

DESCRIPTION

Title of Invention: WARPAGE CORRECTION SYSTEM AND MANUFACTURING SYSTEM

5 Technical Field

[0001] The present invention relates to a warpage correction system and a manufacturing system.

Background Art

10 [0002] JP 2014-192434A (Patent Document 1) discloses a marking apparatus. The marking apparatus includes a liquid drop ejection device and a substrate warpage correction device. In the marking apparatus, warpage of a substrate is corrected by the substrate warpage correction device, and then the substrate is subjected to marking by the liquid drop ejection device (see Patent Document 1).

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Citation List

Patent Document

[0003] Patent Document 1: JP 2014-192434A

20 Summary of Invention

Technical Problem

[0004] There may be a case where a warpage correction device that corrects warpage of a molded substrate and a processing device that processes the molded substrate whose warpage has been corrected are not formed as one piece. In such a case, for example, the
25 molded substrate whose warpage has been corrected is manually transported from the warpage correction device to the processing device. However, manual transport of such a molded substrate is not always efficient. Means for solving such a problem that arises

when a warpage correction device is independent of a processing device is not disclosed in the above-mentioned Patent Document 1.

[0005] The present invention has been made to solve the problem and an object thereof is to provide a warpage correction system that includes a warpage correction device independent of a processing device, and facilitates the transport of a molded substrate from the warpage correction device to the processing device, as well as a manufacturing system that includes the warpage correction system.

Solution to Problem

10 [0006] A warpage correction system according to an aspect of the present invention includes a warpage correction device and a relay unit. The warpage correction device corrects warpage of a first molded substrate and produces a second molded substrate. The relay unit is disposed between an external processing device for the warpage correction device and the warpage correction device. The processing device processes the second molded substrate. The relay unit includes a first transport mechanism configured to receive the second molded substrate from the warpage correction device and transport the second molded substrate to the processing device.

[0007] A manufacturing system according to another aspect of the present invention includes the warpage correction system, and the processing device. The processing device includes an accommodation part and a control unit. The accommodation part accommodates the second molded substrate. The second molded substrate transported by the first transport mechanism is accommodated in the accommodation part. The control unit determines whether or not the second molded substrate is receivable according to the accommodation state of the accommodation part with respect to second molded substrates.

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Advantageous Effects of Invention

[0008] According to the present invention, it is possible to provide a warpage

correction system that includes a warpage correction device independent of a processing device, and facilitates the transport of a molded substrate from the warpage correction device to the processing device, as well as a manufacturing system that includes the warpage correction system.

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Brief Description of Drawings

[0009] FIG. 1 is a front view schematically showing a manufacturing system that includes a warpage correction system.

FIG. 2 is a perspective view schematically showing a warpage correction device.

10 FIG. 3 is a plan view schematically showing the warpage correction device.

FIG. 4 is a diagram schematically showing a cross-section of a lower member and an upper member in a closed state.

FIG. 5 is a plan view schematically showing a jig.

FIG. 6 is a front view schematically showing the jig.

15 FIG. 7 is a diagram schematically showing a cross-section taken along VII-VII in FIG. 5.

FIG. 8 is a plan view schematically showing a first transport mechanism.

FIG. 9 is a diagram schematically showing a cross-section taken along IX-IX in FIG. 8.

20 FIG. 10 is a flowchart of an operation for transporting a second molded substrate from the warpage correction device to a cutting device.

Description of Embodiments

[0010] The following describes in detail an embodiment (also referred to as the “present embodiment”) according to an aspect of the present invention with reference to the drawings. Note that, in the drawings, the same reference signs are given to the same or equivalent parts, and the description thereof will not be repeated. In addition, for ease

of understanding, each drawing is drawn schematically, with objects omitted or exaggerated as appropriate.

[0011] [1. Configuration]

<1-1. Configuration of Manufacturing System>

5 FIG. 1 is a front view schematically showing a manufacturing system 1 that includes a warpage correction system 5, according to the present embodiment. Note that in each of the drawings referred to in the present specification, the X-axis and Y-axis each indicate a common direction.

[0012] As shown in FIG. 1, the manufacturing system 1 includes the warpage correction
10 system 5 and a cutting device 20. In the manufacturing system 1, warpage of a molded substrate is corrected, and the molded substrate whose warpage has been corrected is cut to produce a plurality of electronic components.

[0013] In the molded substrate, for example, a semiconductor chip fixed on a metal frame is resin-encapsulated. In such a molded substrate, warpage may occur, for example,
15 due to the difference between the thermal shrinkage rate of the metal frame and the thermal shrinkage rate of the resin. In the warpage correction system 5, the warpage of the molded substrate is corrected. In the present specification, the molded substrate before warpage is corrected is also referred to as a “first molded substrate” and the molded substrate after warpage is corrected is also referred to as a “second molded substrate”.

20 [0014] Examples of the molded substrate include a molded substrate in which a substrate or lead frame to which a semiconductor chip is fixed is resin-encapsulated, as well as a molded substrate in which capacitors, resistors, and the like are resin-encapsulated. Examples of the molded substrate include a BGA (Ball Grid Array) package substrate, an LGA (Land Grid Array) package substrate, a CSP (Chip Size Package) package substrate,
25 an LED (Light Emitting Diode) package substrate, and a QFN (Quad Flat No-leaded) package substrate.

[0015] The warpage correction system 5 includes a warpage correction device 10 and

a relay unit 30. The warpage correction device 10 is configured to correct warpage of a first molded substrate S1 and produce a second molded substrate S2. The relay unit 30 is fixed to the warpage correction device 10, and includes a first transport mechanism 300 and a jig 350. The warpage correction device 10 is positioned with respect to the cutting device 20 via the jig 350. The first transport mechanism 300 is configured to receive the second molded substrate S2 from the warpage correction device 10 and transport the received second molded substrate S2 to the cutting device 20.

[0016] That is, the warpage correction system 5 is configured to correct warpage of the first molded substrate S1 to produce the second molded substrate S2, and transport the second molded substrate S2 to the cutting device 20. The second molded substrate S2 transported to the cutting device 20 is accommodated in a magazine contained in a second accommodation part 210 of the cutting device 20. The warpage correction device 10 and the relay unit 30 will both be described in detail later.

[0017] The cutting device 20 is configured to cut the second molded substrate S2 so as to divide the second molded substrate S2 into a plurality of electronic components. In the cutting device 20, for example, the second molded substrate S2 placed on a cutting table (not shown) is cut by a rotating blade (not shown). As a result, a plurality of electronic components (cut products) are produced.

[0018] Suppose the relay unit 30 is not fixed to the warpage correction device 10. In this case, there will be no mechanism for transporting the second molded substrate S2 produced by the warpage correction device 10 to the cutting device 20. In such a case, for example, the second molded substrate S2 will be manually transported from the warpage correction device 10 to the cutting device 20. However, manual transport of the second molded substrate S2 is not always efficient.

[0019] In the warpage correction system 5 included in the manufacturing system 1, the first transport mechanism 300 included in the relay unit 30 receives the second molded substrate S2 from the warpage correction device 10 and transports the received second

molded substrate S2 to the cutting device 20. Therefore, according to the warpage correction system 5, since the second molded substrate S2 is transported from the warpage correction device 10 to the cutting device 20 by the first transport mechanism 300, the second molded substrate S2 can be easily transported to the cutting device 20 even if the warpage correction device 10 is independent of the cutting device 20.

[0020] The warpage correction device 10 includes a first control device 160. The first control device 160 includes a first communication unit 161 and a first control unit 162.

[0021] The first communication unit 161 is configured to communicate with, for example, a second communication unit 201 (described later), which is included in the cutting device 20, through a communication line L1. Note that the first communication unit 161 does not necessarily need to communicate with the second communication unit 201 through the communication line L1, but may communicate with the second communication unit 201 through wireless communication. Also, information communicated between the first communication unit 161 and the second communication unit 201 may include not only signals described below, but also at least some of the following: error information in the warpage correction device 10 or the cutting device 20, size information of the object (first molded substrate S1) input to the warpage correction device 10, condition information such as heating time and cooling time in the warpage correction device 10, size information of the cutting object (second molded substrate S2) input to the cutting device 20, and processing condition information such as cutting conditions in the cutting device 20.

[0022] The first control unit 162 includes, for example, a CPU (Central Processing Unit), a RAM (Random Access Memory), and a ROM (Read Only Memory). The first control unit 162 is configured to control constituent components within the warpage correction device 10 and the relay unit 30 in accordance with information processing. For example, the first control unit 162 controls the first transport mechanism 300 based on information obtained by the first communication unit 161.

[0023] The cutting device 20 includes a second control device 200. The second control device 200 includes the second communication unit 201 and a second control unit 202.

[0024] The second communication unit 201 is configured to communicate with, for example, the first communication unit 161, which is included in the warpage correction device 10, through the communication line L1. Note that the second communication unit 201 does not necessarily need to communicate with the first communication unit 161 through the communication line L1, but may communicate with the first communication unit 161 through wireless communication.

[0025] The second control unit 202 includes, for example, a CPU, a RAM, and a ROM. The second control unit 202 is configured to control constituent components within the cutting device 20 in accordance with information processing. The second control unit 202 controls the second communication unit 201 to transmit information to the warpage correction device 10, for example.

[0026] When the warpage correction system 5 completes preparation for transporting the second molded substrate S2 to the cutting device 20, a signal to request receipt of the second molded substrate S2 (hereinafter also referred to as “receiving request signal”) is transmitted from the first communication unit 161 to the second communication unit 201. When there is a sufficient free space in the magazine contained in the second accommodation part 210, a signal indicating that receipt of the second molded substrate S2 is possible (hereinafter, “ready-to-receive signal”) is transmitted from the second communication unit 201 to the first communication unit 161. In response to the ready-to-receive signal being received by the first communication unit 161, the first transport mechanism 300 transports the second molded substrate S2 to the cutting device 20.

[0027] Thus, in the manufacturing system 1, the transport of the second molded substrate S2 from the warpage correction device 10 to the cutting device 20 is performed taking into consideration the free space in the magazine contained in the second

accommodation part 210. Therefore, according to the manufacturing system 1, the second molded substrate S2 can be transported from the warpage correction device 10 to the cutting device 20 at an appropriate timing. The operation of transporting the second molded substrate S2 from the warpage correction device 10 to the cutting device 20 will be described in detail later.

[0028] <1-2. Configuration of Warpage Correction Device>

FIG. 2 is a perspective view schematically showing the warpage correction device 10 according to the present embodiment. FIG. 3 is a plan view schematically showing the warpage correction device 10. Referring to FIGS. 2 and 3, the warpage correction device 10 is configured to correct warpage of the first molded substrate S1 and produce the second molded substrate S2.

[0029] The warpage correction device 10 includes a first accommodation part 100, a carry-in rail part 110, a heating unit 120, a cooling unit 130, a carry-out rail part 140, and a second transport mechanism 150. The second transport mechanism 150 includes transport mechanisms 151, 154, and 157. Note that the present embodiment employs a configuration in which processing of a plurality of (specifically, two) first molded substrates S1 are processed at a time in each of the heating unit 120 and the cooling unit 130, but a configuration in which processing of one first molded substrate S1 or three or more first molded substrates S1 is performed at a time in each of the heating unit 120 and the cooling unit 130 may also be employed. Note that, in FIG. 2, the second transport mechanism 150 is omitted.

[0030] The first accommodation part 100 includes, for example, a plurality of magazines 101. Each of the magazines 101 accommodates a plurality of first molded substrates S1. The first molded substrates S1 accommodated in the magazines 101 are supplied to the carry-in rail part 110.

[0031] The first molded substrates S1 supplied to the carry-in rail part 110 are transported from the carry-in rail part 110 to the heating unit 120 by the transport

mechanism 151. The transport mechanism 151 includes, for example, a plurality of (e.g., two) suction parts 152. Each of the suction parts 152 suctions one first molded substrate S1 to hold the first molded substrate S1. For example, the transport mechanism 151 sequentially suctions a plurality of first molded substrates S1 that are sequentially supplied to the carry-in rail part 110 to hold the first molded substrates S1.

[0032] The heating unit 120 includes a lower member 121 and an upper member 122. The lower member 121 and the upper member 122 each include a heater. The lower member 121 and the upper member 122 face each other in the vertical direction. A plurality of (e.g., two) first molded substrates S1 are placed on the lower member 121.

10 The lower member 121 is configured to rise and lower. As a result of the lower member 121 rising, a part of the upper surface (specifically, upper outer peripheral surface) of the lower member 121 comes into contact with the lower surface of the upper member 122 and the lower member 121 and the upper member 122 overlap each other.

[0033] FIG. 4 is a diagram schematically showing a cross-section of the lower member 121 and the upper member 122 in a closed state. As shown in FIG. 4, recesses C1 in the lower member 121 are closed by the upper member 122, thereby forming a plurality (two) of square internal spaces V1 in the heating unit 120. Each of the internal spaces V1 is, for example, a closed space. Here, a closed space refers to a sealed space. Note that the internal space V1 does not necessarily have to be a closed space. The internal space V1 need only be, for example, a space enclosed by a recess that can accommodate the first molded substrate S1 and a lid that covers at least part of the recess.

[0034] In each of the plurality of internal spaces V1, a first molded substrate S1 is placed. Note that, in the present embodiment, the first molded substrate S1 is placed in the internal space V1 such that the resin portion (black portion in FIG. 4) is located on the lower side (substrate portion is located on the upper side), but the first molded substrate S1 may be placed such that the resin portion is located on the upper side (substrate portion is located on the lower side). The height H1 of each internal space V1 is larger than the

thickness of the first molded substrate S1 without any warpage, for example. The first molded substrate S1 does not come into contact with the upper member 122 and is not pressurized by the upper member 122 except when, for example, excessive warpage has occurred. Therefore, in a state in which the lower member 121 and the upper member 122 are closed, no more force than necessary is applied to the first molded substrate S1.

[0035] In the state in which the lower member 121 and the upper member 122 are closed, heaters 124 and 123 are located above and below the internal spaces V1. The heaters 124 and 123 heat the internal spaces V1. The heaters 124 and 123 also heat the first molded substrates S1 placed in the internal spaces V1. Through the heating, the resin portions of the first molded substrates S1 are softened.

[0036] The time for which the first molded substrate S1 is heated in the internal space V1 refers to, for example, the time required for the temperature of the internal space V1 to stabilize and for all regions of the first molded substrate S1 to be heated substantially equally. Note that the lower member 121 and the upper member 122 are closed at timings other than when the first molded substrates S1 are carried into the heating unit 120 and when the first molded substrates S1 are carried out of the heating unit 120, in order to keep the internal space V1 warm.

[0037] In the warpage correction device 10, the first molded substrates S1 are heated while being placed in the internal spaces V1 of the heating unit 120. Therefore, according to the warpage correction device 10, the efficiency in heating the first molded substrates S1 can be improved compared to the case where, for example, the entire upper part of the heating unit 120 is open. Also, according to the warpage correction device 10, since no more force than necessary is applied to the first molded substrates S1 during heating of the first molded substrates S1, it is possible to reduce the possibility of the first molded substrates S1 being damaged.

[0038] Also, in the warpage correction device 10, the internal spaces V1 are formed with the lower member 121 and the upper member 122 closed. Therefore, according to

the warpage correction device 10, by canceling the state where the lower member 121 and the upper member 122 are closed, it is possible to easily perform both operations of placing the first molded substrates S1 into the internal spaces V1 and taking the first molded substrates S1 out of the internal spaces V1.

5 [0039] Also, in the warpage correction device 10, since the first molded substrates S1 are placed in the recesses C1, when, for example, the lower member 121 is raised so that the lower member 121 overlaps with the upper member 122, it is possible to reduce the possibility of misalignment of the first molded substrates S1 in the horizontal direction during the raising and lowering of the lower member 121.

10 [0040] Referring again to FIGS. 2 and 3, the heated first molded substrates S1 are transported from the heating unit 120 to the cooling unit 130 by the transport mechanism 154. The transport mechanism 154 holds the first molded substrates S1 mechanically without suctioning the first molded substrates S1. This is to avoid suction marks that could be caused by holding the heated and softened resin portions of the first molded substrates S1 from being left.

[0041] The cooling unit 130 includes a lower member 131 and an upper member 132. Each of the lower member 131 and the upper member 132 includes a portion of a tubular flow channel (not shown) through which the low-temperature heat medium supplied by a chiller circulates. The lower member 131 and the upper member 132 face each other in the vertical direction. A plurality of (e.g., two) first molded substrates S1 are placed on the lower member 131. The lower member 131 is configured to rise and lower. As a result of the lower member 131 rising, the upper surfaces of the first molded substrates S1 placed on the lower member 131 come into contact with the lower surface of the upper member 132, and the lower member 131 and the upper member 132 overlap each other with the first molded substrates S1 interposed therebetween. The first molded substrates S1 are pressurized by the lower member 131 and the upper member 132 in such a state that the lower member 131 and the upper member 132 are overlapped in the vertical direction.

The first molded substrates S1 are cooled by the cooling unit 130 while being pressurized by the lower member 131 and the upper member 132. Thereby, warpage of the first molded substrates S1 is corrected and the second molded substrates S2 are produced.

[0042] The second molded substrates S2 produced through cooling of the cooling unit 130 are transported from the cooling unit 130 to the carry-out rail part 140 by the transport mechanism 157. The transport mechanism 157 includes, for example, a plurality of (e.g., two) suction parts 158. Each of the suction parts 158 suctions the second molded substrate S2 to hold the second molded substrate S2. For example, the transport mechanism 157 sequentially suctions a plurality of second molded substrates S2 that are placed on the lower member 131 of the cooling unit 130 to hold the second molded substrates S2. The second molded substrates S2 transported to the carry-out rail part 140 are carried out toward the first transport mechanism 300 of the relay unit 30.

[0043] <1-3. Configuration of Relay unit>

As described above, the relay unit 30 includes the first transport mechanism 300 and the jig 350. First, the configuration of the jig 350 is described and then the configuration of the first transport mechanism 300 is described.

[0044] FIG. 5 is a plan view schematically showing the jig 350. FIG. 6 is a front view schematically showing the jig 350. FIG. 7 is a diagram schematically showing a cross-section taken along VII-VII in FIG. 5. As described above, the warpage correction device 10 is positioned with respect to the cutting device 20 via the jig 350. Note that in each of FIGS. 6 and 7, a caster of the cutting device 20 and a leg that supports the device are indicated by dotted lines.

[0045] Referring to FIGS. 5, 6, and 7, the jig 350 includes a first positioning member 360, a second positioning member 370, and a shaft receiving member 380. The first positioning member 360 and the second positioning member 370 are both fixed to the warpage correction device 10. On the other hand, the shaft receiving member 380 is fixed to the cutting device 20.

[0046] The first positioning member 360 is bolted to a position that is at a lower end of an end of the warpage correction device 10 on the cutting device 20 side in the X-axis direction and at one end in the Y-axis direction (the front end of the warpage correction device 10). The first positioning member 360 includes a shaft 361 and an L-shaped member 362. The shaft 361 is a rod-shaped member extending in the X-axis direction. The L-shaped member 362 includes two faces that are orthogonal to each other, with one face bolted to the warpage correction device 10. The shaft 361 is fixed to the other face. In other words, the shaft 361 is fixed to the warpage correction device 10 via the L-shaped member 362.

10 [0047] The second positioning member 370 is bolted to a position that is at a lower end of the end of the warpage correction device 10 on the cutting device 20 side in the X-axis direction and at another end in the Y-axis direction (the rear end of the warpage correction device 10). The second positioning member 370 includes a shaft 371, a jack bolt 372, and a plate member 373. The shaft 371 is a rod-shaped member extending in the X-axis direction. The jack bolt 372 is attached to the leading end of the shaft 371 and is configured to extend and retract with respect to the shaft 371 in the X-axis direction. The plate member 373 is bolted to the warpage correction device 10, and the shaft 371 is fixed to the plate member 373. In other words, both the shaft 371 and the jack bolt 372 are fixed to the warpage correction device 10 via the plate member 373.

15 [0048] The shaft receiving member 380 includes a fixing part 381 and a receiving part 382. The fixing part 381 has a shape extending in the X-axis direction and is bolted to a square pipe 220 of the cutting device 20. The fixing part 381 has three faces that face the top face and two side faces of the square pipe 220 extending in the X-axis direction. With the three faces respectively facing the top face and two side faces of the square pipe 220, the fixing part 381 is bolted to the square pipe 220.

20 [0049] The receiving part 382 is fixed to a lower end of the fixing part 381. The receiving part 382 has a shape extending in the X-axis direction. A recess C2 is formed

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in the receiving part 382 at an end on the warpage correction device 10 side. The leading end of the shaft 361 is fitted to the recess C2. With this, the position of the warpage correction device 10 is defined relative to the cutting device 20 in the X-axis direction and the Y-axis direction.

5 [0050] By adjusting the state of extension and retraction of the jack bolt 372 with the leading end of the shaft 361 fitted to the recess C2, it is possible to define the position of the warpage correction device 10 in the rotational direction with the leading end of the shaft 361 as the center of rotation. In this way, neither of the first positioning member 360 and the second positioning member 370 is fixed to the cutting device 20. In the
10 present embodiment, the state of extension and retraction of the jack bolt 372 is adjusted so that the warpage correction device 10 and the cutting device 20 are parallel.

[0051] FIG. 8 is a plan view schematically showing the first transport mechanism 300. FIG. 9 is a diagram schematically showing a cross-section taken along IX-IX in FIG. 8.

[0052] Referring to FIGS. 8 and 9, the first transport mechanism 300 includes a base
15 plate 305, a pair of relay rails 310, a pusher 321, an electric actuator 320, a first sensor 340, and a second sensor 341. The base plate 305 is a plate-shaped member and extends in the X-axis direction. The pair of relay rails 310, the electric actuator 320, and the first sensor 340 are fixed to the base plate 305.

[0053] The pair of relay rail 310 extend in the X-axis direction, and are located on an
20 extension line of the carry-out rail part 140 of the warpage correction device 10. The leading ends of the pair of relay rails 310 on the cutting device 20 side are located near the second accommodation part 210 of the cutting device 20. The second molded substrate S2 produced in the warpage correction device 10 is transported from the carry-out rail part 140 to the pair of relay rails 310. The second molded substrate S2 is transported to a
25 substantially central portion of the pair of relay rails 310 in the X-axis direction, for example, by the pusher (not shown) that transports the second molded substrate S2 placed on the carry-out rail part 140 in the X-axis direction.

[0054] The pusher 321 is configured to move in the X-axis direction and transport the second molded substrate S2 placed on the relay rails 310. The pusher 321 is attached to the electric actuator 320.

[0055] The electric actuator 320 extends in the X-axis direction and includes, for example, a ball screw, a motor that drives the ball screw, and a linear guide (all not shown). To the moving part thereof that moves in the X-axis direction by the ball screw being driven, the base part of the pusher 321 is fixed. In other words, the pusher 321 moves in the X-axis direction as driven by the motor included in electric actuator 320. The pusher 321 transports the second molded substrate S2 so that the second molded substrate S2 is accommodated in the magazine contained in the second accommodation part 210.

[0056] The first sensor 340 is located, for example, near the boundary between the carry-out rail part 140 and the pair of relay rails 310. The first sensor 340 is configured to detect that the second molded substrate S2 is passed from the warpage correction device 10 to the first transport mechanism 300. A detection signal from the first sensor 340 is transmitted to the first control unit 162 of the warpage correction device 10.

[0057] The second sensor 341 is located near the ends of the pair of relay rails 310 on the cutting device 20 side. The second sensor 341 is configured to detect that the second molded substrate S2 is passed from the first transport mechanism 300 to the second accommodation part 210 of the cutting device 20. A detection signal from the second sensor 341 is transmitted to the first control unit 162 of the warpage correction device 10.

[0058] The upper part of the first transport mechanism 300 is covered by a cover 330. The cover 330 is made of, for example, acrylic. For example, the pair of relay rails 310, the pusher 321, and the electric actuator 320 are arranged in the space enclosed by the base plate 305 and the cover 330. Specifically, the relay unit 30 is arranged so that the base plate 305 bridges the warpage correction device 10 and the cutting device 20, which are arranged parallel to each other by the jig 350, in a manner such that the pair of relay rails 310 of the first transport mechanism 300 are connected parallel to the carry-out rail part

140 of the warpage correction device 10 and lead to positions at which the second accommodation part 210 of the cutting device 20 can be placed. Thus, the first transport mechanism 300 is not fixed to the cutting device 20.

[0059] [2. Operation]

5 FIG. 10 is a flowchart of an operation of transporting the second molded substrate S2 from the warpage correction device 10 to the cutting device 20. The processing shown in the flowchart on the left side is executed by the first control unit 162 of the warpage correction device 10 after the passage of the second molded substrate S2 is detected by the first sensor 340. The processing shown in the flowchart on the right side is executed by
10 the second control unit 202 of the cutting device 20.

[0060] Referring to the flowchart of FIG. 10 on the left side, the first control unit 162 controls the first communication unit 161 to transmit a receiving request signal to the cutting device 20 (step S100). The first control unit 162 determines whether or not a ready-to-receive signal has been received from the cutting device 20 through the first
15 communication unit 161 (step S110). If it is determined that no ready-to-receive signal has been received (NO, in step S110), the first control unit 162 stands by until a ready-to-receive signal is received.

[0061] On the other hand, if it is determined that a ready-to-receive signal has been received (YES, in step S110), the first control unit 162 controls the electric actuator 320 to
20 start the transport of the second molded substrate S2 placed on the pair of relay rails 310 to the cutting device 20 (step S120). With this, the transport of the second molded substrate S2 by the pusher 321 is started.

[0062] The first control unit 162 determines whether or not a detection signal has been received from the second sensor 341 through the first communication unit 161 (step S130).
25 If it is determined that no detection signal has been received from the second sensor 341 (NO, in step S130), the first control unit 162 stands by until a detection signal is received from the second sensor 341.

[0063] On the other hand, if it is determined that a detection signal has been received from the second sensor 341 (YES, in step S130), the first control unit 162 controls the first communication unit 161 to transmit a signal indicating that the transport of the second molded substrate S2 to the cutting device 20 is complete (hereinafter, referred to also as “transport completion signal”) to the cutting device 20 (step S140). With this, the transport of the second molded substrate S2 to the magazine contained in the second accommodation part 210 of the cutting device 20 is complete.

[0064] Referring to the flowchart of FIG. 10 on the right side, the second control unit 202 determines whether or not a receiving request signal has been received from the warpage correction device 10 through the second communication unit 201 (step S200). If it is determined that no receiving request signal has been received (NO, in step S200), the second control unit 202 stands by until a receiving request signal is received.

[0065] On the other hand, if it is determined that a receiving request signal has been received (YES, in step S200), the second control unit 202 determines whether or not there is a predetermined free space in any of the plurality of magazines contained in the second accommodation part 210 (step S210). Note that the predetermined free space is a predetermined space, and may be a space that can accommodate one second molded substrate S2 or may be a space that can accommodate a plurality of second molded substrates S2.

[0066] If it is determined that there is no predetermined free space in any magazine (NO, in step S210), the second control unit 202 stands by until there is a predetermined free space in a magazine. In the cutting device 20, parallel to the processing shown in this flowchart, processing of taking the second molded substrate S2 out of the second accommodation part 210 and cutting the second molded substrate S2 is executed. As a result of the second molded substrate S2 being taken out of the second accommodation part 210, the free space in the magazine contained in the second accommodation part 210 becomes larger.

[0067] On the other hand, if it is determined that there is a predetermined free space in any of the multiple magazines in step S210 (YES, in step S210), the second control unit 202 controls the second accommodation part 210 so that the magazine having the predetermined free space is positioned at the position at which the second molded substrate S2 is to be received (step S220). Then, the second control unit 202 controls the second communication unit 201 to transmit a ready-to-receive signal to the warpage correction device 10 (step S230).

[0068] The second control unit 202 determines whether or not a transport completion signal has been received from the warpage correction device 10 through the second communication unit 201 (step S240). If it is determined that no transport completion signal has been received (NO, in step S240), the second control unit 202 stands by until a transport completion signal is received.

[0069] On the other hand, if it is determined that a transport completion signal has been received (YES, in step S240), the processing shown in this flowchart ends. With this, the transport of the second molded substrate S2 to the magazine contained in the second accommodation part 210 of the cutting device 20 is complete, and the second control unit 202 can recognize that the transport of the second molded substrate S2 is complete.

[0070] In the warpage correction system 5, a receiving request signal is transmitted to the cutting device 20 in response to detection of the receipt of the second molded substrate S2 by the first sensor 340. Therefore, according to the warpage correction system 5, since the signal that requests receipt of the second molded substrate S2 is transmitted to the cutting device 20 before the second molded substrate S2 is transported to the cutting device 20, it is possible to realize the transport of the second molded substrate S2 according to the conditions of the cutting device 20.

[0071] In the warpage correction system 5, the first transport mechanism 300 transports the second molded substrate S2 to the cutting device 20 in response to the first

communication unit 161 receiving a ready-to-receive signal from the cutting device 20. Therefore, according to the warpage correction system 5, since the second molded substrate S2 is transported after the ready-to-receive signal has been received, it is possible to transport the second molded substrate S2 to the cutting device 20 at an appropriate timing.

5 [0072] In the warpage correction system 5, a transport completion signal is transmitted to the cutting device 20 in response to the second sensor 341 detecting the transport of the second molded substrate S2. Therefore, according to the warpage correction system 5, it is possible for the cutting device 20 to recognize that the transport of the second molded substrate S2 to the cutting device 20 is complete.

10 [0073] In the manufacturing system 1, it is determined whether or not the second molded substrate S2 can be received by the cutting device 20 according to the accommodation state of the second accommodation part 210 with respect to second molded substrates S2 (state of the free space in the magazine). Therefore, according to the manufacturing system 1, it is possible to appropriately determine whether or not the cutting
15 device 20 can receive the second molded substrate S2.

[0074] [3. Features]

As described above, in the warpage correction system 5, the first transport mechanism 300 included in the relay unit 30 receives the second molded substrate S2 from the warpage correction device 10 and transports the received second molded substrate S2
20 to the cutting device 20. Therefore, according to the warpage correction system 5, since the second molded substrate S2 is transported from the warpage correction device 10 to the cutting device 20 by the first transport mechanism 300, the second molded substrate S2 can be easily transported to the cutting device 20 even if the warpage correction device 10 is independent of the cutting device 20.

25 [0075] Note that the warpage correction system 5 is an example of the “warpage correction system” of the present invention. The warpage correction device 10 is an example of the “warpage correction device” of the present invention, and the relay unit 30

is an example of the “relay unit” of the present invention, and the first transport mechanism 300 is an example of the “first transport mechanism” of the present invention. The first control unit 162 is an example of the “first control unit” of the present invention, and the first communication unit 161 is an example of the “communication unit” of the present invention. The first sensor 340 is an example of the “first sensor” of the present invention, and the second sensor 341 is an example of the “second sensor” of the present invention. The pair of relay rails 310 is an example of the “pair of rails” of the present invention, and the pusher 321 is an example of the “transport member” of the present invention.

[0076] The first accommodation part 100 is an example of the “first accommodation part” of the present invention, the heating unit 120 is an example of the “heating unit” of the present invention, and the cooling unit 130 is an example of the “cooling unit” of the present invention. The second transport mechanism 150 is an example of the “second transport mechanism” of the present invention. The second accommodation part 210 is an example of the “second accommodation part” of the present invention. The cutting device 20 is an example of the “processing device” of the present invention. The manufacturing system 1 is an example of the “manufacturing system” of the present invention.

[0077] [4. Other Embodiments]

The ideas of the above-described embodiment are not limited to the above-described embodiment. The following will describe examples of other embodiments to which the ideas of the above-described embodiment can be applied.

[0078] <4-1>

In the above-described embodiment, only one first transport mechanism 300 is provided between the warpage correction device 10 and the cutting device 20. However, the number of the first transport mechanisms 300 is not limited to this. For example, a plurality of first transport mechanisms 300 may be provided between the warpage correction device 10 and the cutting device 20. For example, the plurality of first

transport mechanisms 300 may be provided in a manner such that the plurality of first transport mechanisms 300 are lined up in the Y-axis direction, or the plurality of first transport mechanisms 300 may be provided in a manner such that the plurality of first transport mechanisms 300 are lined up in the height direction. With this, a plurality of
5 second molded substrates S2 can be transported in parallel from the warpage correction device 10 to the cutting device 20.

[0079] <4-2>

In the above-described embodiment, the second molded substrate S2 is transported from the warpage correction device 10 to the cutting device 20. However, the destination
10 of the second molded substrate S2 is not limited to this. The second molded substrate S2 may be transported, for example, to a grinder that grinds the surface of the second molded substrate S2, or to a laser marker that marks the surface of the second molded substrate S2. In other words, the destination of the second molded substrate S2 need only be a processing device that processes the second molded substrate S2.

15 [0080] <4-3>

In the above-described embodiment, the amount of warpage of the second molded substrate S2 transported to the carry-out rail part 140 may be measured. For example, a measuring unit for measuring the warpage of the second molded substrate S2 may be provided in the vicinity of the carry-out rail part 140, and the amount of warpage of the
20 second molded substrate S2 may be measured. The measuring unit may be a laser displacement meter, for example. The laser displacement meter may move in the longitudinal or short-side direction of the second molded substrate S2 to measure the amount of warpage of the second molded substrate S2. For example, a configuration is also possible in which the second molded substrate S2 is transported to the relay unit 30
25 when the amount of warpage of the second molded substrate S2 is less than or equal to an allowable value, and the second molded substrate S2 is not transported to the relay unit 30 when the amount of warpage of the second molded substrate S2 exceeds the allowable

value. For example, when the carry-out rail part 140 extends to the first accommodation part 100 and the amount of warpage of the second molded substrate S2 exceeds the allowable value, the second molded substrate S2 may be accommodated in the magazine contained in the first accommodation part 100.

5 [0081] The exemplary examples of the embodiment of the present invention has been described. That is, the detailed description and accompanying drawings have been disclosed for illustrative purposes. Therefore, some of the constituent components described in the detailed description and the accompanying drawings may include constituent components that are not essential for solving the problem. Accordingly, just
10 because those non-essential constituent components are described in the detailed description and the accompanying drawings, it should not be immediately recognized that those non-essential constituent components are essential.

[0082] Also, the above-described embodiments are merely examples of the present invention in all respects. The above-described embodiments can be improved or modified
15 in various ways within the scope of the present invention. In other words, when implementing the present invention, specific configurations can be adopted as appropriate according to the embodiments.

[0083] [Appendix]

The present specification discloses various technical ideas including at least the
20 following techniques.

[0084] <Technique 1>

(Configuration)

A warpage correction system including:

a warpage correction device configured to correct warpage of a first molded
25 substrate and produce a second molded substrate; and

a relay unit disposed between an external processing device for the warpage correction device and the warpage correction device,

wherein the processing device processes the second molded substrate, and
the relay unit includes a first transport mechanism configured to receive the second molded substrate from the warpage correction device and transport the received second molded substrate to the processing device.

5 [0085] (Effects etc.)

In this warpage correction system, the first transport mechanism included in the relay unit receives the second molded substrate from the warpage correction device and transports the received second molded substrate to the processing device. Therefore, according to this warpage correction system, since the second molded substrate is
10 transported from the warpage correction device to the processing device by the first transport mechanism, the second molded substrate can be easily transported to the processing device even if the warpage correction device is independent of the processing device.

[0086] <Technique 2>

15 (Configuration)

The warpage correction system according to Technique 1, further including: a first control unit configured to control the first transport mechanism; and
a first communication unit configured to communicate with the processing device.

[0087] (Effects etc.)

20 According to this warpage correction system, since the first control unit and the first communication unit are used, and the second molded substrate is transported from the warpage correction device to the processing device by the first transport mechanism, the second molded substrate can be easily transported to the processing device even if the warpage correction device is independent of the processing device.

25 [0088] <Technique 3>

(Configuration)

The warpage correction system according to Technique 2,

wherein the relay unit further includes a first sensor configured to detect that the second molded substrate has been received from the warpage correction device, and

in response to the first sensor detecting the receipt of the second molded substrate, the first control unit controls the first communication unit to transmit a signal to request receipt of the second molded substrate to the processing device.

[0089] (Effects etc.)

In this warpage correction system, in response to the first sensor detecting the receipt of the second molded substrate, a signal to request receipt of the second molded substrate is transmitted to the processing device. Thus, according to the warpage correction system, since the signal to request receipt of the second molded substrate is transmitted to the processing device before the second molded substrate is transported to the processing device, it is possible to realize the transport of the second molded substrate according to the conditions of the processing device.

[0090] <Technique 4>

(Configuration)

The warpage correction system according to Technique 2 or 3,

wherein the first control unit controls the first transport mechanism to transport the second molded substrate to the processing device, in response to the first communication unit receiving a signal indicating that the second molded substrate is receivable from the processing device.

[0091] (Effects etc.)

In this warpage correction system, the first transport mechanism transports the second molded substrate to the processing device in response to the first communication unit receiving a signal indicating that the second molded substrate is receivable from the processing device. Therefore, according to this warpage correction system, since the second molded substrate is transported after the signal indicating that the second molded substrate is receivable has been received, it is possible to transport the second molded

substrate to the processing device at an appropriate timing.

[0092] <Technique 5>

(Configuration)

5 The warpage correction system according to any one of Techniques 2 to 4,
wherein the relay unit further includes a second sensor configured to detect that
the second molded substrate has been transported to the processing device, and

in response to the second sensor detecting the transport of the second molded
substrate, the first control unit controls the first communication unit to transmit a signal
indicating that the transport of the second molded substrate to the processing device is
10 complete to the processing device.

[0093] (Effects etc.)

In this warpage correction system, in response to the second sensor detecting the
transport of the second molded substrate, a signal indicating that the transport of the second
molded substrate to the processing device is complete is transmitted to the processing
15 device. Therefore, this warpage correction system enables the processing device to
recognize that the transport of the second molded substrate to the processing device is
complete.

[0094] <Technique 5-2>

(Configuration)

20 The warpage correction system according to any one of Techniques 1 to 5,
wherein the first transport mechanism includes:

a pair of rails on which the second molded substrate is placed; and

a transport member configured to transport the second molded substrate
placed on the pair of rails.

25 [0095] (Effects etc.)

In this warpage correction system, the second molded substrate received from the
warpage correction device is placed on the pair of rails, and the transport member transports

the second molded substrate placed on the pair of rails to the processing device. Therefore, according to this warpage correction system, since the second molded substrate is transported from the warpage correction device to the processing device by the first transport mechanism, the second molded substrate can be easily transported to the processing device even if the warpage correction device is independent of the processing device.

[0096] <Technique 6>

(Configuration)

The warpage correction system according to any one of Techniques 1 to 5, wherein the warpage correction device includes:

a first accommodation part configured to accommodate the first molded substrate;

a heating unit configured to heat the first molded substrate;

a cooling unit configured to cool the first molded substrate with the first molded substrate pressurized; and

a second transport mechanism configured to transport the first molded substrate supplied from the first accommodation part to the heating unit, and transport the first molded substrate heated by the heating unit to the cooling unit, and

the heating unit heats the first molded substrate with the first molded substrate placed in an internal space formed in the heating unit.

[0097] (Effects etc.)

In this warpage correction device included in the warpage correction system, the first molded substrate is heated while being placed in the internal space of the heating unit. Therefore, according to this warpage correction system, the efficiency of heating the first molded substrate can be improved compared to the case where, for example, the entire upper part of the heating unit is open. Also, according to this warpage correction system, since no more force than necessary is applied to the first molded substrate during heating

of the first molded substrate, it is possible to reduce the possibility of the first molded substrate being damaged.

[0098] <Technique 7>

(Configuration)

5 The warpage correction system according to Technique 6,
 wherein the internal space has a length in a height direction that is greater than a length, in a height direction, of the first molded substrate without warpage.

[0099] (Effects etc.)

 According to this warpage correction system, since the length of the internal space
10 of the heating unit in the height direction is greater than the thickness of the first molded substrate without warpage, it is possible to suppress a situation where more force than necessary is applied to the first molded substrate during heating of the first molded substrate.

[0100] <Technique 8>

15 (Configuration)

 The warpage correction system according to any one of Techniques 1 to 7,
 wherein the processing device includes a second accommodation part configured to accommodate the second molded substrate, and
 the second molded substrate transported by the first transport mechanism is
20 accommodated in the second accommodation part.

[0101] (Effects etc.)

 In this warpage correction system, the second molded substrate transported by the first transport mechanism is accommodated in the second accommodation part. Therefore, according to this warpage correction system, since the second molded substrate
25 is transported from the warpage correction device to the processing device by the first transport mechanism, and the second molded substrate is accommodated in the second accommodation part, the second molded substrate can be easily accommodated in the

second accommodation part even if the warpage correction device is independent of the processing device.

[0102] <Technique 9>

(Configuration)

5 A manufacturing system including:

the warpage correction system according to Technique 8; and

the processing device,

wherein the processing device further includes a second control unit configured to determine whether or not the second molded substrate is receivable according to an accommodation state of the second accommodation part with respect to second molded substrates.

[0103] (Effects etc.)

In this manufacturing system, it is determined whether or not the second molded substrate can be received by the processing device according to the accommodation state of the second accommodation part with respect to second molded substrates. Therefore, according to this manufacturing system, it is possible to appropriately determine whether or not the second molded substrate can be received by the processing device.

[0104] <Technique 10>

(Configuration)

20 The manufacturing system according to Technique 9,

wherein the processing device further includes a second communication unit configured to communicate with the warpage correction system, and

when it is determined that the second molded substrate is receivable, the second control unit controls the second communication unit to transmit a signal indicating that the second molded substrate is receivable to the warpage correction system.

[0105] (Effects etc.)

In this manufacturing system, if it is determined that the second molded substrate

is receivable in the processing device, a signal indicating that the second molded substrate is receivable (ready-to-receive signal) is transmitted from the processing device to the warpage correction system. Therefore, this manufacturing system enables the second molded substrate to be transported from the warpage correction system to the processing device only when the second molded substrate is receivable in the processing device.

List of Reference Numerals

[0106]

1 Manufacturing system, 5 Warpage correction system,
 10 10 Warpage correction device, 20 Cutting device,
 30 Relay unit, 100 First accommodation part, 101 Magazine,
 110 Carry-in rail part, 120 Heating unit, 121, 131 Lower member,
 122, 132 Upper member, 123, 124 Heater, 130 Cooling unit,
 140 Carry-out rail part, 150 Second transport mechanism,
 15 151, 154, 157 Transport mechanisms, 152, 158 Suction part,
 160 First control device, 161 First communication unit,
 162 First control unit, 200 Second control device,
 201 Second communication unit, 202 Second control unit,
 210 Second accommodation part, 220 Square pipe,
 20 300 First transport mechanism, 305 Base plate, 310 Relay rail,
 320 Electric actuator, 321 Pusher, 330 Cover, 340 First sensor,
 341 Second sensor, 350 Jig, 360 First positioning member,
 361, 371 Shaft, 362 L-shaped member,
 370 Second positioning member, 372 Jack bolt, 373 Plate member,
 25 380 Shaft receiving member, 381 Fixing part, 382 Receiving part,
 C1, C2 Recess, L1 Communication line, S1 First molded substrate,
 S2 Second molded substrate, V1 Internal space.

CLAIMS

[Claim 1] A warpage correction system comprising:

a warpage correction device configured to correct warpage of a first molded
5 substrate and produce a second molded substrate; and

a relay unit disposed between an external processing device for the warpage
correction device and the warpage correction device,

wherein the processing device processes the second molded substrate, and

the relay unit includes a first transport mechanism configured to receive the second
10 molded substrate from the warpage correction device and transport the received second
molded substrate to the processing device.

[Claim 2] The warpage correction system according to claim 1, further comprising:

a first control unit configured to control the first transport mechanism; and

15 a first communication unit configured to communicate with the processing device.

[Claim 3] The warpage correction system according to claim 2,

wherein the relay unit further includes a first sensor configured to detect that the
second molded substrate has been received from the warpage correction device, and

20 in response to the first sensor detecting the receipt of the second molded substrate,
the first control unit controls the first communication unit to transmit a signal to request
receipt of the second molded substrate to the processing device.

[Claim 4] The warpage correction system according to claim 2 or 3,

25 wherein the first control unit controls the first transport mechanism to transport
the second molded substrate to the processing device, in response to the first
communication unit receiving a signal indicating that the second molded substrate is

receivable from the processing device.

[Claim 5] The warpage correction system according to any one of claims 2 to 4,
 wherein the relay unit further includes a second sensor configured to detect that
5 the second molded substrate has been transported to the processing device, and
 in response to the second sensor detecting the transport of the second molded
 substrate, the first control unit controls the first communication unit to transmit a signal
 indicating that the transport of the second molded substrate to the processing device is
 complete to the processing device.

10

[Claim 6] The warpage correction system according to any one of claims 1 to 5,
 wherein the warpage correction device includes:
 a first accommodation part configured to accommodate the first molded
 substrate;
15 a heating unit configured to heat the first molded substrate;
 a cooling unit configured to cool the first molded substrate with the first
 molded substrate pressurized; and
 a second transport mechanism configured to transport the first molded
 substrate supplied from the first accommodation part to the heating unit, and transport the
20 first molded substrate heated by the heating unit to the cooling unit, and
 the heating unit heats the first molded substrate with the first molded substrate
 placed in an internal space formed in the heating unit.

[Claim 7] The warpage correction system according to claim 6,
25 wherein the internal space has a length in a height direction that is greater than a
 length, in a height direction, of the first molded substrate without warpage.

[Claim 8] The warpage correction system according to any one of claims 1 to 7,
 wherein the processing device includes a second accommodation part configured
to accommodate the second molded substrate, and
 the second molded substrate transported by the first transport mechanism is
5 accommodated in the second accommodation part.

[Claim 9] A manufacturing system comprising:
 the warpage correction system according to claim 8; and
 the processing device,

10 wherein the processing device further includes a second control unit configured to
determine whether or not the second molded substrate is receivable according to an
accommodation state of the second accommodation part with respect to second molded
substrates.

15 [Claim 10] The manufacturing system according to claim 9,
 wherein the processing device further includes a second communication unit
configured to communicate with the warpage correction system, and
 when it is determined that the second molded substrate is receivable, the second
control unit controls the second communication unit to transmit a signal indicating that the
20 second molded substrate is receivable to the warpage correction system.