

PROCESSING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a processing apparatus.

Description of the Related Art

There is a processing method of dividing a workpiece along projected dicing lines established on the workpiece to fragment the workpiece into a plurality of individual chips by forming grooves or modified layers as division initiating points in the workpiece along the projected dicing lines and thereafter expanding a sheet that supports the workpiece to widen chip-to-chip intervals on the workpiece from the division initiating points. The workpiece is supported in an opening of an annular frame by the sheet that is affixed to the workpiece and the annular frame. After the sheet has been expanded, an excess slackened region of the sheet that lies between an outer edge of the workpiece and an inner edge of the annular frame is caused to shrink in order to maintain the chip-to-chip intervals. Japanese Patent Laid-open No. 2019-117891, for example, discloses a dividing apparatus that includes a heating unit having

heaters or the like for appropriately heating an excess slackened region of an expansion sheet to shrink the same even if the expansion sheet is slackened or stretched in different patterns.

SUMMARY OF THE INVENTION

The disclosed dividing apparatus sets a heating area by establishing a path along which the heating unit is to move. Depending on the heating area setting, however, the excess slackened region of the expansion sheet may possibly include an unprocessed area where the expansion sheet has not been heated. Furthermore, in a case where the dividing apparatus has established a path that does not match intended conditions and hence has set a different heating area, the operator of the dividing apparatus may possibly leave it unnoticed due to oversight.

It is therefore an object of the present invention to provide a processing apparatus that is capable of assisting in confirming a heating area where a heating unit is to heat a sheet that supports a workpiece.

In accordance with an aspect of the present invention, there is provided a processing apparatus including a holding table having a holding surface for

holding a workpiece of a workpiece unit including an annular frame that has an opening, the workpiece being supported in the opening by a sheet affixed to the workpiece and the annular frame, a frame holding unit for holding the annular frame thereon, the frame holding unit having a rest surface for placing the annular frame thereon, a lifting and lowering mechanism for lifting and lowering the holding surface relatively to the rest surface, a heating unit for heating an exposed area of the sheet between an inner edge of the annular frame and an outer edge of the workpiece, a moving mechanism for moving the heating unit relatively to the holding surface, and a control unit, in which the control unit includes a setting section for setting heating conditions for the heating unit to heat the sheet, and a simulating section for estimating heating areas where the heating unit is to heat the workpiece unit on the basis of the heating conditions and generating an image in which the heating areas for the workpiece unit can be identified.

In the processing apparatus, the simulating section may generate an image in which an order in which a plurality of the heating areas corresponding to a plurality of the heating conditions are to be heated can be identified.

In the processing apparatus, the simulating section may generate an image in which one of the heating areas corresponding to any one of the heating conditions included in a heating sequence in which the sheet is heated successively under a plurality of the heating conditions can be identified.

In the processing apparatus, the simulating section may generate an image in which a heating area having a relatively high heating intensity and a heating area having a lower heating intensity can be identified.

The processing apparatus may further include a display unit, in which the control unit may display the image generated by the simulating section on the display unit.

The processing apparatus may be connectable to an information device having a display screen, and the control unit may output information regarding the image generated by the simulating section to the information device.

In the processing apparatus, the setting section may accept a setting of the heating conditions through a touch panel or an information device.

The processing apparatus according to an aspect of the present invention is advantageous in that it can

assist in confirming a heating area where a heating unit is to heat a sheet that supports a workpiece.

The above and other objects, features and advantages of the present invention and the manner of realizing them will become more apparent, and the invention itself will best be understood from a study of the following description and appended claims with reference to the attached drawings showing a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view illustrating an example of a workpiece unit to be divided by a processing apparatus according to an embodiment of the present invention;

FIG. 2 is a perspective view illustrating a configurational example of the processing apparatus according to the embodiment;

FIG. 3 is a cross-sectional view taken along line III - III across a sheet expansion unit of the processing apparatus illustrated in FIG. 2;

FIG. 4 is a top plan view of a heating unit of the processing apparatus illustrated in FIG. 2;

FIG. 5 is a functional block diagram of the heating unit of the processing apparatus illustrated in FIG. 2;

FIG. 6 is a cross-sectional view taken along line VII - VII across the heating unit illustrated in FIG. 4;

FIG. 7 is a functional block diagram illustrating, by way of example, a control unit of the processing apparatus illustrated in FIG. 2;

FIG. 8 is a diagram illustrating, by way of example, a screen for setting heating condition data;

FIG. 9 is a view illustrating, by way of example, an image of a workpiece unit used by the processing apparatus;

FIG. 10 is a diagram illustrating an example of the relation between heating condition data and an image including heating areas;

FIG. 11 is a diagram illustrating another example of the relation between heating condition data and an image including heating areas;

FIG. 12 is a diagram illustrating still another example of the relation between heating condition data and an image including heating areas;

FIG. 13 is a flowchart illustrating, by way of example, the processing sequence of a control process to be performed by the processing apparatus for displaying an image including heating areas; and

FIG. 14 is a schematic cross-sectional view

illustrating another configurational example of the processing apparatus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention will be described in detail hereinbelow with reference to the accompanying drawings. The present invention is not limited to the details of the embodiment described below. The components described below cover those which could easily be anticipated by those skilled in the art and those which are essentially identical to those described above. Furthermore, the arrangements described below can be combined in appropriate manners. Various omissions, replacements, or changes of the arrangements may be made without departing from the scope of the present invention. In the description to be described below, those components that are identical to each other are denoted by identical reference characters, and their redundant description will be omitted.

An XYZ orthogonal coordinate system is established in relation to a processing apparatus to be described below. The positional relation between components of the processing apparatus will be described with respect to the XYZ orthogonal coordinate system. The XYZ orthogonal

coordinate system has an X-axis extending in horizontal directions in a horizontal plane, a Y-axis extending in horizontal directions in the horizontal plane perpendicularly to the X-axis, and a Z-axis extending in vertical directions perpendicularly to the X-axis and the Y-axis. The X-axis and the Y-axis are contained in an XY plane parallel to the horizontal plane, and the Z-axis extends in the vertical directions perpendicularly to the XY plane.

[Embodiment]

FIG. 1 illustrates, in plan, a workpiece unit to be divided by a processing apparatus according to an embodiment of the present invention. The workpiece unit, denoted by 100 in FIG. 1, to be processed or divided by the processing apparatus will be described below with reference to FIG. 1.

As illustrated in FIG. 1, the workpiece unit 100 has a workpiece 101 having a face side 102, a circular sheet 106 such as an expansion sheet affixed to a reverse side of the workpiece 101 that is opposite the face side 102, and an annular frame 107 affixed to an outer circumferential portion of the sheet 106. The workpiece 101 is affixed to a central portion of the sheet 106, for example. The sheet 106 includes an annular region 108

that lies between an inner circumferential edge of the annular frame 107 and an outer circumferential edge of the workpiece 101.

The workpiece 101 is a semiconductor wafer or optical device wafer shaped as a circular plate and including a substrate made of silicon, sapphire, gallium arsenide, silicon carbide (SiC), or the like. The workpiece 101 includes a plurality of square device chips 105 formed in respective areas demarcated on the face side 102 by a grid of intersecting projected dicing lines 103 established on the face side 102. The workpiece 101 also includes modified layers 109 formed therein along the projected dicing lines 103.

The modified layers 109 are formed in the workpiece 101 by a laser beam that is applied to the reverse side thereof along the projected dicing lines 103. The laser beam has a wavelength transmittable through the workpiece 101. The modified layers 109 represent regions whose density, refractive index, mechanical strength, and other physical properties are different from those of the rest of the workpiece 101. Examples of the regions represented by the modified layers 109 include melted regions, cracked regions, dielectric breakdown regions, refractive index varied regions, regions including a mixture of

those regions, and others. The modified layers 109 act as division initiating points where the workpiece 101 starts being divided into the individual device chips 105.

The sheet 106 is made of a stretchable or expandable resin that is thermally shrinkable, i.e., that is shrinkable when heated. The sheet 106 may include an expansion sheet, an adhesive tape, or the like. The sheet 106 may be expandable more easily in some directions and less easily in other directions. The sheet 106 is of a structure including a base layer and a glue layer stacked on the base layer or a structure including only a base layer and free of a glue layer. The sheet 106 may be affixed to the workpiece 101 by pressure bonding or thermocompression bonding.

(Configurational example of processing apparatus)

FIG. 2 illustrates, in perspective, a configurational example of the processing apparatus, denoted by 10, according to the present embodiment. As illustrated in FIG. 2, the processing apparatus 10 is an apparatus for expanding the sheet 106 radially outwardly to divide the workpiece 101 having the modified layers 109 into the individual device chips 105 along the projected dicing lines 103. The processing apparatus 10 includes a chamber 20, a holding table 30, a frame fixing

unit 40, a sheet expanding unit 50, a heating unit 60, and a control unit 70.

The chamber 20 is shaped as a box having a centrally open upper surface. The chamber 20 houses therein the holding table 30, a frame rest plate 41 of the frame fixing unit 40, and the sheet expanding unit 50.

The holding table 30 has a holding surface 31 for holding the workpiece 101 of the workpiece unit 100 under suction through the sheet 106 interposed therebetween. The holding table 30 includes a frame body 32 shaped as an annular plate made of metal such as stainless steel and a suction body 33 shaped as a circular plate made of a porous material such as porous ceramic and surrounded by the frame body 32. The frame body 32 and the suction body 33 have respective upper surfaces lying flush with each other and jointly making up the holding surface 31 for holding the workpiece 101 under suction thereon. The suction body 33 is of substantially the same diameter as the workpiece 101. When the workpiece unit 100 is delivered onto the holding surface 31 by a delivery unit 80, the reverse side of the workpiece 101 is placed on the holding surface 31 with the sheet 106 interposed therebetween. The suction body 33 is fluidly connected to

a vacuum suction source 34. When the vacuum suction source 34 is actuated, it generates and applies a vacuum or negative pressure to the suction body 33, causing the suction body 33 to hold the reverse side of the workpiece 101 under suction on the holding surface 31.

The frame fixing unit 40 fixes the frame 107 of the workpiece unit 100 in position around the holding table 30. The frame fixing unit 40 includes the frame rest plate 41 and a frame pressing plate 42. The frame rest plate 41 that is of a planar shape has a central opening 43 defined therein that is of a circular shape as viewed in plan and an upper surface 44 lying flatwise parallel to a horizontal plane, for supporting the workpiece unit 100 thereon. The opening 43 of the frame rest plate 41 has an inside diameter slightly larger than the inside diameter of the frame 107. The holding table 30 is coaxially disposed in the opening 43 of the frame rest plate 41. The frame rest plate 41 is vertically movable by vertical air cylinders 45 having respective piston rods 45-1 whose upper ends are attached to respective four corners of the frame rest plate 41. The frame rest plate 41 is vertically moved when the piston rods 45-1 are extended or contracted. According to the present embodiment, the air cylinders 45 and the piston rod 45-1

function as a moving mechanism. Centering guides 46 in pairs are horizontally movably disposed in respective four corners of the upper surface 44 of the frame rest plate 41. When the frame 107 is placed on the frame rest plate 41 and the centering guides 46 are horizontally moved, the centering guides 46 positionally adjust the frame rest plate 41 and hence the frame 107, positioning the workpiece 101 in a position coaxial with the suction body 33 of the holding table 30.

The frame pressing plate 42 is of a planar shape and has substantially the same dimensions as the frame rest plate 41. The frame pressing plate 42 has a central opening 47 defined therein that is of a circular shape as viewed in plan. The opening 47 is of the same dimension as the opening 43. The frame pressing plate 42 is attached to a distal end of a piston rod 48-1 of a horizontal air cylinder 48. When the piston rod 48-1 is extended and contracted, it moves the frame pressing plate 42 between a position above the frame rest plate 41 and a retracted position spaced horizontally from the position above the frame rest plate 41. The frame pressing plate 42 has oblong holes 49 defined in respective four corners thereof for receiving therein the centering guides 46, respectively.

When the frame pressing plate 42 is in the retracted position spaced horizontally from the position above the frame rest plate 41 and the centering guides 46 are moved away from each other in each pair, the frame 107 of the workpiece unit 100 is delivered to the upper surface 44 of the frame rest plate 41 by the delivery unit 80 and placed on the upper surface 44 of the frame rest plate 41. The frame fixing unit 40 moves the centering guides 46 toward each other in each pair, positioning the workpiece 101 coaxially with the suction body 33 of the holding table 30. Then, the piston rod 48-1 of the air cylinder 48 is extended to position the frame pressing plate 42 in the position above the frame rest plate 41. The piston rods 45-1 of the air cylinders 45 are extended to lift the frame rest plate 41 until the frame 107 is sandwiched and secured in position between the frame rest plate 41 and the frame pressing plate 42.

FIG. 3 illustrates, in cross section, the sheet expanding unit 50 taken along line III - III of FIG. 2. The sheet expanding unit 50 illustrated in FIG. 3 moves the holding table 30 and the frame fixing unit 40 relatively away from each other along a vertical axis along the Z-axis to press the annular region 108 of the sheet 106 in a direction perpendicular to the face side

102 of the workpiece 101, thereby expanding the sheet 106 to rupture the workpiece 101 from the modified layers 109 as the division initiating points. The sheet expanding unit 50 includes a pusher 51 and a lifting and lowering unit 52.

The pusher 51 is of a hollow cylindrical shape having an outside diameter smaller than the inside diameter of the annular frame 107 placed on the upper surface 44 of the frame rest plate 41 and an inside diameter larger than the diameters of the workpiece 101 affixed to the sheet 106 and the holding table 30. The holding table 30 is disposed within the pusher 51 in coaxial relation thereto. Rolls 53 are rotatably mounted on the upper end of the pusher 51 and disposed in a plane flush with the holding surface 31 of the holding table 30. When the pusher 51 pushes the sheet 106 upwardly, the rolls 53 are held in rolling contact with the sheet 106 to reduce undue frictional abrasion thereof.

The lifting and lowering unit 52 includes air cylinders 54 and 55 disposed below the holding table 30. The air cylinders 54 have respective piston rods 54-1 having respective upper ends connected to the holding table 30. When the piston rods 54-1 are extended and contracted, they lift and lower the holding table 30. The

air cylinders 55 have respective piston rods 55-1 whose upper ends are attached to the pusher 51. When the piston rods 55-1 are extended and contracted, they lift and lower the pusher 51. The air cylinders 54 and 55 are able to lift and lower the holding table 30 and the pusher 51 in unison with each other.

The sheet expanding unit 50 expands the sheet 106 radially in its plane when the lifting and lowering unit 52 lifts the holding table 30 and the pusher 51 in unison with each other from a position where the rolls 53 and the holding surface 31 are lower than the upper surface 44 of the frame rest plate 41 to a position where the rolls 53 and the holding surface 31 are higher than the upper surface 44 of the frame rest plate 41. Then, the lifting and lowering unit 52 lowers the holding table 30 and the pusher 51 in unison with each other from the position where the sheet 106 is expanded radially in its plane to a position where the rolls 53 and the holding surface 31 lie flush with the upper surface 44 of the frame rest plate 41. When the holding table 30 and the pusher 51 are lowered in unison with each other to the position where the rolls 53 and the holding surface 31 lie flush with the upper surface 44 of the frame rest plate 41, the annular region 108 of the sheet 106 is

slackened to develop a slackened portion 108-2.

FIG. 4 illustrates, in plan, the heating unit 60 illustrated in FIG. 2. The heating unit 60 illustrated in FIGS. 2 and 4 heats the annular region 108 of the sheet 106 as it is expanded to shrink the slackened portion 108-2 of the annular region 108.

As illustrated in FIGS. 2 and 4, the heating unit 60 includes a unit body 61 shaped as a circular plate and a plurality of heaters 63-1, 63-2, 63-3, and 63-4 movably mounted in respective retainers 62-1, 62-2, 62-3, and 62-4 in the unit body 61. The retainers 62-1, 62-2, 62-3, and 62-4 will hereinafter be referred to as "retainers 62" insofar as they do not need to be distinguished from each other. Similarly, the heaters 63-1, 63-2, 63-3, and 63-4 will hereinafter be referred to as "heaters 63" insofar as they do not need to be distinguished from each other.

As illustrated in FIG. 2, the unit body 61 is disposed above the holding table 30 in coaxially relation thereto. The unit body 61 is rotatable about a vertical axis parallel to the Z-axis. The unit body 61 is also vertically movable by a moving unit, not illustrated.

As illustrated in FIGS. 2 and 4, the retainers 62 are disposed at circumferentially equal intervals in an

outer edge portion of the unit body 61. The retainers 62 are disposed in vertical alignment with the annular region 108 of the sheet 106 of the workpiece unit 100 that is held on the holding table 30 and the frame fixing unit 40. The retainers 62 retain the respective heaters 63 while allowing the heaters 63 to move radially and vertically with respect to the unit body 61, i.e., in radial directions of the workpiece 101 and in vertical directions toward and away from the sheet 106, in ranges commensurate with the sizes of the retainers 62. The retainers 62 are defined as openings in the unit body 61, and the heaters 63 are movably disposed in the respective openings. The retainers 62 as the openings have radial lengths larger than the radial lengths of the respective heaters 63, so that the heaters 63 are radially movably retained by the retainers 62. According to the present embodiment, the heating unit 60 should preferably have four retainers 62. According to the present invention, however, the heating unit may have more or less retainers.

The heaters 63 are disposed at circumferentially equal intervals on the outer edge portion of the unit body 61 according to the layout of the retainers 62. Since the heaters 63 are retained by the respective

retainers 62, the heaters 63 are disposed in vertical alignment with the annular region 108 of the sheet 106 of the workpiece unit 100 that is held on the holding table 30 and the frame fixing unit 40, and are angularly spaced circumferentially along the annular region 108. According to the present embodiment, the heating unit 60 should preferably have four heaters 63. According to the present invention, however, the heating unit may have more or less heaters. The heaters 63 are heaters for emitting infrared rays downwardly to heat the annular region 108 of the sheet 106, e.g., infrared ceramic heaters that can be heated to radiate infrared rays by a voltage applied thereto. However, the heaters 63 are not limited to heaters for emitting infrared rays, but may be Peltier elements having a junction between two kinds of metal for controlling heat absorption and heat generation by the two kinds of metal with a direct current flowing therethrough. The heaters may include such Peltier devices in addition to the heaters 63.

FIG. 5 illustrates the heating unit 60 in functional block form. FIG. 6 illustrates, in cross section, the heating unit 60 taken along line VII - VII of FIG. 4. As illustrated in FIG. 5, the heating unit 60 includes a plurality of first heated position adjusters

64-1, 64-2, 64-3, and 64-4 and a rotary actuator 65.

The first heated position adjusters 64-1, 64-2, 64-3, and 64-4 are connected respectively to the heaters 63-1, 63-2, 63-3, and 63-4 for moving the heaters 63-1, 63-2, 63-3, and 63-4 radially of the workpiece 101. The first heated position adjusters 64-1, 64-2, 64-3, and 64-4 will hereinafter be referred to as "first heated position adjusters 64" insofar as they do not need to be distinguished from each other. The first heated position adjusters 64 include components for moving the respective heaters 63 radially of the workpiece 101, e.g., belt rollers associated with the heaters 63 and electric motors for rotating the belt rollers. According to the present invention, the first heated position adjusters 64 are not limited to such a structure, but may include air cylinders and ball screws. The rotary actuator 65 includes an electric motor, not illustrated, having an output shaft connected to the unit body 61. When the rotary actuator 65 is energized, it rotates its output shaft to rotate the unit body 61 about the vertical axis parallel to the Z-axis.

The first heated position adjusters 64 of the above structure move the heaters 63, respectively, radially of the workpiece 101 to adjust the radial positions of

regions of the workpiece unit 100 that are to be heated by the heaters 63. As illustrated in FIG. 6, the heaters 63-1 and 63-3 are positioned in diametrically opposite relation to each other on the unit body 61, whereas the heaters 63-2 and 63-4 are positioned in diametrically opposite relation to each other on the unit body 61. Therefore, the heaters 63-1 and 63-3 may be simultaneously moved radially inwardly or outwardly and the heaters 63-2 and 63-4 may be simultaneously moved radially inwardly or outwardly. The rotary actuator 65 rotates the unit body 61 to move all the heaters 63 simultaneously in circumferential directions along the annular region 108 of the sheet 106.

As illustrated in FIG. 2, the control unit 70 controls the components described above of the processing apparatus 10, i.e., the sheet expanding unit 50, the heating unit 60, etc., to enable the processing apparatus 10 to perform a processing sequence on the workpiece unit 100. The control unit 70 includes a processing device such as a central processing unit (CPU), a storage device such as a read only memory (ROM) or a random access memory (RAM), and an input/output interface device. In other words, the control unit 70 is a computer that is capable of executing programs for controlling the

components referred to above according to the processing sequence to be carried out by the processing apparatus 10. The control unit 70 is electrically connected to a touch panel 91.

The touch panel 91 operates under the control of the control unit 70 to display images of the workpiece unit 100 and various pieces of information required for the processing sequence and to accept input operating actions required for the processing sequence from the operator of the processing apparatus 10. The touch panel 91 is positioned on a housing of the processing apparatus 10 at a location where the operator can easily see and operate the touch panel 91. The touch panel 91 includes a display device and an input device. For example, the touch panel 91 may include a touch screen display including a display such as a liquid crystal display or an organic electroluminescent (EL) display and a touch screen for designating input positions and coordinates on a display surface of the display. The touch panel 91 exemplifies a display unit.

The control unit 70 controls communication with an information device 500 via a wireless communication link, a network, or the like. The information device 500 includes a smartphone, a tablet terminal, or the like,

for example. The information device 500 has a display unit 510 and a communication unit 520. The display unit 510 includes a display screen. The information device 500 is arranged to display various items of information received from the processing apparatus 10 via the communication unit 520 on the display unit 510. The control unit 70 can send various items of information to the information device 500 in which they can be displayed on the display unit 510. The processing apparatus 10 may include the touch panel 91 and may be connected to the information device 500, or may include either the touch panel 91 or the information device 500.

According to a method of processing, i.e., dividing, the workpiece 101, when the workpiece 101 is to be divided along the projected dicing lines 103 and fragmented into a plurality of individual chips, grooves or modified layers are formed as division initiating points in the workpiece 101 along the projected dicing lines 103 and thereafter the sheet 106 that supports the workpiece 101 is expanded to widen chip-to-chip intervals on the workpiece 101 from the division initiating points. The workpiece 101 is supported in the opening of the annular frame 107 by the sheet 106 that is affixed to the workpiece 101 and the annular frame 107. After the sheet

106 has been expanded, an excess slackened region of the sheet 106 that lies between the outer circumferential edge of the workpiece 101 and the inner circumferential edge of the annular frame 107 is caused to shrink in order to maintain the chip-to-chip intervals. As illustrated in FIG. 3, the processing apparatus 10 heats the excess slackened region of the sheet 106 with the heaters 63 while moving the heaters 63 and the holding surface 31 relatively to each other, thereby shrinking the excess slackened region of the sheet 106. At this time, the processing apparatus 10 sets heating areas by establishing paths along which the heaters 63 are to move. However, the excess slackened region of the sheet 106 may possibly include an unprocessed area where the sheet 106 has not been heated due to setting errors, and in a case where the processing apparatus 10 has established a path that does not match intended conditions and hence has set a different heating area, the operator may possibly leave it unnoticed due to oversight. According to the present invention, the processing apparatus 10 incorporates a technology for assisting in setting heating areas where the heating unit 60 is to heat the sheet 106 that supports the workpiece 101.

FIG. 7 illustrates in functional block form the control unit 70 illustrated in FIG. 2. As illustrated in FIG. 7, the control unit 70 has a setting section 71, a generating section 72, and a simulating section 73. The control unit 70 performs the functions of the setting section 71, the generating section 72, and the simulating section 73 by running programs.

The setting section 71 sets heating conditions or causes the operator or the like to set heating conditions that include heating areas where the heating unit 60 is to heat the sheet 106. The setting section 71 sets heating areas by setting heating conditions including a path along which the heating unit 60 is to move, a temperature to which the heating unit 60 is to heat the sheet 106, etc. The heating conditions include, for example, areas where the heating unit 60 is to heat the workpiece unit 100, i.e., the sheet 106, the path along which the heating unit 60 is to move, conditions that are able to identify the distances between the heaters 63 and the workpiece unit 100 at the time when the sheet 106 is heated, etc. The setting section 71 sets heating conditions representing the heating areas of the heating unit 60, i.e., the path along which the heating unit 60 is to move, the heating temperature, the heating time,

the distances between the heaters 63 and the holding surface 31, a heating sequence representing a plurality of different heating conditions to be successively carried out and an order in which the different heating conditions to be successively carried out, etc. The setting section 71 prompts the operator to set heating conditions or acquires heating conditions from a server, a database, or the like and sets the acquired heating conditions. The setting section 71 stores heating condition data capable of identifying the set heating conditions in the storage device.

The generating section 72 generates an image of the workpiece 101 supported on the frame 107 by the sheet 106. The generating section 72 generates image data representing an image of an upper surface, i.e., a face side, of the workpiece unit 100 that is able to identify the layout of the workpiece 101, the sheet 106, and the frame 107. The upper surface of the workpiece unit 100 is a surface to be processed. The generating section 72 can generate image data used to display the heating areas of the heating unit 60 on the basis of the image captured of the workpiece unit 100 to be processed, an image acquired from the database, etc. The generating section 72 stores the generated image data in the storage device.

The simulating section 73 displays the heating areas of the heating unit 60 based on the heating conditions set by the setting section 71 identifiably over the image of the workpiece unit 100. The simulating section 73 estimates areas of the workpiece unit 100 to be heated by the heating unit 60 on the basis of the heating conditions set by the setting section 71 and the specifications of the heating unit 60. The specifications of the heating unit 60 include, for example, the layout of the origins of the heaters 63 of the heating unit 60, the sizes of the heaters 63, the paths along which the heaters 63 are movable and that represent ranges in which the heaters 63 are movable, etc. The simulating section 73 calculates a path along which the heating unit 60 is to move, a heating operation of the heating unit 60, etc. depending on the heating conditions, according to a simulating program, a machine learning program, etc. on the basis of data including at least the specifications of the heating unit 60 and the heading conditions, and calculates heating areas on the upper surface of the workpiece unit 100 on the basis of the calculation results. The simulating section 73 calculates heating information representing heating areas of the workpiece unit 100, temperatures of the heating areas or relative

temperature distributions in the heating areas, heating times, etc. The control unit 70 controls the touch panel 91 to display an image that is able to identify the heating areas estimated by the simulating section 73. In other words, the simulating section 73 estimates heating areas where the heating unit 60 heats the workpiece unit 100 on the basis of the heating conditions and generates an image able to identify the heating areas on the workpiece unit 100. The control unit 70 displays the heating information corresponding to the heating conditions over the image.

In a case where a heating sequence for successively performing a plurality of different heating conditions is set, the simulating section 73 displays the heating areas stepwise or in a chronological sequence over the image so as to be able to identify the order of the heating areas where the sheet 106 is heated by the heating unit 60. In other words, the simulating section 73 generates an image capable of identifying the order in which the heating areas corresponding to the heating conditions are heated.

In a case where a heating sequence is set, the simulating section 73 displays heating areas including areas corresponding to any of heating conditions included in a heating sequence. In other words, the simulating

section 73 generates an image in which one of the heating areas corresponding to either one of heating conditions included in a heating sequence in which the sheet 106 is heated successively under a plurality of heating conditions.

A heating sequence includes heating conditions, their order, the number of times that each of the heating conditions is repeated, times over which the heating conditions are carried out, etc. For example, if the heating conditions include four heating conditions including first through fourth heating conditions, then the simulating section 73 can display a heating area corresponding to one of the heating conditions or display heating areas corresponding to some of the heating conditions.

The simulating section 73 can display a first area as a heating area having a relatively high heating intensity and a second area as a heating area having a heating intensity lower than the first area such that the first and second areas can be identified. In other words, the simulating section 73 generates an image in which a first area as a heating area having a relatively high heating intensity and a second area as a heating area having a lower heating intensity can be identified. For

example, the simulating section 73 displays heating intensities in different display modes or display information representing heating intensities.

The control unit 70 is electrically connected to a communication unit 92. The communication unit 92 may be included in the processing apparatus 10 or may be provided as an external device outside of the processing apparatus 10. The communication unit 92 communicates with the information device 500 outside of the processing apparatus 10. The communication unit 92 can store various pieces of information received from the information device 500, for example, in the storage device. The communication unit 92 can send various pieces of information to the information device 500 under the control of the control unit 70.

The configurational example of the processing apparatus 10 has been described above. The configurational example described above with reference to FIGS. 1 through 7 is illustrative only, and the processing apparatus 10 according to the present embodiment is not limited to the above configurational example. The functions and configurations of the processing apparatus 10 according to the present embodiment can be modified flexibly depending on

specifications and operation details. For example, the processing apparatus 10 may be configured such that the functions of the generating section 72 may be realized by the simulating section 73.

(Setting examples of heating conditions)

FIG. 8 illustrates, by way of example, a screen for setting heating condition data. As illustrated in FIG. 8, heating condition data 300 have data representing heating conditions based on data set in a screen 310.

The screen 310 has a plurality of input fields corresponding to a plurality of setting items and capable of setting heating conditions, allowing the operator to set heating conditions. In the example illustrated in FIG. 8, the screen 310 has a plurality of setting items 311, a plurality of input field columns 312-1, 312-2, and 312-3 corresponding to the setting items 311, and a simulation button 313.

The setting items 311 include items representing a start position, an end position, a heater selection, a heating temperature, a distance, an offset value (X), and an offset value (Y). The setting item 311 representing a start position is an item for setting a position, i.e., an angle, where the heaters 63 of the heating unit 60 start heating the sheet 106, for example. The setting

item 311 representing an end position is an item for setting a position, i.e., an angle, where the heaters 63 of the heating unit 60 finish heating the sheet 106, for example. The setting item 311 representing a heater selection is an item for selecting heaters 63 for heating the sheet 106 among the heaters 63, for example. The setting item 311 representing a heater selection makes it possible to select all or some of the heaters 63, for example. The setting item 311 representing a heating temperature is an item for setting a temperature to which the heaters 63 heat the sheet 106, for example. The setting item 311 representing a distance is an item for setting a distance between the heaters 63 and the sheet 106, for example.

The setting items 311 representing an offset value (X) and an offset value (Y) are items for setting offset values for changing the paths along which the heaters 63 are to move from a circular shape to an elliptical shape. For example, the setting items 311 representing an offset value (X) and an offset value (Y) make it possible to set the paths along which the heaters 63 are to move to an elliptical shape by offsetting either an X-axis direction or a Y-axis direction. The sheet 106 has a property tending to stretch more easily in one of longitudinal and

transverse directions. Therefore, providing the paths along which the heaters 63 are to move are set to an elliptical shape, the sheet 106 can be heated and hence shrunk differently in the longitudinal and transverse directions depending on the extent to which the sheet 106 has been stretched, thereby keeping the chip-to-chip intervals on the workpiece 101.

The input field column 312-1 includes a plurality of input fields corresponding to the setting items 311 for first heating conditions. Setting values for performing the first heating conditions are set in these input fields. The first heating conditions represent a first operation cycle in a heating sequence. The input field column 312-2 includes a plurality of input fields corresponding to the setting items 311 for second heating conditions. Setting values for performing the second heating conditions are set in these input fields. The second heating conditions represent a second operation cycle in the heating sequence. The input field column 312-3 includes a plurality of input fields corresponding to the setting items 311 for third heating conditions. Setting values for performing the third heating conditions are set in these input fields. The third heating conditions represent a third operation cycle in

the heating sequence. In the example illustrated in FIG. 8, three sets of heating conditions can be set in the screen 310. However, more or less sets of heating conditions may be set in the screen 310. The heating condition data 300 make it possible to set heating conditions for the processing apparatus 10 on the basis of whether settings have been made in the input field columns 312-1, 312-2, and 312-3 or not. The input field columns 312-1, 312-2, and 312-3 will hereinafter be referred to as "input field columns 312" insofar as they do not need to be distinguished from each other.

The simulation button 313 is a button for displaying an image representing simulation results regarding the heating of the sheet 106 by the heating unit 60 under the heating conditions set in the screen 310, on the display device of the touch panel 91, the information device 500, or the like. When the simulation button 313 is clicked, the setting section 71 finalizes heating conditions based on the setting values set in the screen 310, and the simulating section 73 generates an image representing the heating areas based on the heating conditions. The processing apparatus 10 displays the generated image on the display device of the touch panel 91, the information device 500, or the like for the

operator to confirm the heating areas corresponding to the heating conditions.

The screen 310 has an ENTER button 314 and an EXIT button 315. The ENTER button 314 is a button for registering the heating condition data 300 representing the heating conditions set in the screen 310. The EXIT button 315 is a button for switching from the screen 310 without registering the heating conditions set in the screen 310.

(Example of heating conditions and an image of the workpiece unit)

FIG. 9 illustrates, by way of example, an image of the workpiece unit 100 used by the processing apparatus 10. An image 400 illustrated in an upper section of FIG. 9 is an image capable of identifying the workpiece unit 100 including the workpiece 101 supported on the frame 107 by the sheet 106. The image 400 includes, for example, an image, a diagram, or like captured of the workpiece 101, the sheet 106, and the frame 107 from above. The image 400 may include a still image or a moving image. The image 400 allows a reference angle of 0° and a reference angle of 180° as frames of reference for the rotation of the heating unit 60 to be identified.

In response to a simulation instruction from the

operator, the processing apparatus 10 generates heating information representing heating areas where the four heaters 63 of the heating unit 60 are to heat the sheet 106 under heating conditions. The processing apparatus 10 displays the generated heating information identifiably over the image 400. For example, it is assumed that the heating conditions include conditions for moving each of the heaters 63 of the heating unit 60 in an angular range from 0 degree to 90 degrees. In this case, the processing apparatus 10 presumes a heating area 410 heated by the four heaters 63 to be an exposed area of the sheet 106 between the workpiece 101 and the frame 107 on the basis of the layout of the sheet 106 with respect to the workpiece 101, as illustrated in a lower section of FIG. 9. The processing apparatus 10 displays the presumed heating area 410 over the image 400 in order to cover the exposed portion of the sheet 106. The processing apparatus 10 displays the heating area 410 in a display color such as orange, yellow, or red, for example, over the image 400, thereby making it possible to identify the relation between the exposed area of the sheet 1006 and the heating area 410. By thus displaying the heating area 410 while the sheet 106 is heated under the set heating conditions, the processing apparatus 10 allows the

operator to easily confirm whether there is an unprocessed area not processed by the heating unit 60 or not and whether the sheet 106 is heated under desired conditions or not.

FIGS. 10 through 12 illustrate examples of the relation between the heating condition data 300 and the image 400 including heating areas.

In the example illustrated in an upper section of FIG. 10, heating condition data 300-1 represent first heating conditions including heating conditions in which all of the four heaters 63 heat the sheet 106 in a range from 0 degree to 90 degrees. The heating condition data 300-1 represent second heating conditions including heating conditions in which all of the four heaters 63 heat the sheet 106 in a range from 0 degree to 90 degrees while the heaters 63 are rotated with an offset (X) of -30 and an offset (Y) of -60. The heating condition data 300-1 represent third heating conditions including heating conditions in which no end position is set not to heat the sheet 106.

The processing apparatus 10 accepts a simulation instruction for heating a workpiece unit 100 that includes a workpiece 101 having a first size. The first size means that the workpiece 101 is smaller than the

inside diameter of the frame 107 and the sheet 106 has a large exposed portion. The processing apparatus 10 estimates a heating area 410-1 according to the first heating conditions and a heating area 410-2 according to the second heating conditions on the basis of predicted results obtained when the four heaters 63 of the heating unit 60 are heated under the heating conditions represented by the heating condition data 300-1. As illustrated in a lower section of FIG. 10, the processing apparatus 10 estimates an annular area including part of the exposed portion of the sheet 106 and the entire surface of the frame 107 as a heating area 410-1 according to the first heating conditions. The processing apparatus 10 estimates an elliptical area overlapping part of the heating area 410-1 and including part of the exposed portion of the sheet 106 as a heating area 410-2 according to the second heating conditions.

The processing apparatus 10 displays the heating area 410-1 and the heating area 410-2 that have been estimated over the image 400 in covering relation to the surface of the workpiece unit 100. The processing apparatus 10 displays the image 400 in which an area not heated by the heaters 63 is identifiable as an unprocessed area 420. After the processing apparatus 10

has displayed the image 400 including the heating area 410-1 according to the first heating conditions, for example, the processing apparatus 10 displays the image 400 including the heating area 410-2 according to the second heating conditions, so that the operator can recognize the order in which areas are to be heated and the areas to be heated.

By displaying the image 400 including the heating area 410-1 according to the first heating conditions and the heating area 410-2 according to the second heating conditions, the processing apparatus 10 allows the operator to recognize, in the image 400, the area where the heating area 410-1 and the heating area 410-2 do not overlap each other as the unprocessed area 420. Since the processing apparatus 10 thus displays the heating area 410-1 and the heating area 410-2, to be heated by the heating unit 60, of the sheet 106 supporting the workpiece 101, the processing apparatus 10 is able to assist in confirming the areas to be heated under the heating conditions.

In the example illustrated in an upper section of FIG. 11, heating condition data 300-2 represent first heating conditions including heating conditions in which all of the four heaters 63 heat the sheet 106 in a range

from 0 degree to 90 degrees. The heating condition data 300-2 represent second heating conditions including heating conditions in which all of the four heaters 63 heat the sheet 106 in a range from 0 degree to 90 degrees at a first distance while the heaters 63 are rotated with an offset (X) of -80 and an offset (Y) of -80. The heating condition data 300-2 represent third heating conditions including heating conditions in which the sheet 106 is not to be heated. In other words, the heating condition data 300-2 represent the first heating conditions and the second heating conditions including heating conditions in which the paths along which the four heaters 63 move do not overlap each other.

The processing apparatus 10 accepts a simulation instruction for heating the workpiece unit 100 that includes a workpiece 101 having the first size referred to above. The processing apparatus 10 estimates a heating area 410-1 according to the first heating conditions and a heating area 410-2 according to the second heating conditions on the basis of predicted results obtained when the four heaters 63 of the heating unit 60 are heated under the heating conditions represented by the heating condition data 300-2. As illustrated in a lower section of FIG. 11, the processing apparatus 10 estimates

an annular area near the frame 107 in the exposed portion of the sheet 106 as a heating area 410-1 according to the first heating conditions. The processing apparatus 10 estimates an annular area not overlapping the heating area 410-1 and including part of the exposed portion of the sheet 106 as a heating area 410-2 according to the second heating conditions.

The processing apparatus 10 displays the heating area 410-1 and the heating area 410-2 that have been estimated over the image 400 in covering relation to the surface of the workpiece unit 100. The processing apparatus 10 displays the image 400 in which an area not heated by the heaters 63 is identifiable as an unprocessed area 420. In the example illustrated in a lower section of FIG. 11, the image 400 indicates that the area between the heating area 410-1 and the heating area 410-2 is the unprocessed area 420.

After displaying the image 400 including the heating area 410-1 according to the first heating conditions, for example, the processing apparatus 10 displays the image 400 including the heating area 410-2 according to the second heating conditions, allowing the operator to recognize the order in which areas are to be heated and the areas to be heated. Therefore, the

processing apparatus 10 allows the operator to recognize the heating areas 410 in the order in which the heating area 410-1 according to the first heating conditions and the heating area 410-2 according to the second heating conditions are heated.

In the example illustrated in an upper section of FIG. 12, heating condition data 300-3 represent first heating conditions including heating conditions in which all of the four heaters 63 heat the sheet 106 in a range from 0 degree to 90 degrees. The heating condition data 300-3 represent second heating conditions including heating conditions in which all of the four heaters 63 heat the sheet 106 at a first distance while the heaters 63 are rotated in a range from 0 degree to 20 degrees. The heating condition data 300-3 represent third heating conditions including heating conditions in which the sheet 106 is not to be heated. In other words, the heating condition data 300-3 represent the first heating conditions and the second heating conditions including heating conditions in which the paths along which the four heaters 63 move partly overlap each other.

The processing apparatus 10 accepts a simulation instruction for heating a workpiece unit 100 that includes a workpiece 101 having a second size. The second

size is larger than the first size referred to above. The processing apparatus 10 estimates a heating area 410-1 according to the first heating conditions and a heating area 410-2 according to the second heating conditions on the basis of predicted results obtained when the four heaters 63 of the heating unit 60 are heated under the heating conditions represented by the heating condition data 300-3. As illustrated in a lower section of FIG. 12, the processing apparatus 10 estimates an annular area including the exposed portion of the sheet 106 and the frame 107 as a heating area 410-1 according to the first heating conditions. The processing apparatus 10 estimates four areas overlapping part of the heating area 410-1 as a heating area 410-2 according to the second heating conditions.

The processing apparatus 10 displays the heating area 410-1 and the heating area 410-2 that have been estimated over the image 400 in covering relation to the surface of the workpiece unit 100. By displaying the heating area 410-2 in overlapping relation to the heating area 410-1, the processing apparatus 10 allows the operator to recognize the overlapping heating area 410-2 as a first area having a high heating intensity and a non-overlapping area as a second area having a heating

intensity lower than the first area. By thus displaying the image 400, the processing apparatus 10 is able to assist in confirming the heating areas 410 to be heated a plurality of times or with a high heating intensity depending on heating conditions. In addition, the processing apparatus 10 is able to assist in confirming a heating sequence according to heating conditions by displaying the heating area 410-1 according to the first heating conditions and the heating area 410-2 according to the second heating conditions stepwise in the order in which they are heated. A high heating intensity is achieved by either a longer time in which an area is heated than other areas because the area is present in the path along which the heaters 63 move a plurality of times, or a longer time in which an area is heated than other areas because the relative speed at which the holding table 30 and the lower surfaces of the heaters 63 move is low, or a smaller distance between the heaters 63 and the upper surface of the workpiece unit 100 at the time when the sheet 106 is heated by the heaters 63, or a high temperature of the heaters 63 at the time when the sheet 106 is heated by the heaters 63.

(Example of controlling the processing apparatus)

FIG. 13 is a flowchart illustrating, by way of

example, the processing sequence of a control process to be performed by the processing apparatus 10 for displaying an image including heating areas. The processing sequence illustrated in FIG. 13 is realized when the control unit 70 of the processing apparatus 10 runs programs. The processing sequence illustrated in FIG. 13 is executed by the control unit 70 in response to an instruction from the operator.

As illustrated in FIG. 13, the control unit 70 displays the screen 310 of heating conditions on the touch panel 91 (step 1001). For example, the control unit 70 controls the touch panel 91 to display the screen 310 that is capable of setting the heating condition data 300. The touch panel 91 then displays the screen 310, making itself ready for accepting operating actions on the screen 310. When the processing of step 1001 is ended, the control unit 70 has its processing go to step 1002.

The control unit 70 generates heating information based on the heating conditions set in the screen 310 (step 1002). For example, the control unit 70 generates image data representing an image of an upper surface where the layout of the workpiece 101, the sheet 106, and the frame 107 to be heated can be identified, in response

to an operating action on the simulation button 313 in the screen 310. The control unit 70 carries out a simulation based on heating conditions included in the first heating conditions of the heating condition data 300, specifications of the heating unit 60, the size of the workpiece 101, the size of the frame 107, the positional relation between the workpiece 101 and the frame 107, etc., thereby generating heating information including the heating areas 410 of the heating unit 60, a heating intensity, a heating order, etc. When the processing of step 1002 is ended, the control unit 70 has its processing go to step 1003.

The control unit 70 displays an image 400 including the heating information on the touch panel 91 (step 1003). For example, the control unit 70 controls the touch panel 91 to display an image 400 where the heating areas 410, the unprocessed area 420, etc. represented by the heating information can be identified. The touch panel 91 then displays the image 400 where at least the heating areas 410 can be identified. When the processing of step 1003 is ended, the control unit 70 has its processing go to step 1004.

The control unit 70 determines whether all the heating conditions have been finished or not (step 1004).

For example, the control unit 70 determines that all the heating conditions have been finished in a case where next heating conditions of the heating condition data 300 have not been set. If the control unit 70 determines that all the heating conditions have not been finished (No in step 1004), then the control unit 70 has its processing go to step 1005.

The control unit 70 generates heating conditions based on next heating conditions (step 1005). For example, the control unit 70 carries out a simulation based on the next heating conditions of the heating condition data 300, specifications of the heating unit 60, a makeup of the workpiece unit 100, etc., thereby generating heating information including the heating areas 410 of the heating unit 60, a heating intensity, a heating order, etc. When the processing of step 1005 is ended, the control unit 70 has its processing go to step 1006.

The control unit 70 displays an image including the heating information of the next heating conditions on the touch panel 91 (step 1006). For example, the control unit 70 controls the touch panel 91 to display an image 400 where the heating areas 410, the unprocessed area 420, etc. represented by the heating information can be

identified. The touch panel 91 then displays the image 400 where the heating areas 410 according to the heating conditions can be identified. When the processing of step 1006 is ended, the control unit 70 has its processing go to step 1004.

If the control unit 70 determines that all the heating conditions have been finished (Yes in step 1004), then the control unit 70 has its processing go to step 1007. The control unit 70 finishes displaying the image 400 including the heating information (step 1007). For example, the control unit 70 controls the touch panel 91 to finish displaying the image 400. When the processing of step 1007 is ended, the control unit 70 puts an end to the processing sequence illustrated in FIG. 13.

According to the processing sequence illustrated in FIG. 13, the control unit 70 displays the image 400 on the touch panel 91. However, the present invention is not limited to such details. For example, the control unit 70 may display the image 400 on the display unit 510 of the information device 500 by instructing the information device 500 to display the image 400. In such a case, the control unit 70 may change the scale, the size, etc. of the image 400 so as to make the image 400 fit the screen size of the display unit 510, and then may display the

changed image on the display unit 510 of the information device 500. In other words, it is enough for the control unit 70 to output information regarding the image 400 to the information device 500. The control unit 70 can display the image 400 on at least one of the touch panel 91 and the display unit 510 of the information device 500. Moreover, the control unit 70 may display the screen 310 capable of setting heating conditions on at least one of the touch panel 91 and the display unit 510 of the information device 500. In other words, the control unit 70 can accept a setting of heating conditions through the touch panel 91 or the information device 500.

With the processing apparatus 10 according to the present embodiment, the heating unit 60 heats the holding surface 31 vertically from above. However, the present invention is not limited to such details. FIG. 14 schematically illustrates, in cross section, another configurational example of the processing apparatus 10. As illustrated in FIG. 14, the processing apparatus 10 may be of such a structure that the holding surface 31 is oriented vertically downwardly and the holding table 30 and the frame fixing unit 40 are disposed closely to the heaters 63 on the bottom of the apparatus for heating the sheet 106. With such a structure, the processing

apparatus 10 may display the image 400 including the heating areas 410 to assist in confirming whether there is an unprocessed area 420 that has not been heated or not and whether the sheet 106 has been heated under desired heating conditions or not.

The present invention is not limited to the above embodiment. Various changes and modifications may be made therein without departing from the scope of the present invention.

The present invention is not limited to the details of the above described preferred embodiment. The scope of the invention is defined by the appended claims and all changes and modifications as fall within the equivalence of the scope of the claims are therefore to be embraced by the invention.

WHAT IS CLAIMED IS:

1. A processing apparatus comprising:

a holding table having a holding surface for holding a workpiece of a workpiece unit including an annular frame that has an opening, the workpiece being supported in the opening by a sheet affixed to the workpiece and the annular frame;

a frame holding unit for holding the annular frame thereon, the frame holding unit having a rest surface for placing the annular frame thereon;

a lifting and lowering mechanism for lifting and lowering the holding surface relatively to the rest surface;

a heating unit for heating an exposed area of the sheet between an inner edge of the annular frame and an outer edge of the workpiece;

a moving mechanism for moving the heating unit relatively to the holding surface; and

a control unit, wherein

the control unit includes

a setting section for setting heating conditions for the heating unit to heat the sheet, and

a simulating section for estimating heating areas where the heating unit is to heat the workpiece

unit on a basis of the heating conditions and generating an image in which the heating areas for the workpiece unit are able to be identified.

2. The processing apparatus according to claim 1, wherein

the simulating section generates an image in which an order in which a plurality of the heating areas corresponding to a plurality of the heating conditions are to be heated is able to be identified.

3. The processing apparatus according to claim 1, wherein

the simulating section generates an image in which one of the heating areas corresponding to any one of the heating conditions included in a heating sequence in which the sheet is heated successively under a plurality of the heating conditions is able to be identified.

4. The processing apparatus according to claim 1, wherein

the simulating section generates an image in which a heating area having a relatively high heating intensity and a heating area having a lower heating intensity are able to be identified.

5. The processing apparatus according to claim 1, further comprising:

a display unit, wherein
the control unit displays the image generated by
the simulating section on the display unit.

6. The processing apparatus according to claim 1,
wherein

the processing apparatus is connectable to an
information device having a display screen, and

the control unit outputs information regarding the
image generated by the simulating section to the
information device.

7. The processing apparatus according to any one
of claims 1 through 3, wherein

the setting section accepts a setting of the
heating conditions through a touch panel or an
information device.