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SHAPING DEVICE

Abstract

The shaping device includes a pushing tool that pushes a plate-shaped object, which is disposed in such a manner that one main surface thereof faces upward. from a side of the object, and a heating unit that heats the object.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of PCT Patent Application No. PCT/JP2023/038478, filed Oct. 25, 2023, which claims priority to Japanese Patent Application No. 2022-178389 filed Nov. 7, 2022. These documents are herein incorporated in their entireties by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to a shaping device.

BACKGROUND ART

[0003] Japanese Patent Application Laid-Open No. 2002-76580 (PTL 1) discloses a warp correction device for correcting warpage of a plate-shaped object. According to PTL 1, this device can be used to correct warpage deformation to a uniform flat shape without causing any surface damage to a printed resin substrate. This device includes a hot water tank and a cooling water tank. This device includes a press unit. The press unit includes an upper die having a downwardly convex surface and a lower die having a downwardly concave surface. The warpage deformation of the printed resin substrate is corrected by sandwiching the printed resin substrate between the upper die and the lower die in hot water. The printed resin substrate in high temperature is carried into cooling water tank and held between an upper warp return prevention plate and a lower warp return prevention plate.

BRIEF SUMMARY

Technical Problem

[0004] In the device described in PTL 1, a jig having a shape suitable for the correction amount is required. In the case of correcting an object having a plurality of shapes, it is necessary to prepare a plurality of types of jigs in advance for each shape. In addition, when the desired deformation amount changes, it is necessary to replace the jig each time, which makes the operation complicated.

[0005] Therefore, an object of the present disclosure is to provide a shaping device that can easily deal with a change in a desired deformation amount.

Solution to Problem

[0006] In order to achieve the above object, a shaping device according to the present disclosure includes a pushing tool that pushes a plate-shaped object, which is disposed in such a manner that one main surface thereof faces upward, from a side of the object, and a heating unit that heats the object.

Advantageous Effects

[0007] According to the present disclosure, since the shaping device includes a pushing tool that pushes the object from a side thereof, it is possible to easily deal with a change in the desired deformation amount.

Description

BRIEF DESCRIPTION OF DRAWINGS

[0008] FIG. **1** is a conceptual diagram illustrating a shaping device according to a first embodiment of the present disclosure.

[0009] FIG. **2** is a plan view illustrating an object supporting unit provided in the shaping device according to the first embodiment of the present disclosure.

[0010] FIG. **3** is a cross-sectional view illustrating a first state of the object supporting unit provided in the shaping device according to the first embodiment of the present disclosure.

[0011] FIG. **4** is a cross-sectional view illustrating a second state of the object supporting unit

provided in the shaping device according to the first embodiment of the present disclosure.
[0012] FIG. **5** is an explanatory view illustrating a state in which an object is disposed on the object supporting unit of the shaping device according to the first embodiment of the present disclosure.
[0013] FIG. **6** is an explanatory diagram illustrating a state in which the object is heated by a heating unit of the shaping device according to the first embodiment of the present disclosure.
[0014] FIG. **7** is an explanatory view illustrating a state in which a pushing tool is moved to sandwich the object in the shaping device according to the first embodiment of the present disclosure.
[0015] FIG. **8** is an explanatory view illustrating a state in which the object held by the pushing tool is cooled in the shaping device according to the first embodiment of the present disclosure.
[0016] FIG. **9** is an explanatory view illustrating a state in which a plurality of support pins are lifted and the pushing tool is moved backward after cooling is completed in the shaping device according to the first embodiment of the present disclosure.
[0017] FIG. **10** is a conceptual diagram illustrating a shaping device according to a second embodiment of the present disclosure.
[0018] FIG. **11** is an explanatory diagram illustrating a state in which an object is deformed by moving a pushing tool forward in the shaping device according to the second embodiment of the present disclosure.
[0019] FIG. **12** is an explanatory diagram illustrating how the position of an outer edge of the object in the height direction is adjusted using a pressing member in the shaping device according to the second embodiment of the present disclosure.
[0020] FIG. **13** is an explanatory view illustrating a state in which the pressing member is lifted and a plurality of support pins are lowered in the shaping device according to the second embodiment of the present disclosure.
[0021] FIG. **14** is an explanatory diagram illustrating how the deformation amount of the object is adjusted using the pushing tool in the shaping device according to the second embodiment of the present disclosure.
[0022] FIG. **15** is an explanatory diagram illustrating another method of using the pressing member in the shaping device according to the second embodiment of the present disclosure.
[0023] FIG. **16** is an explanatory diagram illustrating a state in which a plurality of support pins are lowered when the object is sandwiched by the pushing tools and held by the same in the shaping device according to the second embodiment of the present disclosure.
[0024] FIG. **17** is a conceptual diagram illustrating a shaping device according to a third embodiment of the present disclosure.
[0025] FIG. **18** is an explanatory diagram illustrating a state in which an object is disposed on an object supporting unit in the shaping device according to the third embodiment of the present disclosure.
[0026] FIG. **19** is a conceptual diagram illustrating a shaping device according to a fourth embodiment of the present disclosure.
[0027] FIG. **20** is a conceptual diagram illustrating a modification of the shaping device according to the fourth embodiment of the present disclosure.
[0028] FIG. **21** is a conceptual diagram illustrating a shaping device according to a fifth embodiment of the present disclosure.
[0029] FIG. **22** is a conceptual diagram illustrating a first modification of the shaping device according to the fifth embodiment of the present disclosure.
[0030] FIG. **23** is a conceptual diagram illustrating a second modification of the shaping device according to the fifth embodiment of the present disclosure.
[0031] FIG. **24** is a conceptual diagram illustrating a third modification of the shaping device according to the fifth embodiment of the present disclosure.
[0032] FIG. **25** is a conceptual diagram illustrating a fourth modification of the shaping device

according to the fifth embodiment of the present disclosure.
[0033] FIG. **26** is a conceptual diagram illustrating a shaping device according to a sixth embodiment of the present disclosure.
[0034] FIG. **27** is a conceptual diagram illustrating a modification of the shaping device according to the sixth embodiment of the present disclosure.
[0035] FIG. **28** is an explanatory diagram illustrating a state in which an object is disposed on an object supporting unit in the shaping device according to a sixth embodiment of the present disclosure.
[0036] FIG. **29** is an explanatory view illustrating a state in which the object is deflected by lifting a pressing member and moving a pushing tool forward in the shaping device according to the sixth embodiment of the present disclosure.
[0037] FIG. **30** is an explanatory diagram illustrating a state in which an object is disposed on an object supporting unit in a modification of the shaping device according to the sixth embodiment of the present disclosure.
[0038] FIG. **31** is an explanatory view illustrating a state in which an object is deflected by lifting a pressing member and moving a pushing tool forward in a modification of the shaping device according to the sixth embodiment of the present disclosure.
[0039] FIG. **32** is a plan view illustrating an object supporting unit provided in a shaping device according to a seventh embodiment of the present disclosure.
[0040] FIG. **33** is a cross-sectional view taken along line XXXIII-XXXIII in FIG. **32**.
[0041] FIG. **34** is a first explanatory diagram illustrating an operation of a pushing unit provided in the shaping device according to the seventh embodiment of the present disclosure.
[0042] FIG. **35** is a second explanatory diagram illustrating an operation of the pushing unit provided in the shaping device according to the seventh embodiment of the present disclosure.
[0043] FIG. **36** is a plan view illustrating an object supporting unit provided in a shaping device according to an eighth embodiment of the present disclosure.
[0044] FIG. **37** is a cross-sectional view taken along line XXXVII-XXXVII in FIG. **36**.
[0045] FIG. **38** is a plan view illustrating an object supporting unit in which a pushing unit is provided only at one corner.
[0046] FIG. **39** is a plan view illustrating an object supporting unit in which a pushing unit is provided only at two corners.

DETAILED DESCRIPTION

[0047] The dimensional ratios illustrated in the drawings are not necessary to faithfully represent actual dimensions, and the dimensional ratios may be exaggerated for convenience of description. In the following description, when referring to the concept of top or bottom, it does not necessarily mean absolute top or bottom, but may mean relative top or bottom in the illustrated posture.
[0048] The concept of “shaping” as used herein includes removing an undesired warpage from an object to make the object flat or reducing the warpage. Further, the concept of “shaping” also includes intentionally deforming an object into a desired shape when the object is not in the desired shape.

First Embodiment

[0049] A shaping device according to a first embodiment of the present disclosure will be described with reference to FIGS. **1** to **5**. FIG. **1** illustrates a shaping device **101** according to the present embodiment. Shaping device **101** includes an object supporting unit **10** and a heating unit (e.g., a heater) **2**. FIG. **2** illustrates object supporting unit **10** as viewed directly from the top. Object supporting unit **10** includes a pushing unit **20**. Each pushing unit **20** includes a pushing tool **21** and a driving member **22**. FIG. **3** is a cross-sectional view of object supporting unit **10** in a first state, and FIG. **4** is a cross-sectional view of object supporting unit **10** in a second state. FIG. **5** illustrates a state in which an object **80** is disposed on object supporting unit **10**. In the present embodiment, object **80** includes a first resin layer **81** and a second resin layer **82**. First resin layer **81** is a plate-

shaped member formed of resin. Second resin layer **82** is disposed to cover a part of one surface of first resin layer **81**. Object **80** illustrated in the present embodiment is as an example, and it may have other structures. Object **80** may include, for example, a material layer other than a resin layer, or may be composed of three or more layers. Object **80** is not limited as long as it is a plate-shaped object.

[0050] Shaping device **101** includes a pushing tool **21** that pushes the plate-shaped object **80**, which is disposed in such a manner that one main surface thereof faces upward, from a side of object **80**, and a heating unit **2** that heats object **80**.

[0051] Furthermore, in the present embodiment, shaping device **101** includes a plurality of support pins **4** that supports object **80**. Object supporting unit **10** includes an outer periphery **11** and a base **12**. Base **12** is surrounded by outer periphery **11**. Base **12** is provided with at least one suction port **13** and a plurality of through holes **14**. The plurality of support pins **4** pass through the plurality of through holes **14**, respectively.

[0052] Heating unit **2** may be configured to irradiate halogen light, for example. Heating unit **2** may be, for example, an infrared heater. Heating unit **2** may be configured to blow warm air, for example. The heating method by heating unit **2** may be any method other than the method described in the present embodiment.

[0053] The operation of shaping device **101** according to the present embodiment will be described with reference to FIGS. **5** to **9**.

[0054] First, as illustrated in FIG. **5**, object **80** is disposed on object supporting unit **10**. At this time, object **80** is warped. Object **80** is supported by the plurality of support pins **4**.

[0055] Next, as illustrated in FIG. **6**, object **80** is heated using heating unit **2**. Object **80** is softened by the heating, which reduces warpage, and then the object is supported by the plurality of support pins **4**.

[0056] As illustrated in FIG. **7**, pushing unit **20** is operated. Specifically, each pushing tool **21** is moved in the direction of an arrow **93** to sandwich object **80**. Object **80** is sandwiched by pushing tools **21** and deflected in the direction of an arrow **95**. In this state, the plurality of support pins **4** are lowered as indicated by an arrow **94**. By lowering a support pin holding member **5**, the plurality of support pins **4** can be lowered at the same time. As illustrated in FIG. **8**, the plurality of support pins **4** are further lowered. In FIG. **8**, the plurality of support pins **4** are all separated from object **80**. Object **80** is sandwiched by pushing tools **21** in a deflected state and held by the same. In this state, the cooling is performed. After the cooling is completed, the plurality of support pins **4** are lifted as indicated by an arrow **96** in FIG. **9**. At this time, each pushing tool **21** is moved backward as indicated by an arrow **97**. Each pushing tool **21** is moved away from object **80**. Object **80** is supported by the plurality of support pins **4**.

[0057] Even if object **80** is initially deflected in a downward convex direction as illustrated in FIG. **5**, after heating, the object can be made flat as illustrated in FIG. **9** by temporarily deforming the object in an upward convex direction with pushing tool **21** as illustrated in FIGS. **7** to **8** and then cooling the object. However, this is merely an example. The heating conditions, the pushing amount by pushing tool **21**, the holding time by pushing tool **21**, and the like may be adjusted according to the shape of object **80** to be finally obtained.

[0058] In the present embodiment, since pushing tool **21** that pushes object **80** from a side is provided, it is possible to realize a shaping device that can easily deal with a change in the target correction amount.

[0059] In the present embodiment, object supporting unit **10** includes a base **12**. Although base **12** is not essential, as described in the present embodiment, it is preferable to provide base **12** to support object **80**. According to this configuration, object **80** can be stably supported.

[0060] In the present embodiment, base **12** includes a cooling unit (e.g., a cooler). Although the cooling unit is not essential, as described in the present embodiment, it is preferable that base **12** includes a cooling unit to cool object **80**. According to this configuration, object **80** can be

efficiently cooled.
[0061] In the present embodiment, base **12** is provided with at least one suction port **13**, and suction port **13** is connected to a suction device (not shown). As described in the present embodiment, it is preferable that shaping device **101** includes a suction device to suck object **80** downward. According to this configuration, object **80** can be held by suction.
[0062] In the present embodiment, shaping device **101** includes a plurality of support pins **4** that support object **80**. As described in the present embodiment, it is preferable that shaping device **101** includes a plurality of support pins **4** protruding upward to support object **80**. According to this configuration, object **80** can be held by the plurality of support pins **4**. Further, it is preferable that the plurality of support pins **4** are movable in the vertical direction. According to this configuration, object **80** can be lifted or lowered by the plurality of support pins **4**.
[0063] With respect to the lifting or lowering of the plurality of support pins **4**, it is described in the present embodiment that all the plurality of support pins **4** are integrated and are lifted or lowered simultaneously, but the present disclosure is not limited thereto. For example, each of the plurality of support pins **4** may be lifted or lowered independently.
[0064] As described in the present embodiment, assuming an imaginary plane that connects all upper ends of the plurality of support pins **4**, the imaginary plane is preferably convex upward. According to this configuration, object **80** can be appropriately supported.
[0065] In the present embodiment, it is described that object **80** has a rectangle shape, the shape of object **80** is not limited to a rectangle. Object **80** may have a square shape, a polygonal shape, a circular shape, an elliptical shape, or any other shape. The configuration of a shaping device, which is particularly suitable for shaping an object **80** having a square shape, will be described in detail in a seventh embodiment and an eighth embodiment.

Second Embodiment

[0066] A shaping device according to a second embodiment of the present disclosure will be described with reference to FIG. **10**. FIG. **10** illustrates a shaping device **102** according to the present embodiment. Shaping device **102** includes an object supporting unit **10**, a heating unit **2**, and a pressing member **3**. Heating unit **2** and pressing member **3** are movable in the lateral direction, for example, as indicated by an arrow **91**. Heating unit **2** and pressing member **3** can be moved right above object supporting unit **10** as necessary. Shaping device **102** includes pressing member **3**, and pressing member **3** is provided with protrusions **6** extending downward, and when the tip of each projection **6** is brought into contact with object **80**, object **80** is pressed downward.
[0067] The operation of shaping device **102** according to the present embodiment will be described with reference to FIGS. **5**, **6**, and FIGS. **11** to **14**.
[0068] First, as illustrated in FIG. **5**, object **80** is disposed on object supporting unit **10**. At this time, object **80** is warped. Object **80** is supported by the plurality of support pins **4**.
[0069] Next, as illustrated in FIG. **6**, object **80** is heated by using heating unit **2**. Object **80** is softened by the heating, which reduces warpage, and then the object is supported by the plurality of support pins **4**.
[0070] As illustrated in FIG. **11**, pushing tool **21** is moved forward in the direction of arrow **93** to deform object **80**. Object **80** is deformed into an upward convex shape. The upper ends of the plurality of support pins **4** are arranged along the deformed object **80**. As indicated by an arrow **98** in FIG. **12**, pressing member **3** is lowered to press against the outer edge of object **80** to adjust the position of the outer edge of object **80** in the height direction. At this time, it is desirable to adjust the position of the outer edge of object **80** in FIG. **11** so that the position of a left edge portion of object **80** in the height direction is the same as the position of a right edge portion in the height direction. When adjusted in this way, a force is applied to the left edge portion and the right edge portion of object **80** at the same position in the height direction, respectively, and thereby object **80** can be deflected in a state closer to symmetry. In this state, object **80** is sandwiched by pushing tools **21** and held by the same. As indicated by an arrow **99** in FIG. **13**, pressing member **3** is lifted,

and the plurality of support pins **4** are lowered. As indicated by arrow **93** in FIG. **14**, pushing tool **21** is moved forward to adjust the deformation amount of object **80**. Object **80** is deflected in the direction of arrow **95** to adjust the deformation amount thereof. In this manner, object **80** can have a desired shape.

[0071] Also, the same effects as those described in the first embodiment can be obtained in the present embodiment. Further, since shaping device **102** includes pressing member **3**, object **80** can be more reliably held at a desired position.

[0072] Another application of pressing member **3** will be described with reference to FIG. **15**. In FIG. **15**, object **80** has not been sufficiently deformed by the heating, and the outer edge of object **80** still remains higher than the upper end of pushing tool **21**. Since the outer edge of object **80** cannot be pushed by pushing tool **21** even if it is moved forward, the application of pressing member **3** is considered as a countermeasure. In the state illustrated in FIG. **15**, the position of the outer edge of object **80** can be lowered by lowering pressing member **3** to press the outer edge of object **80** downward, and thereby object **80** can be sandwiched and held by pushing tools **21** by moving pushing tools **21** forward.

[0073] When object **80** is sandwiched and held by pushing tools **21**, as indicated by an arrow **94** in FIG. **16**, the plurality of support pins **4** can be lowered to be completely separated from object **80**. By moving pushing tool **21** forward in the direction of arrow **93**, object **80** is deflected in the direction of arrow **95**. In this state, the cooling may be performed.

[0074] The shape of protrusions **6** of pressing member **3** is not limited to the example illustrated in FIG. **10**. Protrusions **6** are not necessarily fixed, but may be configured to be replaceable in any number and at any position. The length of each protrusion **6** may be extendable and contractible. Pressing member **3** can have various shapes by replacing each of protrusions **6** or by changing the length of each of protrusions **6**.

Third Embodiment

[0075] A shaping device according to a third embodiment of the present disclosure will be described with reference to FIGS. **17** and **18**. FIG. **17** illustrates an object supporting unit **10** of the shaping device according to the present embodiment. In the shaping device according to the present embodiment, a pushing unit **20** is provided only at one side of object supporting unit **10**. FIG. **18** illustrates a state in which object **80** is disposed in the shaping device according to the present embodiment. On the side opposite to pushing unit **20**, object **80** is pushed against the outer periphery. The shaping device may include a pressing member **3** as illustrated in FIG. **18**.

[0076] Also, the same effects as those described in the first embodiment can be obtained in the present embodiment. In the present embodiment, since the number of pushing units **20** can be reduced, the configuration of the shaping device can be simplified. Thus, the number of components in the shaping device can be reduced.

Fourth Embodiment

[0077] A shaping device according to a fourth embodiment of the present disclosure will be described with reference to FIGS. **19** and **20**. FIG. **19** illustrates an object supporting unit **10** of the shaping device according to the present embodiment. In the shaping device according to the present embodiment, base **12** does not include a cooling unit. Outer periphery **11** and base **12** are formed into an integrated body from the same material. As described above, base **12** may not include a cooling unit. The cooling may be performed by another device provided at a position other than base **12**. Alternatively, the cooling may be performed by naturally radiating heat to the surroundings, rather than by using a cooling unit that performs active cooling.

[0078] FIG. **20** illustrates an object supporting unit **10** of a modification of the shaping device according to the present embodiment. In the example illustrated in FIG. **20**, pushing unit **20** is provided only at one side. Such a configuration may be employed.

[0079] Also, the same effects as those described in the first embodiment can be obtained in the present embodiment. In the present embodiment, since base **12** of object supporting unit **10** does

not include a cooling unit, the structure of object supporting unit **10** can be simplified.

Fifth Embodiment

[0080] A shaping device according to a fifth embodiment of the present disclosure will be described with reference to FIG. **21**. FIG. **21** illustrates an object supporting unit **10** of the shaping device according to the present embodiment. In the shaping device according to the present embodiment, pushing unit **20** includes a stopper **23**. Pushing tool **21** is provided with a stopper **23** which is a protrusion that limits upward displacement of object **80**. More specifically, stopper **23** is provided as a protrusion protruding forward from an upper portion of a distal end surface of pushing tool **21**. However, stopper **23** illustrated in the present embodiment is merely an example. Stopper **23** is not limited to the configuration illustrated in FIG. **21** as long as it can limit upward displacement of the outer edge of object **80**. Stopper **23** is not limited to having one step as illustrated in FIG. **21**, and may have two or more steps. Stopper **23** may be in the form of an inverted slope. Stopper **23** is not limited to a protrusion. For example, a non-slip region may be provided on a surface of pushing tool **21** that comes into contact with object **80**, and this region may be used as stopper **23**. Assuming an imaginary plane that connects upper ends of the plurality of support pins **4**, the imaginary plane is convex downward.

[0081] In the present embodiment, since stopper **23** is provided in pushing tool **21**, it is possible to prevent an end of object **80** from excessively slipping and thereby significantly shifting on object supporting unit **10** or prevent it from dropping out from object supporting unit **10**.

[0082] Although FIG. **21** illustrates an example in which pushing unit **20** is provided on both sides, in a first modification as illustrated in FIG. **22**, pushing unit **20** may be provided only on one side. In the first modification illustrated in FIG. **22**, one end of the object is pressed against outer periphery **11**, but in order to prevent this end of object **80** from excessively sliding upward, in a second modification illustrated in FIG. **23**, a stopper **24** may be provided on outer periphery **11** on the side where pushing unit **20** is not provided. Stopper **24** is provided as a protrusion protruding from an upper portion of an inner peripheral surface of outer periphery **11**.

[0083] Although FIGS. **21** to **23** illustrate an example in which base **12** of object supporting unit **10** includes a cooling unit, as illustrated in a third modification of FIG. **24** or a fourth modification of FIG. **25**, base **12** of object supporting unit **10** may not include a cooling unit. Since base **12** of object supporting unit **10** does not include a cooling unit, the structure of object supporting unit **10** can be simplified.

[0084] Assuming an imaginary plane that connects all upper ends of the plurality of support pins **4**, the imaginary plane is preferably convex downward. According to this configuration, object **80** can be appropriately supported.

Sixth Embodiment

[0085] A shaping device according to a sixth embodiment of the present disclosure will be described with reference to FIGS. **26** and **27**. FIG. **26** illustrates a shaping device according to the present embodiment. The shaping device according to the present embodiment does not include a plurality of support pins that support object **80**. Base **12** has a convex or concave upper surface that comes into contact with object **80**. As one example, as illustrated in FIG. **26**, base **12** has a convex upper surface that comes into contact with object **80**.

[0086] In a modification as illustrated in FIG. **27**, pushing unit **20** may be provided only on one side of object supporting unit **10**.

[0087] The operation of the shaping device according to the present embodiment will be described with reference to FIGS. **28** to **31**.

[0088] First, as illustrated in FIG. **28**, an object **80** is disposed on object supporting unit **10** and heated. When the heating is finished, object **80** is warped. Object **80** is supported by the convex upper surface of base **12**. Pressing member **3** is lowered in the direction of arrow **98** to press the outer edge of object **80** downward. The floating position of object **80** is appropriately adjusted by pressing member **3**.

[0089] As indicated by arrow **99** in FIG. **29**, pressing member **3** is lifted. Pushing tool **21** of pushing unit **20** on each side is moved forward as indicated by arrow **93** to sandwich object **80**. As a result, object **80** is deflected. In this state, the cooling is performed. Thus, object **80** is shaped into a desired shape.

[0090] The same applies to the configuration according to a modification in which pushing unit **20** is provided only on one side of object supporting unit **10**. In other words, as illustrated in FIG. **30**, pressing member **3** is lowered in the direction of arrow **98** to press the outer edge of object **80** downward. The floating position of object **80** is appropriately adjusted by pressing member **3**. As indicated by arrow **99** in FIG. **31**, pressing member **3** is lifted. Pushing tool **21** of the pressing unit **20** is moved forward as indicated by arrow **93** to press object **80** against outer periphery **11**. As a result, object **80** is deflected. In this state, the cooling is performed. Thus, object **80** is shaped into a desired shape.

Seventh Embodiment

[0091] A shaping device according to a seventh embodiment of the present disclosure will be described with reference to FIGS. **32** to **35**. FIG. **32** illustrates an object supporting unit **10***i* of the shaping device according to the present embodiment. The shaping device is configured to shape a square object **80**. FIG. **33** is a cross-sectional view taken along line XXXIII-XXXIII in FIG. **32**.

[0092] When the shape of object **80** is rectangular, since warpage is almost limited to such a manner that the long side deflects when viewed from the direction perpendicular to the long side, the warpage can be handled by pushing the short side of object **80** with pushing tool **21**. However, when object **80** has a square shape, there is no long side or short side, and the warping direction of the object cannot be determined. In such an object **80**, there may be a number of possible warping patterns. Therefore, when object **80** has a square shape, it is preferable to use object supporting unit **10***i* as described in the present embodiment.

[0093] The shaping device according to the present embodiment includes an object supporting unit **10***i*. Object supporting unit **10***i* has a square outer periphery **11**. Each of the four corners of outer periphery **11** is provided with a pushing unit **20**. Pushing unit **20** includes an L-shaped pushing tool **21** and a driving member **22**. Pushing tool **21** and driving member **22** are connected by a shaft, and the shaft passes through outer periphery **11**. However, the shape of pushing unit **20** illustrated in the present embodiment is merely an example. The shaft that passes through outer periphery **11** is merely an example. A notch may be formed on outer periphery **11** to install pushing unit **20**. The shape of pushing unit **20** illustrated in the present embodiment is merely an example, and is not limited to thereto. For example, the structure of the shaft that connects pushing tool **21** to driving member **22** is not limited to that illustrated in the drawings.

[0094] FIGS. **34** to **35** are enlarged views illustrating one corner of object supporting unit **10***i*. Hereinafter, the operation of pushing unit **20** will be described.

[0095] FIG. **34** illustrates a state in which pushing tool **21** is mostly moved backward. Pushing tool **21** is moved backward by the driving of driving member **22** as indicated by arrow **97**. The profile of object **80** is indicated by a two-dot chain line. At this time, pushing tool **21** is sufficiently far away from object **80**.

[0096] FIG. **35** illustrates a state in which pushing tool **21** is moved backward. Pushing tool **21** is moved backward by the driving of driving member **22** as indicated by arrow **93**. Pushing tool **21** is brought into contact with a corner of object **80** to press object **80** in a diagonal direction of object **80**.

[0097] As described above, the shaping device according to the present embodiment includes a pushing tool **21** that pushes a plate-shaped object **80**, which is disposed in such a manner that one main surface thereof faces upward, from a side of object **80**, and a heating unit **2** that heats object **80**.

[0098] The term “pushing from a side” as used herein includes not only pushing a side of an object in a direction perpendicular to the side but also pushing a corner of the object in a diagonal

direction. For example, in the case where object **80** is circular, "pushing object **80** from a side" includes pushing object **80** in the radial direction.

[0099] In the present embodiment, since pushing unit **20** including an L-shaped pushing tool **21** is provided at each corner of object supporting unit **10***i* of the shaping device, and each pushing tool **21** is configured to push one corner of object **80** in the diagonal direction, even when object **80** has a square shape, it can be appropriately shaped.

Eighth Embodiment

[0100] A shaping device according to an eighth embodiment of the present disclosure will be described with reference to FIGS. **36** and **37**. FIG. **36** illustrates an object supporting unit **10***i* and a pressing member **3** of the shaping device according to the present embodiment. FIG. **37** is a cross-sectional view taken along line XXXVII-XXXVII in FIG. **36**. The shaping device according to the present embodiment includes a pressing member **3** which includes projections **6** extending downward, and is configured to press object **80** downward by bringing the tip of each projection **6** into contact with object **80**. As seen in a plan view of FIG. **36**, four projections **6** are disposed at four corners of pressing member **3**, respectively. In FIG. **36**, since the four protrusions **6** are located on the back side of pressing member **3** and are not directly visible, they are indicated by broken lines.

[0101] Also, the same effects as those described in the seventh embodiment can be obtained in the present embodiment. Further, in the present embodiment, since pressing member **3** is provided, object **80** can be more reliably held at a desired position.

Modification

[0102] A modification of the shaping device applicable to any of the seventh and eighth embodiments will be described with reference to FIGS. **38** and **39**.

[0103] In the example illustrated in FIG. **38**, a pushing unit **20** is provided only on one corner of an object supporting unit **10***i* having a square shape. A pushing tool **21** included in pushing unit **20** can be moved forward as indicated by arrow **93** or backward as indicated by arrow **97** by the driving of driving member **22**. When pushing tool **21** is moved forward, pushing tool **21** pushes object **80** in the diagonal direction, and thereby object **80** is pressed against a corner of outer periphery **11** at a position facing the pressing unit **20**. In this way, object **80** is sandwiched between pushing tool **21** and outer periphery **11** and held by the same. According to the shaping device having such a configuration, the square-shaped object **80** can be appropriately shaped.

[0104] In the example illustrated in FIG. **39**, a pushing unit **20** is provided at each of two opposing corners of an object supporting unit **10***i* having a square shape. A pushing tool **21** included in each of the two pushing units **20** can be moved forward as indicated by arrow **93** or backward as indicated by arrow **97** by the driving of driving member **22**. When the two pushing tools **21** are moved forward, object **80** is sandwiched by the two pushing tools **21** in the diagonal direction and held by the same. According to the shaping device having such a configuration, the square-shaped object **80** can be appropriately shaped.

[0105] The embodiments described above may be combined appropriately.

[0106] It should be understood that the embodiments disclosed herein are illustrative and non-restrictive in all respects. The scope of the present disclosure is defined by the terms of the claims, and is intended to include any modifications within the scope and meaning equivalent to the terms of the claims.

ASPECTS

First Aspect

[0107] A shaping device comprising: [0108] a pushing tool that pushes a plate-shaped object, which is disposed in such a manner that one main surface thereof faces upward, from a side of the object; and [0109] a heating unit that heats the object

Second Aspect

[0110] The shaping device according to the first aspect, wherein the pushing tool is provided with a

stopper which is a protrusion that limits upward displacement of the object.
Third Aspect
[0111] The shaping device according to the first aspect or the second aspect, further comprising:
[0112] a base that supports the object.
Fourth Aspect
[0113] The shaping device according to the third aspect, wherein the base includes a cooling unit that cools the object.
Fifth Aspect
[0114] The shaping device according to the third aspect or the fourth aspect, wherein the base has a convex or concave upper surface that comes into contact with the object.
Sixth Aspect
[0115] The shaping device according to any one of the first aspect to the fifth aspect, further comprising: [0116] a suction device that suctions the object downward.
Seventh Aspect
[0117] The shaping device according to any one of the first aspect to the sixth aspect, further comprising: [0118] a plurality of support pins protruding upward to support the object.
Eighth Aspect
[0119] The shaping device according to the seventh aspect, wherein the plurality of support pins are movable in the vertical direction.
Ninth Aspect
[0120] The shaping device according to any one of the first aspect to the eighth aspect, further comprising: [0121] a pressing member that includes a projection extending downward, and [0122] a tip of the projection is brought into contact with the object to press the object downward.
Tenth Aspect
[0123] The shaping device according to the seventh aspect or the eighth aspect, wherein assuming an imaginary plane that connects upper ends of all of the plurality of support pins, the imaginary plane is convex upward.
Eleventh Aspect
[0124] The shaping device according to the seventh aspect or the eighth aspect, wherein assuming an imaginary plane that connects upper ends of all of the plurality of support pins, the imaginary plane is convex downward.
REFERENCE SIGNS LIST
[0125] **2**: heating unit; **3**: pressing member; **4**: support pin; **5**: support pin holding member; **6**: protrusion; **10**, **10***i:* object supporting unit; **11**: outer periphery; **12**: base; **13**: suction port; **14**: through hole; **20**: pushing unit; **21**: pushing tool; **22**: driving member; **23**, **24**: stopper; **80**: object; **81**: first resin layer; **82**: second resin layer; **91**, **92**, **93**, **94**, **95**, **96**, **97**, **98**, **99**: arrow; **101**, **102**: shaping device.

Claims

1. A shaping device comprising: a pushing tool configured to push a plate-shaped object, which is disposed in such a manner that one main surface thereof faces upward, from a side of the object; and a heater configured to heat the object.
2. The shaping device according to claim 1, wherein the pushing tool comprises with a stopper which is a protrusion that limits upward displacement of the object.
3. The shaping device according to claim 1, further comprising: a base that supports the object.
4. The shaping device according to claim 3, wherein the base comprises a cooler configured to cool the object.
5. The shaping device according to claim 3, wherein the base has a convex or concave upper surface that contacts the object.

6. The shaping device according to any one of claim 1, further comprising: a suction device that configured to suction the object downward.
7. The shaping device according to any one of claim 1, further comprising: a plurality of support pins protruding upward so as to support the object.
8. The shaping device according to claim 7, wherein the plurality of support pins are movable in the vertical direction.
9. The shaping device according to any one of claim 1, further comprising: a pressing member comprising a projection extending downward, wherein a tip of the projection is contacts the object when pressing the object downward.
10. The shaping device according to claim 7. wherein an imaginary plane that connects upper ends of all of the plurality of support pins is convex upward.
11. The shaping device according to claim 7. wherein an imaginary plane that connects upper ends of all of the plurality of support pins is convex downward.