereof inside the printer.

[0007] For example, a circuit substrate includes (a) a printed wiring board on which an electronic circuit component is not mounted, (b) a printed circuit board in which the electronic circuit component is mounted on and electrically connected to one face, and in which the electronic circuit component is not mounted on the other face, (c) a substrate which has a bare chip mounted thereon and configures a chip-mounted board, (d) a substrate on which the electronic circuit component including a ball grid array is mounted, and (e) a substrate which has a three dimensional shape rather than a flat plate shape.

Advantageous Effects of Invention

[0008] According to the screen printer related to the invention, it is possible to control a temperature in a squeegee moving region inside the printer without moving the heating/cooling unit. The temperature is appropriately controlled for a temperature control target without adopting a complicated configuration for the screen printer.

Brief Description of Drawings

[0009]

[Fig. 1] Fig. 1 is a perspective view illustrating a state where a portion of a cover is removed from a screen printer according to an embodiment of the invention.
[Fig. 2] Fig. 2 is a side view illustrating a squeegee device of the above-described screen printer.
[Fig. 3] Fig. 3 is a perspective view illustrating a heating/cooling unit of a temperature control device in the above-described screen printer.
[Fig. 4] Fig. 4 is a side view (partial cross-sectional view) illustrating the above-described heating/cooling unit.
[Fig. 5] Fig. 5 is a perspective view illustrating an air guiding device of the above-described temperature control device.
[Fig. 6] Fig. 6 is a block diagram illustrating a control device in the screen printer.
[Fig. 7] Fig. 7 is a front view illustrating a heating/cooling unit of a temperature control device in a screen printer according to another embodiment.
[Fig. 8] Fig. 8 is a side view (partial cross-sectional view) illustrating the heating/cooling unit illustrated in Fig. 7.

Description of Embodiments

[0010] Hereinafter, embodiments according to the invention will be described with reference to the drawings. In addition to the following embodiments, the invention can be modified in various ways, based on knowledge of those skilled in the art.

[0011] Fig. 1 illustrates a screen printer (hereinafter, abbreviated as a printer) according to an embodiment of the invention. Except for a part related to the invention, this printer has a configuration similar to a printer disclosed in JP-A-2011-230353, and thus this printer will be briefly described. As illustrated in Fig. 2, this printer includes a printer main body 10, a circuit board conveyance device 12 serving as a circuit substrate conveyance device, a circuit board holding device 14 serving as a circuit substrate holding device, a mask holding device 16, a squeegee device 18, a temperature control device 20,

and a control device 22 (refer to Fig. 6). This printer is entirely covered with a cover 24. As partially illustrated by a solid line and partially illustrated by a two-dot chain line in Fig. 1, the cover 24 includes a top wall 26, a front wall 28, a pair of side walls 30, and a rear wall 32, and is attached to the outside of the printer main body 10. The circuit board conveyance device 12 and the like are disposed in an inner space of the printer surrounded by the cover 24.

[0012] In the present embodiment, the circuit board conveyance device 12 is configured to include a belt conveyor, and horizontally conveys a circuit board 36 (hereinafter, abbreviated as a board 36, refer to Fig. 2) which is one type of circuit substrates. In the present embodiment, a "circuit board" is a general term for a printed wiring board and a printed circuit board. In addition, in this description, a board conveyance direction which represents a conveyance direction of the board 36 is referred to as a lateral direction or a width direction, and a direction orthogonal to the board conveyance direction is referred to as a longitudinal direction. In the present embodiment, both the lateral direction and the longitudinal direction are horizontal. As illustrated in Fig. 2, the circuit board conveyance device 12 is arranged in a front section of the printer main body 10. The circuit board holding device 14 is disposed in the middle of the circuit board conveyance device 12 in the board conveyance direction, and includes a board support device and board clamping device. The circuit board holding device 14 is raised and lowered by a raising and lowering device 38.

[0013] As illustrated in Fig. 2, the mask holding device 16 is disposed above the circuit board conveyance device 12. The mask holding device 16 includes a pair of mask frame supports 40 illustrated in Fig. 1, a mask fixing device 42 (refer to Fig. 6), and a position control device 44 (refer to Fig. 6), and horizontally holds a screen mask 46 (hereinafter, referred to as a mask 46). The mask 46 extends to a mask frame 48. Multiple through-holes 50 are formed in the mask 46.

[0014] As illustrated in Fig. 2, the squeegee device 18 includes a squeegee device main body 60, a pair of squeegee heads 62, a squeegee moving device 64, and a pair of squeegee raising and lowering devices 66 (refer to Fig. 6). The squeegee device main body 60 is fixed to an upper face of the mask frame support 40. The squeegee moving device 64 includes a squeegee slide 70 serving as a movable member, and a squeegee slide drive device 72. The squeegee slide drive device 72 according to the present embodiment includes multiple pulleys 74, a belt 76 wound around the multiple pulleys 74, and an electric motor 78 which rotatably drives one of the multiple pulleys 74. While guiding the squeegee slide 70 to a guide rod 82 serving as a guide member, the squeegee slide drive device 72 moves the squeegee slide 70 in the longitudinal direction. As the pulley 74 and the belt 76, it is suitable to use a timing pulley and a timing belt. As the electric motor 78, it is suitable to use an electric motor such as a servo motor which can control a rotation angle.

[0015] The pair of squeegee raising and lowering devices 66 are disposed in the squeegee slide 70, and respectively raise and lower the squeegee heads 62. As illustrated in Fig. 2, the pair of squeegee heads 62 respectively include a squeegee holding member 90 and a squeegee 92. The squeegee 92 has a longitudinally extending plate shape, is disposed so that the longitudinal direction is parallel to the width direction of the printer, and is moved in the longitudinal direction by the squeegee moving device 64.

[0016] In the present embodiment, as illustrated in Fig. 3, the temperature control device 20 includes a heating/cooling unit 100, an airflow generation device 102, and an air guiding device 104, and is arranged inside the printer. The heating/cooling unit 100 is disposed in at least one location, for example, at multiple locations (four locations in the present embodiment). In the present embodiment, as illustrated in Figs. 1 and 2, the heating/cooling units 100 are arranged behind the mask holding device 16, the circuit board holding device 14, and the squeegee moving device 64 which are arranged in the front section of the printer main body 10, within an upper section inside the inner space covered with the cover 24 of the printer. In the present embodiment, the four heating/cooling units 100 configure a heating/cooling device 106. The heating/cooling units 100 have the same configuration, and thus one heating/cooling unit 100 will be described as a representative.

[0017] In the present embodiment, the heating/cooling unit 100 heats and cools air by using a Peltier device. Therefore, as illustrated in Fig. 4, the heating/cooling unit 100 includes a Peltier device assembly 110. The Peltier device assembly 110 includes a semiconductor element group 112 in which multiple metal electrodes, multiple p-type semiconductors, multiple n-type semiconductors are connected to one another in a plate shape, and a pair of heat radiating plates 114 and 116 interposing the semiconductor element group 112 therebetween from both sides. One heat radiating plate 114 configures a first unit of the Peltier device assembly 110, and a heat exchanger 118 is closely attached thereto so as to configure a first heat transfer body, and a fan 120 is attached thereto. The other heat radiating plate 116 configures a second unit of the Peltier device assembly 110, and a heat exchanger 122 is closely attached thereto so as to configure a second heat transfer body, and a fan 124 is attached thereto.

[0018] As illustrated in Fig. 3, each of the Peltier device assemblies 110 having four heating/cooling units 100 is fixed to a common attachment member 130. The attachment member 130 has a plate shape. The four Peltier device assemblies 110 are attached side by side in one row so as to be parallel to the width direction of the printer. As illustrated in Fig. 4, the Peltier device assembly 110, the heat exchanger 118, and the fan 120 protrude from one face of the attachment member 130, and a surrounding space thereof is surrounded by a housing 132 serving as a first housing. The housing 132 is common to the

four heating/cooling units 100, and surrounds each heat exchanger 118 and each fan 120. In this manner, an inner space thereof configures a common temperature control chamber 133.

[0019] As illustrated in Fig. 4, the housing 132 is formed by integrally assembling multiple plates to one another, and includes a top wall 134, a front wall 136, a pair of side walls 138 (refer to Fig. 3), and a bottom wall 140. The attachment member 130 configures a rear wall of the housing 132. A heat insulating material 142 adheres to an inner side face of these walls 134, 136, 138, and 140. The heat insulating material 142 also adheres to the attachment member 130 excluding the four Peltier device assemblies 110, thereby insulating the temperature control chamber 133. In Fig. 3, illustration of the heat insulating material 142 is omitted. As illustrated in Fig. 4, vertically penetrating holes 146 are disposed on the bottom wall 140 of the housing 132. Multiple holes 146 are disposed in a direction parallel to a direction where the heating/cooling units 100 are arrayed side by side, at appropriate intervals. In the present embodiment, multiple holes 146 are disposed side by side at equal intervals. A temperature-controlled air extracting body 148 (hereinafter, abbreviated as an extracting body 148) for extracting air whose temperature is controlled by being heated or cooled in the temperature control chamber 133 (hereinafter, abbreviated as temperature-controlled air) is attached to one of the four fans 120. A connection portion 150 of the extracting body 148 protrudes outward of the housing 132 from the front wall 136.

[0020] As illustrated in Fig. 4, the heat exchanger 122 and the fan 124 protrude from the other face of the attachment member 130, and a surrounding space thereof is surrounded by a housing 160 serving as a second housing. The housing 160 is also common to the four heating/cooling units 100, and entirely surrounds the heat exchanger 122 and the fan 124. The housing 160 includes a pair of side walls 162 (one side wall 162 is illustrated in Fig. 3, and the other side wall 162 is illustrated in Fig. 4), a rear wall 164, and a bottom wall 166. The attachment member 130 configures a front wall. The housing 160 is open upward. An opening 168 is disposed in a portion opposing each of the four fans 124 on the rear wall 164.

[0021] Fans 170 are respectively attached to the pair of side walls 162. Fig. 3 illustrates one side wall 162 and one fan 170, and Fig. 4 illustrates the other side wall 162 and the other fan 170. The fans 170 serve as an air suction fan for sucking external air of the printer into the housing 160, and a space inside the housing 160 serves as an air suction chamber 172. As illustrated in Fig. 4, a saucer 174 is disposed below the heat exchanger 122 inside the air suction chamber 172. The saucer 174 is disposed throughout the four heat exchangers 122. Holes 176 which vertically penetrate a bottom portion of the saucer 174 and the bottom wall 166 are formed therein. The multiple holes 176 are disposed at appropriate intervals (in the present embodiment, disposed side by side at equal intervals) in a direction parallel to a direction where the heating/cooling units 100 are arrayed side by side. Fig. 4 illustrates one hole 176.

[0022] As illustrated in Fig. 4, a saucer 178 is disposed below the housings 132 and 160. The saucer 178 is long in the direction where the heating/cooling units 100 are arrayed side by side, and is disposed so as to oppose all of the holes 146 of the housing 132 and the holes 176 of the housing 160. In addition, as illustrated in Fig. 3, a bottom face of the saucer 178 is tilted downward as the bottom face is oriented from one side toward the other side in a direction where the four Peltier device assemblies 110 are arrayed side by side. As illustrated in Fig. 4, the bottom face of the saucer 178 is tilted downward as the bottom face is oriented from a front side toward a rear side of the printer.

[0023] As illustrated in Fig. 4, another housing 180 is attached to a rear side of the housing 160. The housing 180 includes a front wall 182, a pair of side walls 184 (one side wall 184 is illustrated in Fig. 3, and the other side wall 184 is illustrated in Fig. 4), a bottom wall 186, and a rear wall 187. Four openings 188 corresponding to each of the four openings 168 of the housing 160 are formed on the front wall 182 which is closely attached to the rear wall 164 of the housing 160. As illustrated in Fig. 3, a pair of fans 190 while facing upward are attached to an upper portion of the housing 180. The fans 190 are disposed at intervals in the width direction of the printer, and discharge the air inside the housing 180 outward from the printer. The fans 190 configure an exhaust fan, and a space inside the housing 180 serves as an air exhaust chamber 192. Furthermore, a vertically penetrating opening 194 is formed on the bottom wall 186. The opening 194 is disposed in at least one location. For example, multiple openings 194 (four in the present embodiment) are disposed at appropriate intervals (in the present embodiment, disposed side by side at equal intervals) in the direction where the heating/cooling units 100 are arrayed side by side.

[0024] As illustrated in Fig. 4, the four heating/cooling units 100, the housing 180, and the fans 170 and 190 which are integrally disposed in this way are fixed to the inside of the cover 24, and are fixed to the printer main body 10 via the cover 24. Openings 204 and 206 are disposed in portions respectively corresponding to the housings 160 and 180 of the top wall 26 in the cover 24. The air suction chamber 172 and the air exhaust chamber 192 are open to an outer space of the printer. The fan 190 is disposed to face outward from the printer.

[0025] In the present embodiment, as illustrated in Fig. 1, air heated and cooled by the heating/cooling unit 100 is caused to blow from a temperature-controlled air blower 220 (hereinafter, abbreviated as a blower 220) disposed in the mask frame support 40 toward a moving region of the squeegee 92 above the mask 46, and then the temperature in the squeegee moving region is controlled. The temperature in the inner space of the printer which is covered with the cover 24 increases due to op-

erations of various devices. In this manner, liquid contained in solder placed on the mask 46, that is, flux evaporates, and viscosity of the solder increases, thereby causing difficulties in printing. On the other hand, even when the temperature becomes low, the viscosity of the solder increases, thereby causing difficulties in printing. For this reason, the temperature in the squeegee moving region is controlled.

[0026] As illustrated in Fig. 5, the blower 220 has a longitudinal shape, and is attached to an upper side portion from the mask frame 48 on a vertical side wall 222 of the mask frame support 40 so that a longitudinal direction thereof is parallel to a printing direction. The blower 220 has a tubular shape, and a heat insulating material (not illustrated) adheres to the inside thereof. As illustrated in Fig. 1, a rear end portion of the blower 220 is connected to a connection portion 150 of the extracting body 148 by using a hose 224 serving as a connection member. The hose 224 is flexible, and a heat insulating material (not illustrated) is wound around the hose 224 for insulation. In Fig. 2, illustration of the blower 220 and the hose 224 is omitted.

[0027] A front end portion of the blower 220 is arranged in a central portion in the longitudinal direction of the pair of mask frame supports 40, and an opening 226 is formed on a side face thereof. As illustrated in Fig. 5, the opening 226 is long in a direction parallel to the longitudinal direction, and is tilted downward in a direction away from the mask 46. The opening 226 is open toward the mask 46. A filter 228 is detachably attached to the opening 226. A fan 230 is disposed in the vicinity of the opening 226 inside the blower 220. In the present embodiment, the fan 230 serves as a static pressure fan. In addition, a vertically penetrating hole 232 is disposed on an upper wall of a portion corresponding to the opening 226 of the blower 220, thereby configuring an outlet. A temperature sensor 234 is attached to a portion directly above the exit of the hole 232 outside the blower 220, and detects the temperature of the air inside the blower 220 which flows out from the hole 232. The hole 232 is disposed in the vicinity of the opening 226. The temperature of the flowing-out air is the same as the temperature of the air blowing from the opening 226 toward the squeegee moving region. The temperature of the blowing air is detected by the temperature sensor 234. A diameter of the hole 232 is sized so as to allow adequate detection of the temperature without outflow of the air affecting outflow of the blowing air.

[0028] As illustrated in Fig. 1, a drain bottle 240 is arranged in a front lower section of the printer. The drain bottle 240 is arranged inside the cover 24, and is connected to the saucer 178 by a tube 242. Although not illustrated, a connection tube is disposed on a side below the lowest portion in the longitudinal direction and the width direction of the saucer 178, and the tube 242 is connected thereto. A full water level detecting sensor 244 serving as a drain water storage amount detecting device is attached to the drain bottle 240. For example, the full water level detecting sensor 244 is configured to include a capacitance sensor which is a non-contact-type sensor. The full water level detecting sensor 244 outputs an OFF signal when the water stored in the drain bottle 240 is less than a full amount of the water, and outputs an ON signal at the time of the full amount of the water.

[0029] As illustrated in Fig. 6, the control device 22 is configured to mainly have a computer 250 including a CPU, a RAM, a ROM, and an I/O port, and is arranged inside the printer. As illustrated in Fig. 1, the control device 22 is disposed in a rear section on a middle stage of the printer main body 10. The heating/cooling unit 100 is located above the control device 22. Various detection devices and operation devices are connected to the computer 250. Among the devices, a device having a close relationship with the invention is illustrated. The computer 250 controls a drive source of the operation devices such as the circuit board conveyance device 12 or a warning device 254 via a drive circuit 252. Among the pair of squeegee raising and lowering devices 66 and the four Peltier device assemblies 110, each one is illustrated as a representative. For example, the warning device 254 is configured to include a display device having a display screen, and issues a warning by displaying a message on the display screen. The warning device may issue a warning by device of buzzer sounding, lamp lighting, lamp blinking, or a voice. In addition, the temperature sensor 234 and the full water level detecting sensor 244 are connected to the computer 250.

[0030] During printing in the printer configured as described above, the board 36 is conveyed by the circuit board conveyance device 12, is stopped at a predetermined position, and thereafter is held by the circuit board holding device 14. Then, a fiducial mark imaging device (not illustrated) images fiducial marks respectively disposed in the board 36 and the mask 46, and the position control device 44 performs positioning between the mask 46 and the board 36. The blower 220 is attached to the mask frame support 40, and a position of the blower 220 with respect to the mask 46 is not changed even after the positioning is performed. The hose 224 is flexible, and allows movement of the blower 220 which is caused by movement of the mask frame support 40 during the positioning. After the position is controlled, the circuit board holding device 14 is raised by the raising and lowering device 38, and the board 36 is brought into contact with a lower face of the mask 46. Then, one of the pair of squeegees 92 is lowered and moved in a state of being in contact with the mask 46. The squeegee 92 pushes and sends solder placed on the mask 46 along the mask 46 into the through-hole 50, thereby printing the solder on the board 36. After the printing, the board 36 is lowered and separated from the mask 46. The board 36 is released and conveyed outward from the circuit board holding device 14.

[0031] The temperature control device 20 controls a temperature by causing the blower 220 to blow warm air or cool air which is temperature-controlled air to a central

portion in the printing direction in the squeegee moving region. In this printer, a temperature of the blowing air is acquired in advance in a state where temperature suitable for the squeegee moving region can be obtained, and the temperature is set to a target temperature. If the temperature of the blowing air which is detected by the temperature sensor 234 is the target temperature, the temperature in the squeegee moving region is controlled to be suitably high. The temperature sensor 234 is disposed in a front end portion of the blower 220, and detects the temperature of the central portion in the squeegee moving region. The heating/cooling unit 100 performs a heating operation if the temperature detected by the temperature sensor 234 is lower than the target temperature, and performs a cooling operation if the temperature is higher than the target temperature.

[0032] The computer 250 controls operation switching of the heating/cooling unit 100. During the cooling, a current to be supplied to the Peltier device assembly 110 is controlled so that heat is absorbed by the heat radiating plate 114 side and heat radiation is performed by the heat radiating plate 116 side. In this manner, the four heat exchangers 118 are cooled. In addition, the four fans 120 are rotated so that the air inside the printer is sucked into the temperature control chamber 133 through the holes 146 and is cooled while being circulated. The cool air is fed from the extracting body 148 attached to one of the four fans 120 to the hose 224, and is supplied to the blower 220. Although the heating/cooling unit 100 and the blower 220 are separated from each other, the rotation of the fan 230 allows the cool air to be efficiently supplied to the blower 220 through the hose 224. As illustrated by a two-dot chain line in Fig. 5, the cool air blows to the squeegee moving region through the filter 228. The diameter and the number of the holes 146 are set so that an amount of the air sucked into the temperature control chamber 133 is substantially the same as an amount of the air blowing from the blower 220. In the present embodiment, the blower 220, the hose 224, and the fan 230 configure the air guiding device 104.

[0033] The opening 226 is long in the longitudinal direction, and the cool air blows to a wide region in the squeegee moving region. In addition, air flow obtained by the rotation of the fan 230 is weakened by the filter 228, and is uniformly distributed. The air flow is not concentrated on one location, and air having a suitable air amount blows to the squeegee moving region, thereby preventing flux from being dried. The filter 228 removes foreign substances which may be contained in the air flowing out from the opening 226, for example, dust or dirt. When the filter 228 becomes clogged due to dust, a worker detaches the filter 228 from the opening 226, and cleans the filter 228.

[0034] Condensation occurs inside the housing 132 due to the cooled air. Drain water generated due to the condensation is discharged through the holes 146, and is received by the saucer 178. Tilting therebetween causes the drain water to flow into the tube 242 illustrated in Fig. 1. Then, a difference in height between the saucer 178 and the drain bottle 240 causes the drain water to accumulate in the drain bottle 240 through the tube 242. The holes 146 serve as not only air suction holes but also drain holes. If the drain bottle 240 is full of the water and an ON signal is input to the computer 250, the warning device 254 issues a warning. In this manner, a worker performs appropriate processing such as replacement of the drain bottle 240 with an empty drain bottle 240, and resetting the drain bottle 240 in the printer after detaching the drain bottle 240 and discarding the accumulated water. The drain bottle 240 is disposed in the front end section of the printer, thereby facilitating the worker's work. For example, an opening is disposed or an openable lid is disposed in a portion corresponding to the drain bottle 240 in the cover 24, thereby enabling the worker's work.

[0035] During the cooling, in the heating/cooling unit 100, the temperature increases on the heat radiating plate 116 side of the Peltier device assembly 110. The heat is radiated from the heat exchanger 122, and the air inside the air suction chamber 172 is heated. The fans 124 and 170 are rotated in the housing 160. The rotation of the fan 170 draws the external air of the printer into the air suction chamber 172, thereby assisting the heat radiation of the heat exchanger 122. The rotation of the fan 124 causes the heated air inside the air suction chamber 172 to be fed to the air exhaust chamber 192 through the openings 168 and 188 as illustrated by an arrow in Fig. 4. Furthermore, the rotation of the fan 190 causes the air to be discharged outward from the printer through the opening 206. In this manner, the heat is efficiently discharged. The air inside the air suction chamber 172 is discharged outward from the printer through the air exhaust chamber 192 mainly by the fans 124 and 190. However, the housing 160 is open upward, and the air suction chamber 172 is open to the outer space of the printer by using the opening 204. Accordingly, if the air suction using the fan 170 exceeds the air exhaust using the fan 190, the air is exhausted from the opening 204, and the heat radiation is assisted. If the air exhaust using the fan 190 exceeds the sir suction using the fan 170, the air is sucked through the opening 204. In any case, the discharge chamber 192 is disposed independently from the air suction chamber 172, and the two fans 170 and the four fans 124 are disposed in series in the air suction chamber 172. Furthermore, the two fans 190 of the air exhaust chamber 192 are disposed in series with respect to the fans 170 and 124. In this manner, it is possible to achieve a heating/cooling device 106 which has a sufficient exhaust flow rate while having a compact configuration using multiple fans with a small diameter. According to the heating/cooling device 106, the heat is efficiently radiated in the heating/cooling unit 100, and the temperature of the air in the temperature control chamber 133 is efficiently controlled. In addition, as illustrated by the arrow in Fig. 4, the heat generated from the control device 22 arranged below the heating/cooling unit

100 is discharged outward from the printer through the opening 194 of the housing 180 and the opening 206 of the cover 24, and is discharged outward from the printer by the rotation of the fan 190.

[0036] When the temperature is caused to increase in the squeegee moving region, a current is supplied to the Peltier device assembly 110 so that the heat is absorbed on the heat radiating plate 116 side and the heat is radiated on the heat radiating plate 114 side. Then, the air sucked into the housing 132 from the holes 146 is heated, is supplied to the blower 220, and is caused to blow to the squeegee moving region. When warm air blows, the fans 124, 170, and 190 are also rotated. The air inside the air suction chamber 172 is positively discharged, thereby efficiently generating the warm air. In some cases, the air is discharged or sucked through the opening 204. In addition, although condensation occurs inside the housing 160, drain water is received by the saucer 174, is received by the saucer 178 through the holes 176, and then is collected by the drain bottle 240.

[0037] The Peltier device assembly 110 is miniaturized, and thus, it is possible to achieve a compact configuration of the heating/cooling unit 100 by using the Peltier device assembly 110. Therefore, the heating/cooling unit 100 may be suitably arranged in a limited space such as the inside of the printer. The heating/cooling unit 100 can be disposed at multiple locations, and thus it is possible to achieve a temperature control device 20 whose installation space is small and which has superior heating and cooling capability. In particular, even when the four heating/cooling units 100 are surrounded by one housing 132 so as to circulate the air inside the common temperature control chamber 133, it is possible to achieve temperature control capability equivalent to that of a heating/cooling device having high capacity.

[0038] In addition, the temperature control chamber 133 and the air suction chamber 172 are disposed independently from each other. The temperature control chamber 133 is insulated by the heat insulating material 142, and is shielded from the inner space of the printer and the air suction chamber 172. Therefore, the air heated or cooled inside the temperature control chamber 133 does not mix with the air heated or cooled on the heat radiating plate 116 side of the Peltier device assembly 110, and thus the temperature is efficiently controlled.

[0039] Furthermore, the heating/cooling unit 100 is disposed behind the mask holding device 16. Accordingly, a worker is not hindered from checking an operation while looking into the inside of the printer through a window (not illustrated) disposed in the front portion of the cover 24. The heating/cooling unit 100 is separated from the squeegee moving region which is a temperature control target. However, the blower 220 is disposed in the squeegee moving region, and the temperature-controlled air is supplied by the hose 224. Accordingly, the temperature is efficiently controlled without any hindrance.

[0040] Furthermore, if the heating/cooling unit 100 is disposed inside the printer, without a need to secure the installation space for the heating/cooling unit as in a case where the heating/cooling unit is disposed outside the printer, the printer sufficiently secures a smaller installation space. In addition, when configuring a printing system including multiple printers, or an electronic circuit assembly system including at least one printer and a board working machine in addition to the printer, for example, an electronic-circuit-component mounting machine, it is sufficient to consider only the arrangement of a single of the printer, thereby allowing an easy configuration. Furthermore, a shuttle conveyor for conveying boards is easily disposed so as to be adjacent to the printer.

[0041] Furthermore, the configuration is suitably used in matching two printers back to back. For example, if the heating/cooling unit is disposed outside the printer, when the printers are the same type, positions of the heating/cooling units are laterally reversed in the two printers matched back to back, and thus the installation space becomes larger. In addition, since the heating/cooling units are disposed in the rear section of the printer, the heat is collectively discharged from the two printers matched back to back, in the central portion of the printers in the longitudinal direction.

[0042] As is apparent from the above description, in the present embodiment, the fan 120 configures the airflow generation device 102, and the fans 124, 170, and 190 configure an air exhaust device. The fan 170 sucks external air into the air suction chamber 172, the fan 124 discharges the air inside the air suction chamber 172 to the air exhaust chamber 192, the fan 190 discharges the air outward from the air exhaust chamber 192. In this manner, the air suction chamber 172 is ventilated by using the external air.

[0043] The air suction fan 170 of the air suction chamber 172 may be disposed in the upper section of the housing 160. Instead of the air suction fan 170, an air sucking opening may be disposed in the upper section or on the side face of the housing 160.

[0044] In addition, the air inside the housing 160 may be directly discharged outward from the printer from the housing 160 by omitting the air exhaust chamber 192. In this case, one fan and one opening may be disposed in the housing 160. In this manner, one may be used for the purpose of the air suction, and the other may be used for the purpose of the air exhaust. Alternatively, one may be used as an air suction fan, and the other may be used as an air exhaust fan by disposing two fans therein. Alternatively, one may be used as an air suction port, and the other may be used as an air exhaust port by disposing two openings therein.

[0045] When the temperature control device includes multiple heating/cooling units, multiple heating/cooling units may be disposed by being connected to one another in series. An example thereof will be described with reference to Figs. 7 and 8.

[0046] As illustrated in Fig. 7, the temperature control device according to the present embodiment includes

multiple (for example, three) heating/cooling units 302. In the present embodiment, three heating/cooling units 302 configure a heating/cooling device 303. As illustrated in Fig. 8, similarly to the heating/cooling units 100, the heating/cooling units 302 respectively include a Peltier device assembly 304, a heat exchanger 308 and a fan 310 which are disposed on a heat radiating plate side for configuring a first unit, and a heat exchanger 312 and a fan 314 which are disposed on a heat radiating plate side for configuring a second unit.

[0047] Each Peltier device assembly 304, the heat exchanger 308, and the fan 310 of the three heating/cooling units 302 are surrounded by the separate housings 320 which are independent from each other. A space inside the respective housings 320 is vertically divided into three by horizontal plate-shaped partition members 322 located along a rotational axis of the fan 310 and partition members 323 located below the partition member 322. As a result, the fan 310 is disposed across an upper side chamber 324 and a lower side chamber 326 of the partition member 322, and a suction chamber 328 is formed below the two chambers 324 and 326. The suction chamber 328 is located away from the fan 310, and overlaps a portion of the heat exchanger 308. Each heat exchanger 312 and each fan 314 of the three heating/cooling units 302 are also surrounded by the housings 330 which are independent from each other. Although not illustrated, the inner space of the housings 330 communicates with a common air exhaust chamber configured to have a separate housing, due to the rotation of the air exhaust fan, the air inside the housing 330 is discharged outward from the printer.

[0048] As illustrated in Fig. 7, the three heating/cooling units 302 are attached to an attachment member 332 side by side in one row in a direction parallel to the width direction of the printer. The suction chamber 328 of the heating/cooling unit 302 in one end communicates with a space inside the printer through a suction port 334. The upper side chamber 324 is connected to the suction chamber 328 of the adjacent heating/cooling unit 302 by a hose 336 serving as a connection member. The upper side chamber 324 of the heating/cooling unit 302 is also connected to the suction chamber 328 of the heating/cooling unit 302 by the hose 336 in the other end. The upper side chamber 324 of the heating/cooling unit 302 is connected to a blower (not illustrated) by a hose 338. A heat insulating material 340 adheres to an inner surface of the housing 320. Holes (not illustrated) are disposed on a bottom wall of the housings 320 and 330, and a saucer is disposed below the holes.

[0049] In the respective heating/cooling units 302, as illustrated by an arrow in Fig. 8, the air is circulated through the heat exchanger 308 and both the chambers 324 and 326 by the fan 310, thereby controlling the temperature during that time. The circulating air partially flows out from a discharge port 342 of the upper side chamber 324, and the equivalent amount of air is sucked into the suction chamber 328 through the suction port 334. As a result, the air inside the printer which is sucked into the suction chamber 328 of the heating/cooling unit 302 in one end passes through the three heating/cooling units 302 sequentially while the temperature is controlled in the respective heating/cooling units 302, and is discharged from the heating/cooling unit 302 in the opposite side end to the squeegee moving region through the hose 338 and the blower.

[0050] In addition to a unit including the Peltier device assembly, the heating/cooling unit can employ a unit including a compressor.

[0051] In addition, the heating/cooling unit may be disposed adjacent to the temperature control target. In this case, it is possible to directly supply the temperature-controlled air to the temperature control target by omitting the hose for supplying the temperature-controlled air to the temperature control target and by disposing an outlet of the temperature-controlled air in the heating/cooling unit.

[0052] Furthermore, from a viewpoint of an advantage which can configure a compact heating/cooling device including multiple heating/cooling units whose main body is a small heating/cooling body such as the Peltier device assembly, it is not always necessary to arrange the heating/cooling device inside the screen printer. This compact heating/cooling device may be disposed outside the screen printer. Since a smaller space is required for the installation of the heating/cooling device, the heating/cooling device can be disposed while suppressing an increase in the installation space of the screen printer. In particular, if the heating/cooling device is disposed inside the installation space of the screen printer by disposing the heating/cooling device on the top wall of the cover in the screen printer, it is also possible to avoid the increase in the installation space. In addition, in addition to the screen printer, this heating/cooling device can be disposed in a circuit substrate working machine which carries out work for a circuit substrate, such as an electronic-circuit-component mounting machine which mounts an electronic circuit component on the circuit substrate.

Reference Signs List

[0053]

20: TEMPERATURE CONTROL DEVICE
46: SCREEN MASK
92: SQUEEGEE
100: HEATING/COOLING UNIT
110: PELTIER DEVICE ASSEMBLY
220: TEMPERATURE-CONTROLLED AIR BLOWER

Claims

1. A screen printer which causes a squeegee to push

and send paste solder placed on a screen mask along the screen mask, and which prints the paste solder on a circuit substrate through multiple through-holes formed on the screen mask,
wherein a temperature control device which includes a heating/cooling unit and controls a temperature in at least a moving region of the squeegee above the screen mask by using air whose temperature is controlled by the heating/cooling unit is arranged inside the screen printer, and
wherein the heating/cooling unit is fixed to a printer main body which is a main body of the screen printer.

2. The screen printer according to Claim 1,
wherein a mask holding device for holding the screen mask, a circuit substrate holding device for holding the circuit substrate, and a squeegee moving device for holding and moving the squeegee are arranged in a front section of the printer main body, and
wherein the heating/cooling unit is arranged behind the mask holding device, the circuit substrate holding device, and the squeegee moving device.

3. The screen printer according to Claim 1 or 2,
wherein the temperature control device includes an airflow generation device which generates airflow from a portion of an inner space of the screen printer toward the moving region of the squeegee through the heating/cooling unit.

4. The screen printer according to Claim 3,
wherein the temperature control device includes an air guiding device which guides air whose temperature is controlled by the heating/cooling unit to a space above the screen mask, and
wherein the air guiding device has an opening which is open toward the moving region of the squeegee, and the opening has a filter which removes foreign substances likely to be contained in air flowing out from the opening and diffuses the airflow.

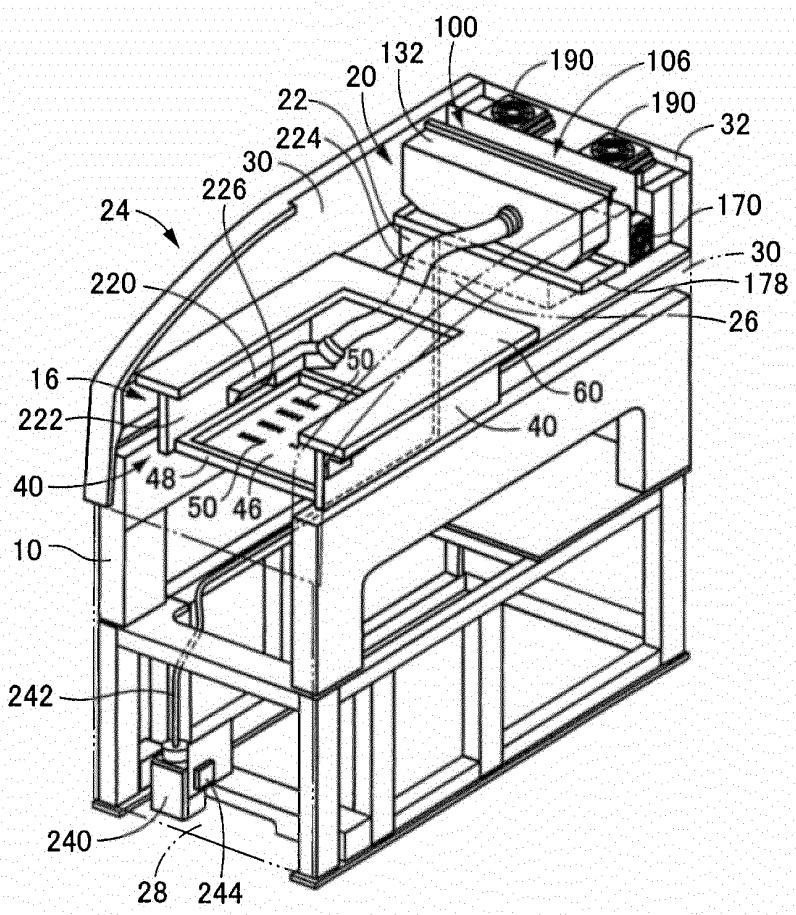
5. The screen printer according to Claim 4 further comprising:

a control device that controls the heating/cooling unit; and
a temperature sensor that is installed in the vicinity of an outlet disposed in the air guiding device,
wherein the control device controls the heating/cooling unit so that a temperature detected by the temperature sensor becomes a target temperature.

6. The screen printer according to any one of Claims 3 to 5,
wherein the heating/cooling unit includes a Peltier device assembly, a first heat transfer body which is brought into close contact with a first portion of the Peltier device assembly, a second heat transfer body which is brought into close contact with a second portion of the Peltier device assembly, a first housing which surrounds a space around the first heat transfer body, and a second housing which surrounds a space around the second heat transfer body, and
wherein there is provided an air discharge device which discharges the air inside the second housing outward from the screen printer while causing the airflow generation device to generate the airflow passing through the inside of the first housing.

7. The screen printer according to Claim 6,
wherein the heating/cooling unit is installed side by side at multiple locations in a width direction of the screen printer so as to configure a heating/cooling device.

[FIG. 1]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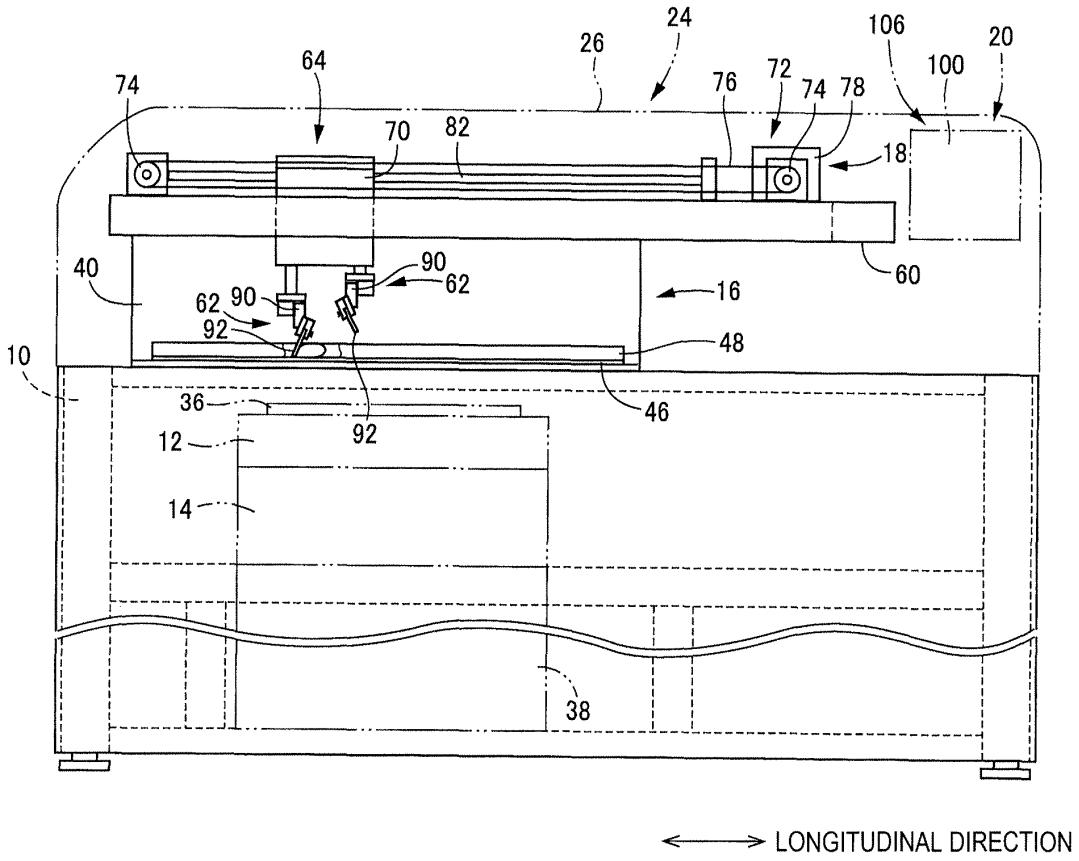
[FIG. 2]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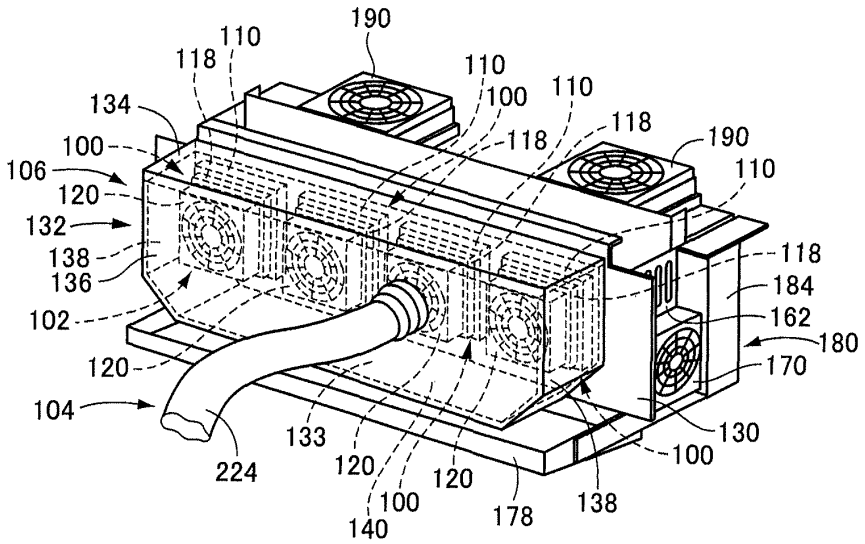
LONGITUDINAL DIRECTION

[FIG. 3]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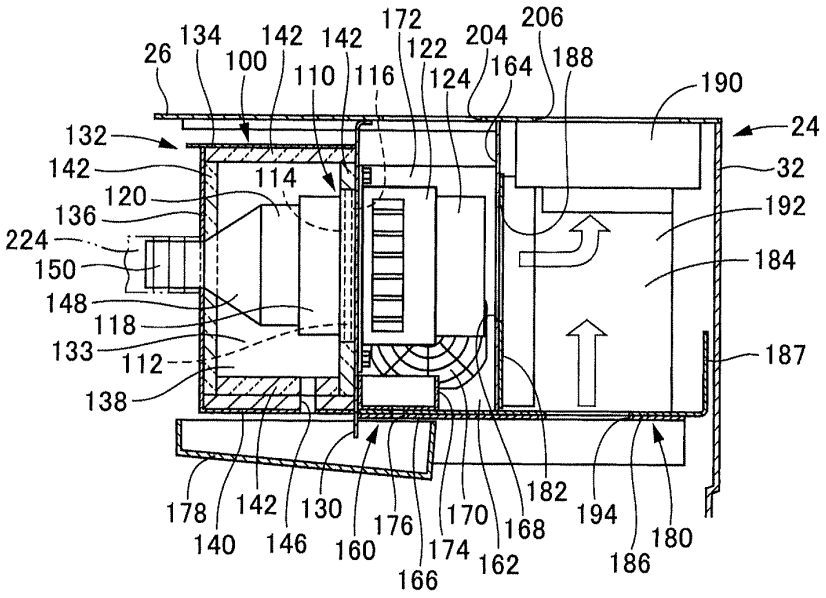
[FIG. 4]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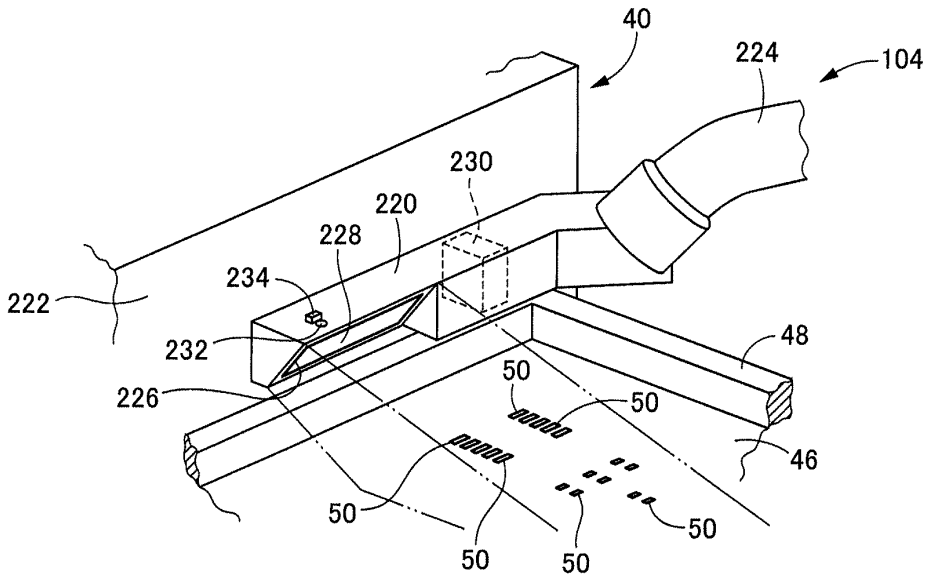
[FIG. 5]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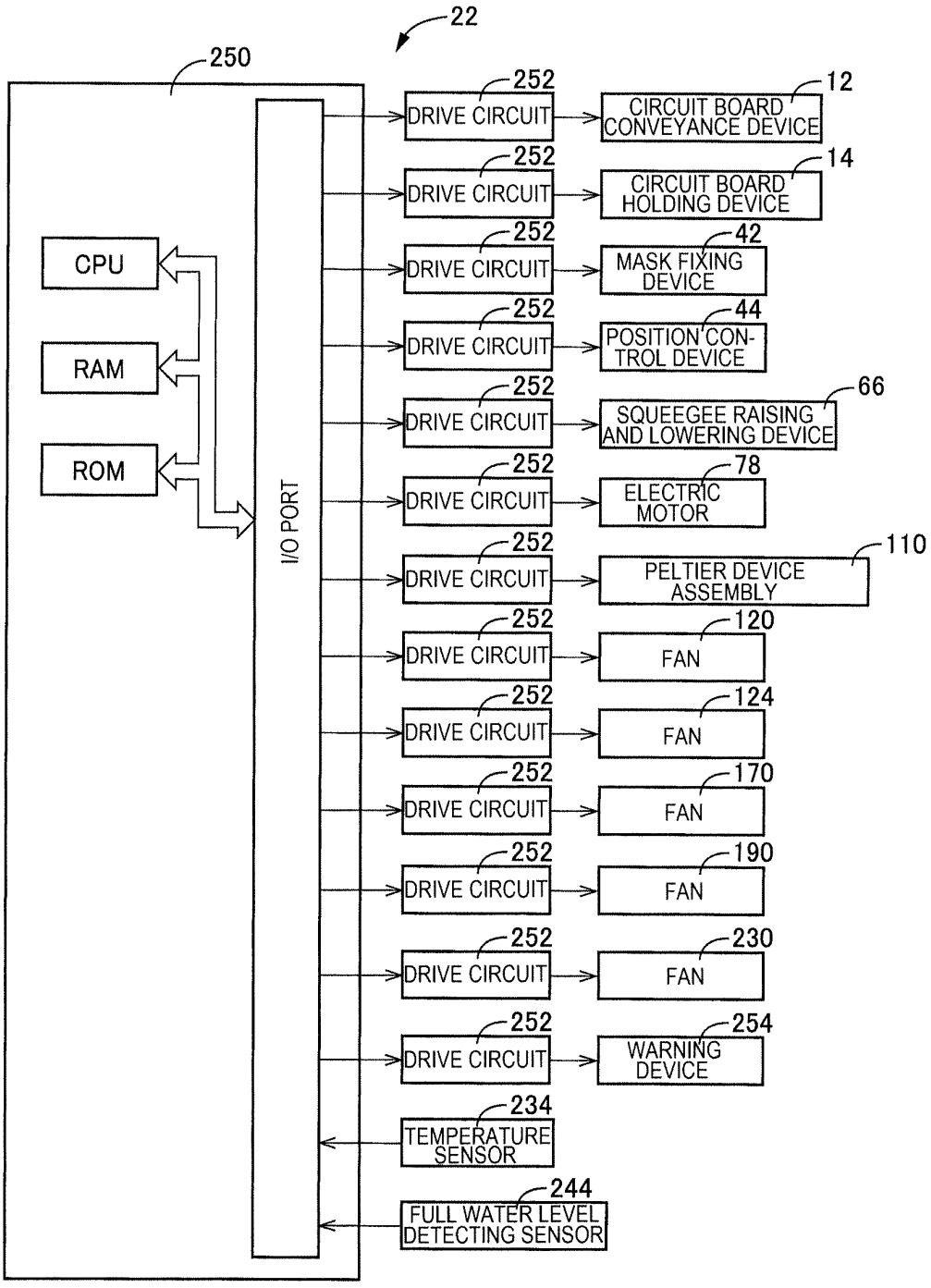
[FIG. 6]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14
CIRCUIT BOARD HOLDING DEVICE
42
MASK FIXING DEVICE
44
POSITION CONTROL DEVICE
66
SQUEEGEE RAISING AND LOWERING DEVICE
78
ELECTRIC MOTOR
110
PELTIER DEVICE ASSEMBLY
120
FAN
124
FAN
170
FAN
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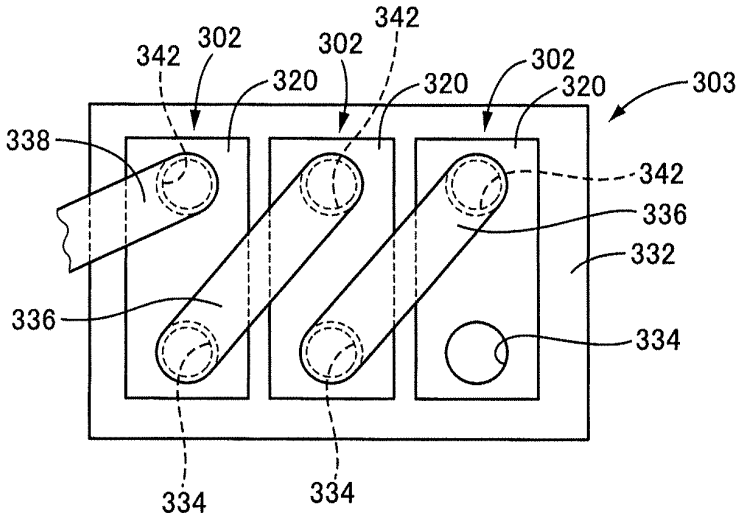
WARNING DEVICE
234
TEMPERATURE SENSOR
244
FULL WATER LEVEL DETECTING SENSOR

[FIG. 7]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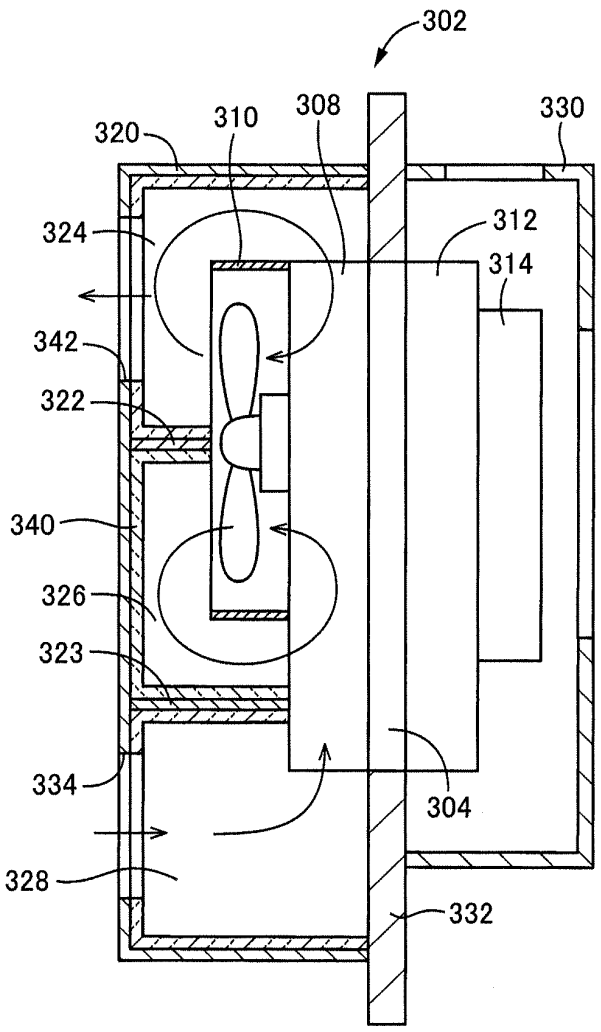
[FIG. 8]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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/050977

A. CLASSIFICATION OF SUBJECT MATTER
B41F15/12(2006.01)i, *B41F15/00*(2006.01)i, *B41F15/08*(2006.01)i, *B41F15/14*(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)
B41F15/12, B41F15/00, B41F15/08, B41F15/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2013
Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 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	JP 2001-47601 A (Tani Electronics Corp.), 20 February 2001 (20.02.2001), paragraphs [0014] to [0015], [0021], [0023]; fig. 1 (Family: none)	1-5 6-7
Y A	JP 2005-22093 A (Matsushita Electric Industrial Co., Ltd.), 27 January 2005 (27.01.2005), paragraphs [0016], [0025] (Family: none)	1-5 6-7
Y	JP 2006-72290 A (Ricoh Co., Ltd.), 16 March 2006 (16.03.2006), paragraphs [0060] to [0062], [0082]; fig. 1 to 2, 10, 12 (Family: none)	3-5

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 April, 2013 (02.04.13)	16 April, 2013 (16.04.13)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/050977

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2006-243686 A (Ricoh Co., Ltd.), 14 September 2006 (14.09.2006), paragraph [0027]; fig. 2 (Family: none)	3-5
Y	JP 2006-195357 A (Kyocera Mita Corp.), 27 July 2006 (27.07.2006), paragraphs [0060] to [0061]; fig. 5 to 6 (Family: none)	3-5

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 7323516 A **[0003]**
- JP 2011230353 A **[0011]**