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SHAPING DEVICE

Abstract

A shaping device comprises: a base that can support a plate-shaped object; a plurality of support pins as a support member that can assume a first position to project upward from the base to support the object; a heating unit to heat the object while the object is supported by the plurality of support pins; and a biasing unit to bias the object downward, the plurality of support pins being movable upward and downward relative to the base.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATION [0001] This is a continuation of International Application No. PCT/JP2023/037357 filed on Oct. 16, 2023 which claims priority from Japanese Patent Application No. 2022-178388 filed on Nov. 7, 2022. The contents of these applications are incorporated herein by reference in their entireties.

BACKGROUND OF THE DISCLOSURE

Field of the Disclosure

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

Description of the Related Art

[0003] In some cases, shaping a plate-shaped object is required as the object undergoes heat treatment or cooling treatment. A substrate processing apparatus for achieving such an object is described in Japanese Patent Laid-Open No. 2008-177303. The substrate processing apparatus comprises a heating plate. The heating plate has a surface with a plurality of pin-shaped projections formed thereon to form a gap having a predetermined dimension with a wafer. Furthermore, the heating plate has the surface with a ring-shaped partition wall disposed thereon to partition the gap in a radial direction. Such a structure is used to apply heat treatment to a distorted wafer.

BRIEF SUMMARY OF THE DISCLOSURE

[0004] The substrate processing apparatus described in Japanese Patent Laid-Open No. 2008-177303 heats an object from below by the heating plate. The object is held by the plurality of pin-shaped projections. When the object is a soft object, such as a resin substrate, it is difficult to accurately shape the object into a planar shape while the object is held by the plurality of pin-shaped projections. Further, when the object is required to be shaped into a desired shape other than a planar shape, it is difficult to shape the object into a desired shape while the object is simply supported by the plurality of pin-shaped projections.

[0005] Accordingly, a possible benefit of the present disclosure is to provide a shaping device that can easily shape a plate-shaped object into a desired shape.

[0006] In order to achieve the above possible benefit, a shaping device according to the present disclosure comprises a base that can support a plate-shaped object, a support member that can assume a first position to project upward from the base to support the object, a heating unit to heat the object while the object is supported by the support member, and a biasing unit to bias the object downward. The support member is movable upward and downward relative to the base.

[0007] The present disclosure comprising a plurality of support pins movable upward and downward can facilitate shaping a plate-shaped object into a desired shape.

Description

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0008] FIG. 1 represents a concept of a shaping device according to a first embodiment based on the present disclosure.

[0009] FIG. 2 is a plan view of an object supporting unit that the shaping device according to the first embodiment based on the present disclosure comprises.

[0010] FIG. 3 is a cross section of the object supporting unit that the shaping device according to the first embodiment based on the present disclosure comprises for a first position.

[0011] FIG. 4 is a cross section of the object supporting unit that the shaping device according to the first embodiment based on the present disclosure comprises for a second position.

[0012] FIG. 5 illustrates a state in which an object is set in the object supporting unit of the shaping device according to the first embodiment based on the present disclosure.

[0013] FIG. **6** illustrates how the shaping device according to the first embodiment based on the present disclosure heats the object by a heating unit.

[0014] FIG. **7** illustrates a state in which the shaping device according to the first embodiment based on the present disclosure has a plurality of support pins moved downward.

[0015] FIG. **8** illustrates how the shaping device according to the first embodiment based on the present disclosure sucks the object through a suction port.

[0016] FIG. **9** illustrates how the shaping device according to the first embodiment based on the present disclosure lifts up the object after the shaping device completes cooling the object.

[0017] FIG. **10** is a first diagram for illustrating how the shaping device according to the first embodiment based on the present disclosure presses the object by a pressing member.

[0018] FIG. **11** is a second diagram for illustrating how the shaping device according to the first embodiment based on the present disclosure presses the object by the pressing member.

[0019] FIG. **12** is a cross section of an object supporting unit of a shaping device according to a second embodiment based on the present disclosure.

[0020] FIG. **13** illustrates a state in which an object is set in the object supporting unit of the shaping device according to the second embodiment based on the present disclosure.

[0021] FIG. **14** illustrates how the shaping device according to the second embodiment based on the present disclosure presses the object by the pressing member.

[0022] FIG. **15** is a cross section of an object supporting unit of a shaping device according to a third embodiment based on the present disclosure.

[0023] FIG. **16** illustrates a state in which an object is set in the object supporting unit of the shaping device according to the third embodiment based on the present disclosure.

[0024] FIG. **17** illustrates how the shaping device according to the third embodiment based on the present disclosure presses the object by the pressing member.

[0025] FIG. **18** illustrates an example of a shaping device according to the present disclosure comprising a pressing member that presses both a peripheral edge portion of an object and a middle portion of the object.

[0026] FIG. **19** is a cross section of an object supporting unit of a shaping device according to a fourth embodiment based on the present disclosure.

[0027] FIG. **20** is a cross section of an object supporting unit that a first modification of the shaping device according to the fourth embodiment based on the present disclosure comprises.

[0028] FIG. **21** is a cross section of an object supporting unit that a second modification of the shaping device according to the fourth embodiment based on the present disclosure comprises.

[0029] FIG. **22** is a cross section of an object supporting unit that a third modification of the shaping device according to the fourth embodiment based on the present disclosure comprises.

[0030] FIG. **23** is a cross section of an object supporting unit that a fourth modification of the shaping device according to the fourth embodiment based on the present disclosure comprises.

[0031] FIG. **24** is a cross section of an object supporting unit that a fifth modification of the shaping device according to the fourth embodiment based on the present disclosure comprises.

[0032] FIG. **25** is a cross section of an object supporting unit of a shaping device according to a fifth embodiment based on the present disclosure.

[0033] FIG. **26** is a cross section of an object supporting unit of a first modification of the shaping device according to the fifth embodiment based on the present disclosure.

[0034] FIG. **27** is a cross section of an object supporting unit of a second modification of the shaping device according to the fifth embodiment based on the present disclosure.

[0035] FIG. **28** is a cross section of an object supporting unit and a pressing member of a shaping device according to a sixth embodiment based on the present disclosure.

[0036] FIG. **29** is a cross section taken along a line XXIX-XXIX indicated in FIG. **28**.

[0037] FIG. **30** is a cross section of a bar that a first modification of the shaping device according to the sixth embodiment based on the present disclosure comprises.

[0038] FIG. **31** is a cross section of a bar that a second modification of the shaping device according to the sixth embodiment based on the present disclosure comprises.

[0039] FIG. **32** is a cross section of a bar that a third modification of the shaping device according to the sixth embodiment based on the present disclosure comprises.

[0040] FIG. **33** is a cross section of a bar that a fourth modification of the shaping device according to the sixth embodiment based on the present disclosure comprises.

[0041] FIG. **34** is a cross section of an object supporting unit and a pressing member of a shaping device according to a seventh embodiment based on the present disclosure.

[0042] FIG. **35** is an enlarged view of a portion **Z1** shown in FIG. **34**.

[0043] FIG. **36** is a cross section taken along a line XXXVI-XXXVI indicated in FIG. **35**.

[0044] FIG. **37** is a partially enlarged view of a bar that a first modification of the shaping device according to the seventh embodiment based on the present disclosure comprises.

[0045] FIG. **38** is a cross section taken along a line XXXVIII-XXXVIII indicated in FIG. **37**.

[0046] FIG. **39** is a partially enlarged view of a bar that a second modification of the shaping device according to the seventh embodiment based on the present disclosure comprises.

[0047] FIG. **40** is a cross section taken along a line XL-XL indicated in FIG. **39**.

[0048] FIG. **41** is a partially enlarged view of a bar that a third modification of the shaping device according to the seventh embodiment based on the present disclosure comprises.

[0049] FIG. **42** is a cross section taken along a line XLII-XLII indicated in FIG. **41**.

[0050] FIG. **43** is a cross section of an object supporting unit and a pressing member of a shaping device according to an eighth embodiment based on the present disclosure.

[0051] FIG. **44** illustrates an operation of the object supporting unit of the shaping device according to the eighth embodiment based on the present disclosure.

[0052] FIG. **45** is a plan view of the object supporting unit of the shaping device according to the eighth embodiment based on the present disclosure.

[0053] FIG. **46** is a cross section of an object supporting unit and a pressing member of a shaping device according to a ninth embodiment based on the present disclosure.

[0054] FIG. **47** is a partial enlarged view of a portion **Z2** shown in FIG. **46**.

[0055] FIG. **48** is a partially enlarged view of the shaping device according to the ninth embodiment based on the present disclosure in use.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0056] Note that the figures do not necessarily faithfully represent a dimensional ratio as an actual dimensional ratio, and may instead exaggerate it for the sake of illustration. In the following description, when a reference is made to a concept of being upper or lower, it does not necessarily mean being absolutely upper or lower and may instead mean being relatively upper or lower with respect to a position illustrated in a figure.

[0057] A concept of “shaping” as referred to herein includes removing an undesired warpage of 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 does not have the desired shape.

First Embodiment

[0058] A shaping device according to a first embodiment based on the present disclosure will now be described with reference to FIGS. **1** to **5**. FIG. **1** shows a shaping device **101** according to the present embodiment. Shaping device **101** comprises an object supporting unit **10**, a heating unit **2**, and a pressing member **3**. Heating unit **2** and pressing member **3** may be movable laterally for example as indicated by an arrow **91**. Heating unit **2** and pressing member **3** can move above object supporting unit **10**, as necessary. FIG. **2** shows object supporting unit **10** as viewed from directly above. FIG. **3** is a cross section of object supporting unit **10** for a first position, and FIG. **4** is a cross section of the object supporting unit for a second position. FIG. **5** shows object **80** set in object supporting unit **10**. In the example shown herein, 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 so as to cover a portion of one surface of first resin layer **81**. The structure of object **80** indicated herein is merely an example, and it may be a different structure. Object **80** may have a configuration for example including a layer of a material other than resin, and may have a configuration composed of three or more layers deposited one on another. Object **80** may be any object insofar as it is a plate-shaped object.

[0059] Shaping device **101** comprises a base **12** that can support plate-shaped object **80**, a support member that can assume a first position to project upward from base **12** to support object **80**, heating unit **2** to heat object **80** while the object is supported by the support member, and a biasing unit to bias object **80** downward. The support member is movable upward and downward relative to base **12**. A variety of structures can be considered for the structure of the support member. In the present embodiment, the support member includes a plurality of support pins **4**. This is merely one example of the support member. The plurality of support pins **4** are movable upward and downward all together relative to base **12**. Note that the plurality of support pins **4** as referred to herein may each have a tip having any shape insofar as it can support object **80** in contact with object **80**, and are not limited to having the shape shown herein. The plurality of support pins **4** may each come into point contact with object **80**. The plurality of support pins **4** are held together by a support pin holding unit **5**. Object supporting unit **10** includes an outer periphery **11** and 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. When the plurality of support pins **4** are moved upward, the first position is assumed as shown in FIG. **3**, whereas when the plurality of support pins **4** are moved downward, the second position is assumed as shown in FIG. **4**.

[0060] Heating unit **2** may emit halogen light, for example. Heating unit **2** may for example be an infrared heater. Heating unit **2** may blow warm air, for example. Heating unit **2** may heat in a method other than the method indicated herein by way of example.

[0061] Base **12** may include a cooling unit. That is, base **12** has a cooling function. Base **12** may have the cooling function implemented for example by circulating a fluid inside base **12**. Base **12** may have the cooling function implemented for example by a Peltier element.

[0062] The biasing unit may be an instrument that presses object **80** downward from above, may be a suction device to suck object **80** from below, or may include both of them. Pressing member **3** is included in the biasing unit. Suction port **13** provided in base **12** is included in the biasing unit. While shaping device **101** comprises pressing member **3**, it is not essential that the shaping device comprises pressing member **3**.

[0063] An operation of the shaping device according to the present embodiment will now be described with reference to FIGS. **5** to **9**. It should be noted, however, that what will be described hereafter is an operation of a shaping device that does not comprise pressing member **3**.

[0064] Initially, as shown in FIG. **5**, an object **80** is disposed in object supporting unit **10**. At this point in time, object **80** is warped. Object **80** is supported by the plurality of support pins **4**.

[0065] Subsequently, as illustrated in FIG. **6**, heating unit **2** is used to heat object **80**. As it is heated, object **80** is softened and thus less warped, and the object is thus supported by the plurality of support pins **4**.

[0066] As shown in FIG. **7**, the plurality of support pins **4** are moved downward. Moving support pin holding unit **5** downward allows the plurality of support pins **4** to be moved downward all together. At this point in time, the plurality of support pins **4** may have their upper ends in contact with object **80** or detached from object **80**. In this state, as shown in FIG. **8**, object **80** is sucked through suction port **13** in a direction indicated by an arrow **92**. The cooling function of base **12** is used to cool object **80**. When cooling the object is completed, the plurality of support pins **4** are moved upward as shown in FIG. **9**. Object **80** is lifted upward away from base **12**. At this point in time, object **80** has been shaped into a desired shape.

[0067] In the present embodiment, the plurality of support pins **4** can support object **80** and the plurality of support pins **4** are movable upward and downward relative to base **12**, and when the object is heated the object can be supported by the plurality of support pins **80** whereas when the object is cooled the object can be supported by base **12**, and the plate-shaped object is thus easily shaped into a desired shape.

[0068] Note that it is preferable that the biasing unit include pressing member **3** including a projection **6** extending downward and having a tip to abut against object **80** to press object **80** downward. When the shaping device comprises the biasing unit including pressing member **3**, then, for example as shown in FIG. **10**, the shaping device can press a portion of a warped object **80** downward by pressing member **3**. Pressing member **3** includes projection **6**. In the example shown in FIG. **10**, object **80** has a peripheral edge portion detached from the plurality of support pins **4** above, and pressing member **3** has projection **6** abutting against the peripheral edge portion of object **80**. Object **80** having the peripheral edge portion pressed downward is deformed as shown in FIG. **11**. Cooling the object in such a deformed state can more reliably shape the object into a desired shape.

[0069] As has been described in the present embodiment, the biasing unit may include a suction device to suck object **80** downward. This configuration allows object **80** to be sucked and thus held.

[0070] As has been described in the present embodiment, the plurality of support pins **4** can be moved from the first position downward to assume the second position, and it is preferable that base **12** be disposed such that for the first position object **80** is not in contact with base **12** and for the second position object **80** is in contact with base **12**. This configuration allows object **80** to be held in contact with base **12** when it is unnecessary to lift object **80** by the plurality of support pins **4**. A state of lifting and supporting object **80** by the plurality of support pins **4** and a state of disposing and supporting object **80** on base **12** can be easily switched by moving the plurality of support pins **4** upward and downward.

[0071] While in the present embodiment the plurality of support pins **4** are moved upward and downward all together, this is not exclusive. For example, the plurality of support pins **4** may be configured to be each capable of independently moving upward and downward.

[0072] As has been indicated in the present embodiment, the plurality of support pins **4** may have their upper ends flush with one another. This configuration allows object **80** to be heated while the plurality of support pins **4** are used to support object **80** flat.

[0073] While the first embodiment has been described based on an example with the plurality of support pins **4** having their upper ends flush with one another, a different configuration is also considered.

[0074] While the present embodiment has been described assuming that object **80** is a rectangle, object **80** is not limited in shape to a rectangle. Object **80** may have a square, polygonal, circular, elliptical, or any other shape.

Second Embodiment

[0075] A shaping device according to a second embodiment based on the present disclosure will now be described with reference to FIGS. **12** to **14**. For the second and subsequent embodiments, a part of the shaping device, or an object supporting unit, will be illustrated and described.

[0076] FIG. **12** shows object supporting unit **10** of the shaping device according to the present embodiment. In the present embodiment, when an imaginary plane connecting the upper ends of the plurality of support pins **4** is assumed, the imaginary plane is convex upward. In this example, an example with object **80** set is shown in FIG. **13**. In this example, pressing member **3** is prepared for pressing a peripheral edge portion of object **80**. By pressing the object downward using pressing member **3**, a state as shown in FIG. **14** is achieved. The object can be heated or cooled while the object is thus pressed.

[0077] The present embodiment facilitates shaping a plate-shaped object into a desired shape.

Third Embodiment

[0078] A shaping device according to a third embodiment based on the present disclosure will now be described with reference to FIGS. **15** to **17**.

[0079] FIG. **15** shows object supporting unit **10** of the shaping device according to the present embodiment. In the present embodiment, when an imaginary plane connecting the upper ends of the plurality of support pins **4** is assumed, the imaginary plane is convex downward. In this example, an example with object **80** set is shown in FIG. **16**. In this example, pressing member **3** is prepared for pressing a middle portion of object **80**. By pressing the object downward using pressing member **3**, a state is achieved as shown in FIG. **17**. The object can be heated or cooled while the object is thus pressed.

[0080] The present embodiment facilitates shaping a plate-shaped object into a desired shape.

[0081] As shown in FIG. **18**, pressing member **3** may press object **80** at both a peripheral edge portion and a middle portion.

[0082] Projection **6** of pressing member **3** is not limited in form to the examples shown in FIGS. **14**, **17**, **18**, etc. Projection **6** is not necessarily fixed and may be any number of projections and may be repositionable. Projection **6** may be individually expandable and contractible in length. Projection **6** each repositionable or expandable and contractible in length may enable a configuration allowing a single pressing member **3** to be variously modified in form.

Fourth Embodiment

[0083] A shaping device according to a fourth embodiment based on the present disclosure will now be described with reference to FIGS. **19** to **24**.

[0084] FIG. **19** shows an example of object supporting unit **10** of the shaping device according to the present embodiment. Herein, base **12** has a convex upper surface. The plurality of support pins **4** have their upper ends flush with one another.

[0085] In the shaping device according to the present embodiment, base **12** has a convex or concave upper surface that comes into contact with object **80** for the second position.

[0086] FIGS. **20** to **24** show modifications of the shaping device according to the present embodiment. In the example shown in FIG. **20**, base **12** has a convex upper surface, and when an imaginary plane connecting the upper ends of the plurality of support pins **4** is assumed, the imaginary plane is convex upward. In the example shown in FIG. **21**, base **12** has a convex upper surface, and when an imaginary plane connecting the upper ends of the plurality of support pins **4** is assumed, the imaginary plane is convex downward. In the example shown in FIG. **22**, base **12** has a concave upper surface, and the plurality of support pins **4** have their upper ends flush with one another. In the example shown in FIG. **23**, base **12** has a concave upper surface, and when an imaginary plane connecting the upper ends of the plurality of support pins **4** is assumed, the imaginary plane is convex upward. In the example shown in FIG. **24**, base **12** has a concave upper surface, and when an imaginary plane connecting the upper ends of the plurality of support pins **4** is assumed, the imaginary plane is convex downward.

[0087] The present embodiment facilitates shaping a plate-shaped object into a desired shape. When it is desired to intentionally deflect the object in any direction and thus cool the object, it is convenient to convex or concave the upper surface of base **12** as indicated in the present embodiment.

Fifth Embodiment

[0088] A shaping device according to a fifth embodiment based on the present disclosure will now be described with reference to FIGS. **25** to **27**. FIG. **25** shows object supporting unit **10** and pressing member **3** of the shaping device according to the present embodiment. For this object supporting unit **10**, pressing member **3** can press object **80** at both a peripheral edge portion and a middle portion. In the shaping device according to the present embodiment, base **12** does not include a cooling unit. Outer periphery **11** and base **12** are integrally formed of the same material. Thus, base **12** may be configured without including the cooling unit. The object may be cooled by a function of some device provided at a location other than base **12**. Alternatively, the object may not

be cooled by an actively cooling unit, and may instead be cooled by heat naturally radiated to the surroundings.

[0089] FIGS. **26** and **27** show modifications of the shaping device according to the present embodiment. The examples shown in FIGS. **26** and **27** differ from the example shown in FIG. **25** in how the plurality of support pins **4** and pressing member **3** are configured. Even when base **12** is configured without including the cooling unit, a variety of modifications are considered as illustrated in FIGS. **25** to **27**.

[0090] The present embodiment facilitates shaping a plate-shaped object into a desired shape. In the present embodiment, object supporting unit **10** including base **12** can be simply structured.

Sixth Embodiment

[0091] A shaping device according to a sixth embodiment based on the present disclosure will now be described with reference to FIGS. **28** and **29**. FIG. **28** shows object supporting unit **10** and a pressing member **3i** of the shaping device according to the present embodiment. In the shaping device according to the present embodiment, the biasing unit includes pressing member **3i** including a bar **33** held in parallel to an upper surface of an object. Pressing member **3i** can abut bar **33** against the object to press the object downward. Pressing member **3i** includes two bar supports **34** and a single bar **33**. Bar **33** is supported by two bar supports **34**.

[0092] FIG. **29** is a cross section taken along a line XXIX-XXIX indicated in FIG. **28**. Bar **33** in cross section has a shape of a combination of a rectangle and a semicircle. Bar **33** in cross section has a shape with a rounded lower side.

[0093] In the shaping device according to the present embodiment, the biasing unit's pressing member **3i** can abut bar **33** against an object to bias the object downward, and thus more appropriately press the object. Bar **33** comes into contact with the object in a line.

[0094] Note that the shape in cross section shown in FIG. **29** according to the present embodiment is merely one example. Instead of the shape shown in FIG. **29**, bar **33** in cross section may have a shape with a lower side pointed as shown in FIGS. **30** and **31**, for example. Alternatively, bar **33** in cross section may have a shape shown in FIGS. **32** and **33**. FIG. **33** shows bar **33** in a rectangle in cross section. That is, bar **33** has a flat lower surface. When bar **33** in cross section has a shape shown in FIGS. **32** and **33**, bar **33** will come into contact with an object in a plane.

Seventh Embodiment

[0095] A shaping device according to a seventh embodiment based on the present disclosure will now be described with reference to FIGS. **34** to **36**. FIG. **34** shows object supporting unit **10** and a pressing member **3j** of the shaping device according to the present embodiment. In the shaping device according to the present embodiment, the biasing unit includes pressing member **3j** including bar **33** held in parallel to an upper surface of an object. FIG. **35** is an enlarged view of a portion **Z1** shown in FIG. **34**. Although pressing member **3j** is common in basic configuration to pressing member **3i**, pressing member **3j** includes bar **33** including a bar body **35** and one or more projections **36** disposed on a lower surface of bar body **35**. In the example indicated herein, a plurality of projections **36** are disposed equidistantly on the lower surface of bar body **35**. FIG. **36** is a cross section taken along a line XXXVI-XXXVI indicated in FIG. **35**.

[0096] In the shaping device according to the present embodiment, the biasing unit's pressing member **3j** can abut bar **33** against an object to bias the object downward, and when bar **33** abuts against the object, projections **36** abut against the object. That is, a point contact is made at a plurality of points. In the shaping device according to the present embodiment, the biasing unit can thus press an object more appropriately.

[0097] Note that the structure shown in FIGS. **35** and **36** according to the present embodiment is merely an example. The structure shown in FIG. **35** may be replaced with a structure shown in FIG. **37**. FIG. **38** is a cross section taken along a line XXXVIII-XXXVIII indicated in FIG. **37**. In this example, a plurality of projections **36j** are disposed on a lower side of bar body **35**. Projection **36j** has a flat lower surface. As shown in FIG. **38**, projection **36j** is smaller in width than bar body **35**.

[0098] Bar **33** may be structured as shown in FIG. **39**, for example. FIG. **40** is a cross section taken along a line XL-XL indicated in FIG. **39**. In this example, a projection **36k** that is one piece is disposed on the lower side of bar body **35**. Bar **33** includes bar body **35** and projection **36k**. Projection **36k** has a flat lower surface. As shown in FIG. **40**, projection **36k** is smaller in width than bar body **35**.

[0099] Bar **33** may be structured as shown in FIG. **41**, for example. FIG. **42** is a cross section taken along a line XLII-XLII indicated in FIG. **41**. In this example, a plurality of projections **36n** are disposed on the lower side of bar **35**. Each projection **36n** in cross section has a triangular shape.

Eighth Embodiment

[0100] A shaping device according to an eighth embodiment based on the present disclosure will now be described with reference to FIGS. **43** to **45**. FIG. **43** shows object supporting unit **10** and pressing member **3i** of the shaping device according to the present embodiment. In this shaping device, the biasing unit includes pressing member **3i** including bar **33** held in parallel to an upper surface of an object. The shaping device comprises a support member **40**. Support member **40** includes two or more columns **42** and a beam member **43** connecting upper ends of the two or more columns **42**.

[0101] The shaping device may further have the following configuration. Base **12** has a beam member accommodating section **44** corresponding to beam member **43**. In the second position, beam member **43** is accommodated in beam member accommodating section **44**. FIG. **44** is a cross section of object supporting unit **10** while support member **40** assumes the second position. In the second position, column **42** is moved downward through a through hole **14i**. In the second position, beam member **43** has an upper end equal to or lower than an uppermost surface of base **12** in level. FIG. **45** is a plan view of object supporting unit **10** for this position. In the example shown herein, base **12** has an upper surface provided with three linear beam member accommodating sections **44** in parallel. This is merely one example, and beam member **43** may be disposed in a positional relationship which is not parallel. Beam member **43** and beam member accommodating section **44** may not be three beam members and three beam member accommodating sections. In the example shown herein, bar **33** and beam member **43** are disposed in a position so that they overlap when viewed from directly above. Thus, three bars **33** are disposed in parallel when viewed from directly above. While a beam member **43** is visible in FIG. **43**, the remaining two beam members **43** are located on a side behind this one beam member **43** with respect to the plane of the sheet of the figure.

[0102] The shaping device according to the present embodiment comprising support member **40** can support an object with beam member **43** and hence more appropriately.

Ninth Embodiment

[0103] A shaping device according to a ninth embodiment based on the present disclosure will now be described with reference to FIGS. **46** and **47**. FIG. **46** shows object supporting unit **10** and pressing member **3j** of the shaping device according to the present embodiment. Pressing member **3j** that this shaping device comprises is similar in configuration to pressing member **3j** described in the seventh embodiment. FIG. **47** is an enlarged view of a portion **Z2** shown in FIG. **46**. Beam member **43** includes a body **45** of the beam member and a projection **37**. The shape of projection **37** shown herein is merely an example. A variety of variations in structure of beam member **43** are considered. The variations in structure of beam member **43** are similar to those in structure of bar **33** shown in FIGS. **35** to **42**, except that upper and lower sides are inverted. FIG. **48** is a partially enlarged view of a state in which object **80** is sandwiched between beam member **43** that is a part of support member **40** and bar **33** that is a part of pressing member **3j**. A point at which projection **37** of beam member **43** abuts against object **80** and a point at which projection **36** of bar **33** abuts against object **80** correspond to each other, and are in a positional relationship in which they appear to overlap when viewed from directly above.

[0104] In the present embodiment, projection **37** of beam member **43** and projection **36** of bar **33**

can sandwich and hold object **80** in point contact with object **80**. This allows the object to be supported more appropriately.

[0105] Beam member **43** that is a part of support member **40** is not necessarily in a perfectly straight line. Beam member **43** may have a curved shape that is generally convex upward or convex downward. Such a configuration facilitates shaping a plate-shaped object into a desired shape.

[0106] Bar **33** that is a part of pressing member **3i** or pressing member **3j** is similarly

[0107] discussed. Bar **33** is not necessarily in a perfectly straight line. Bar **33** may have a curved shape that is generally convex upward or convex downward. Such a configuration facilitates shaping a plate-shaped object into a desired shape.

[0108] A plurality of the above-described embodiments may be combined, as appropriate, and employed. Note that the presently disclosed embodiments are illustrative and non-restrictive in any respect. The scope of the present disclosure is defined by the terms of the claims, and encompasses any modification falling within a meaning and scope equivalent to the claimed scope.

Additional Notes

Additional Note 1

[0109] A shaping device comprising: a base that can support a plate-shaped object; a plurality of support pins that can assume a first position to project upward from the base to support the object; a heating unit to heat the object while the object is supported by the plurality of support pins; and a biasing unit to bias the object downward, the plurality of support pins being movable upward and downward relative to the base.

Additional Note 2

[0110] The shaping device according to Additional Note 1, wherein the biasing unit includes a pressing member including a projection extending downward and having a tip to abut against the object to press the object downward.

Additional Note 3

[0111] The shaping device according to any one of Additional Notes 1 or 2, wherein the biasing unit includes a suction device to suck the object downward.

Additional Note 4

[0112] The shaping device according to any one of Additional Notes 1 to 3, wherein the plurality of support pins can be moved from the first position downward to assume a second position, and the base is disposed such that for the first position the object does not come into contact with the base and for the second position the object comes into contact with the base.

Additional Note 5

[0113] The shaping device according to Additional Note 4, wherein the base has a convex or concave upper surface that comes into contact with the object for the second position.

Additional Note 6

[0114] The shaping device according to Additional Note 4 or 5, wherein the base includes a cooling unit.

Additional Note 7

[0115] The shaping device according to any one of Additional Notes 1 to 6, wherein the plurality of support pins have upper ends flush with one another.

Additional Note 8

[0116] The shaping device according to any one of Additional Notes 1 to 6, wherein when an imaginary plane connecting upper ends of the plurality of support pins is assumed, the imaginary plane is convex upward.

Additional Note 9

[0117] The shaping device according to any one of Additional Notes 1 to 6, wherein when an imaginary plane connecting upper ends of the plurality of support pins is assumed, the imaginary plane is convex downward.

[0118] **2** heating unit, **3**, **3i**, **3j** pressing member, **4** support pin, **5** support pin holding unit, **5f**

holding unit, **6** projection, **10** object supporting unit, **11** outer periphery, **12** base, **13** suction port, **14,14i** through hole, **33** bar, **34** bar support, **35** bar body, **36, 36j, 36k, 36n** projection (provided on the bar), **37** projection (provided on a beam member), **40** support member, **42** column, **43** beam member, **44** beam member accommodating section, **45** body of beam member, **80** object, **81** first resin layer, **82** second resin layer, **91, 92** arrow, **101** shaping device.

Claims

1. A shaping device comprising: a base configured to support a plate-shaped object; a support member configured to take a first position to project upward from the base to support the object; a heating unit configured to heat the object while the object is supported by the support member; and a biasing unit configured to bias the object downward, the support member being movable upward and downward relative to the base.
2. The shaping device according to claim 1, wherein the biasing unit includes a pressing member including a projection extending downward and having a tip to abut against the object to press the object downward.
3. The shaping device according to claim 1, wherein the biasing unit includes a pressing member including a bar held in parallel to an upper surface of the object, wherein the pressing member is configured to abut the bar against the object to press the object downward.
4. The shaping device according to claim 1, wherein the biasing unit includes a suction device to suck the object downward.
5. The shaping device according to claim 1, wherein the support member is configured to take a second position moved downward from the first position, and the base is disposed such that at the first position the object does not come into contact with the base and at the second position the object comes into contact with the base.
6. The shaping device according to claim 5, wherein the base has a convex or concave upper surface configured to come into contact with the object at the second position.
7. The shaping device according to claim 5, wherein the base includes a cooling unit.
8. The shaping device according to claim 1, wherein the support member includes a plurality of support pins.
9. The shaping device according to claim 8, wherein the plurality of support pins has upper ends flush with one another.
10. The shaping device according to claim 8, wherein when an imaginary plane connecting upper ends of the plurality of support pins is assumed, the imaginary plane is convex upward.
11. The shaping device according to claim 8, wherein when an imaginary plane connecting upper ends of the plurality of support pins is assumed, the imaginary plane is convex downward.
12. The shaping device according to claim 1, wherein the support member includes two or more columns and a beam member connecting upper ends of the two or more columns.
13. The shaping device according to claim 5, wherein the support member includes two or more columns and a beam member connecting upper ends of the two or more columns, the base includes a beam member accommodating section corresponding to the beam member, and at the second position the beam member is accommodated in the beam member accommodating section.
14. The shaping device according to claim 2, wherein the biasing unit includes a suction device to suck the object downward.
15. The shaping device according to claim 3, wherein the biasing unit includes a suction device to suck the object downward.
16. The shaping device according to claim 2, wherein the support member is configured to take a second position moved downward from the first position, and the base is disposed such that at the first position the object does not come into contact with the base and at the second position the object comes into contact with the base.

- 17.** The shaping device according to claim 3, wherein the support member is configured to take a second position moved downward from the first position, and the base is disposed such that at the first position the object does not come into contact with the base and at the second position the object comes into contact with the base.
- 18.** The shaping device according to claim 4, wherein the support member is configured to take a second position moved downward from the first position, and the base is disposed such that at the first position the object does not come into contact with the base and at the second position the object comes into contact with the base.
- 19.** The shaping device according to claim 6, wherein the base includes a cooling unit.
- 20.** The shaping device according to claim 2, wherein the support member includes a plurality of support pins.
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