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Jung et al.

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(54) **WIDE AREA FORMING DEVICE**

(71) Applicant: **DAEHO TECHNOLOGY KOREA CO., LTD.**, Gyeongsangnam-do (KR)

(72) Inventors: **Yong Wha Jung**, Gyeongsangnam-do (KR); **Yeoung Hyung Lee**, Gyeongsangnam-do (KR); **Dong Yeon Jung**, Gyeongsangnam-do (KR)

(73) Assignee: **DAEHO TECHNOLOGY KOREA CO., LTD.**, Gyeongsangnam-Do (KR)

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C03B 11/08 (2006.01)

(52) **U.S. Cl.**
CPC ***C03B 11/08*** (2013.01); *C03B 2215/46* (2013.01)

(58) **Field of Classification Search**
CPC C03B 25/06
See application file for complete search history.

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Primary Examiner — Lisa L Herring
(74) *Attorney, Agent, or Firm* — The PL Law Group, PLLC

(57) **ABSTRACT**

A wide area forming device according to an embodiment of the present disclosure includes a mold unit in which an object to be formed is received, and a main chamber having an upper block press the mold unit to form the object to be formed, and a lower block supporting the mold unit.

10 Claims, 7 Drawing Sheets

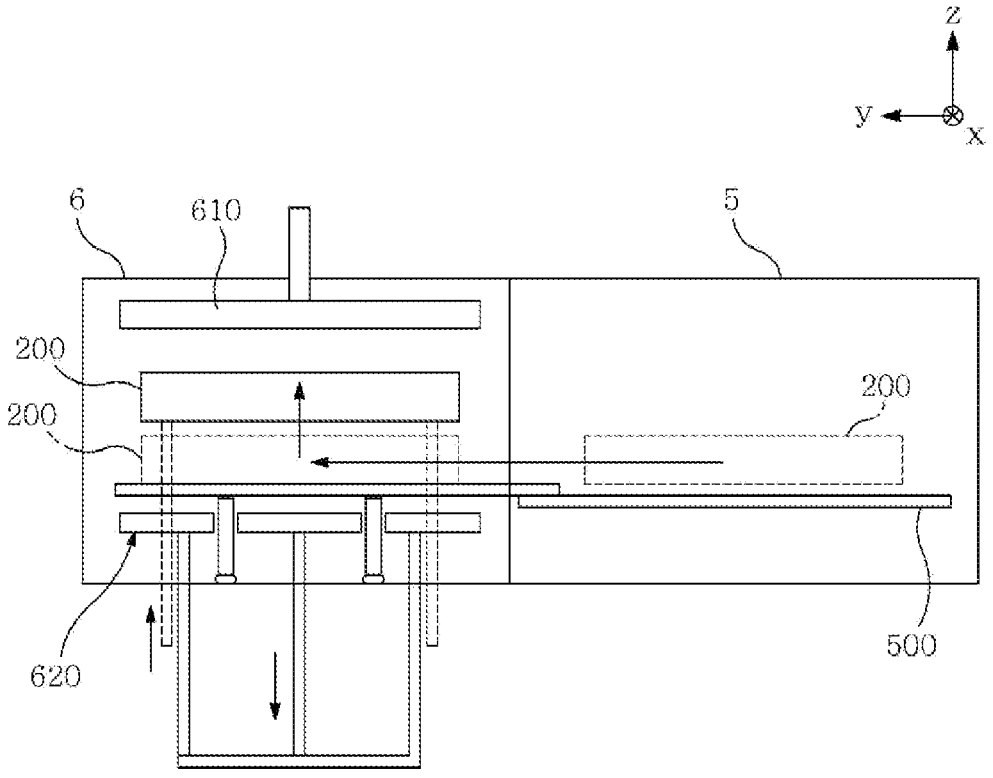


FIG. 1

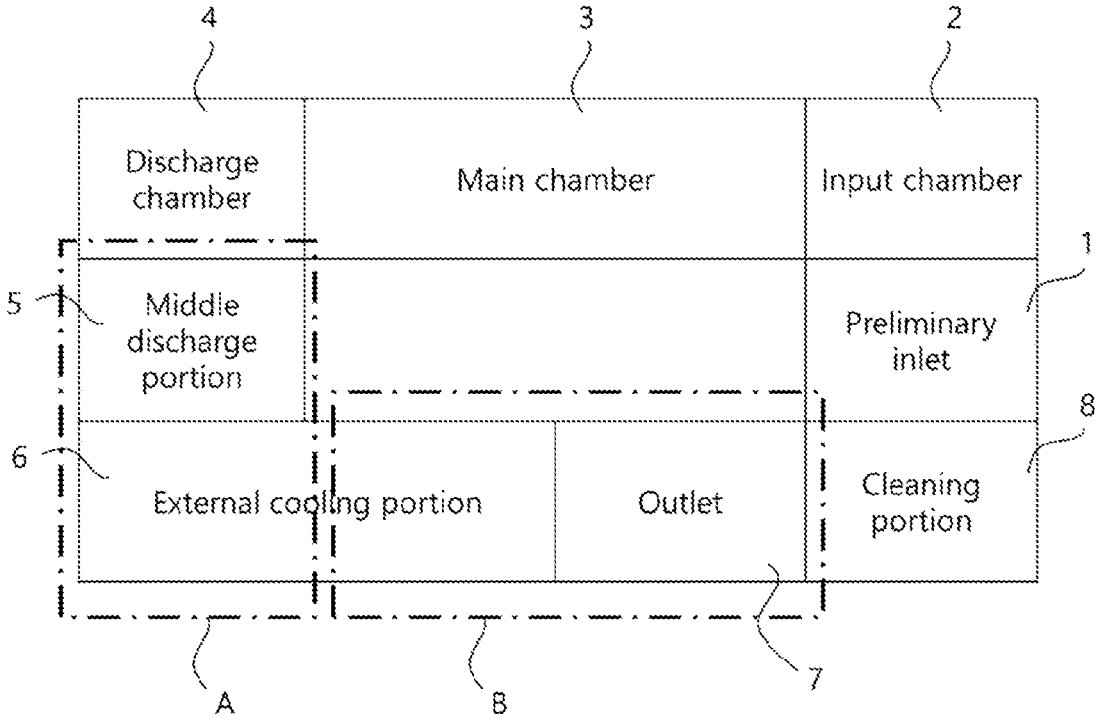

4
3
2
Discharge chamber
Main chamber
Input chamber
1
5
Middle discharge portion
Preliminary inlet
8
6
External cooling portion
Outlet
Cleaning portion
A
B
7

FIG. 2

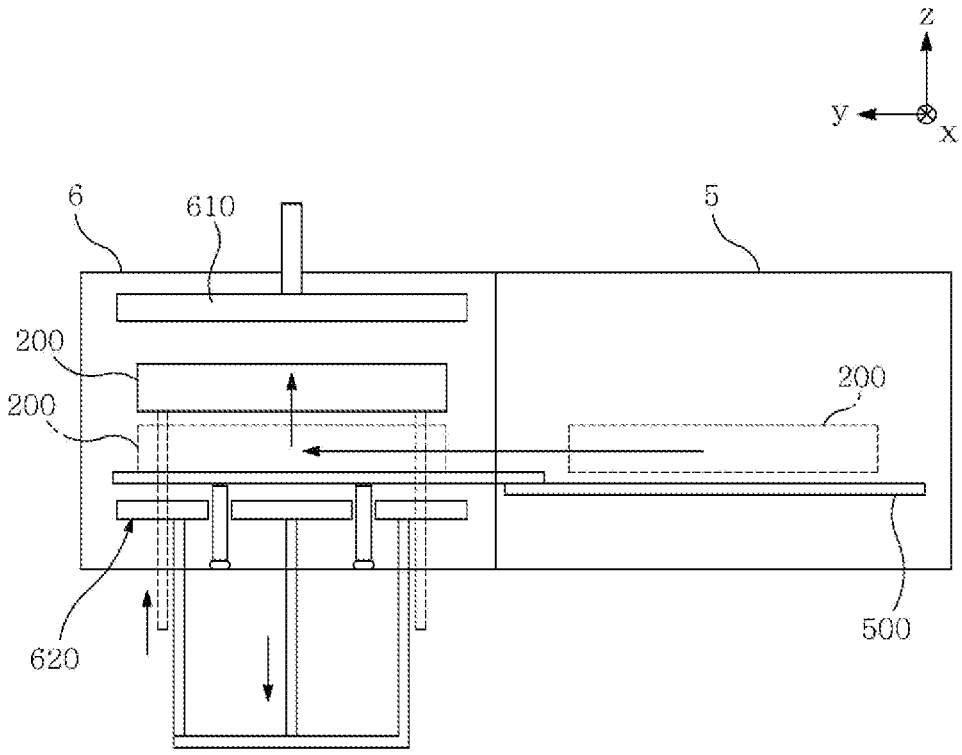


FIG. 3

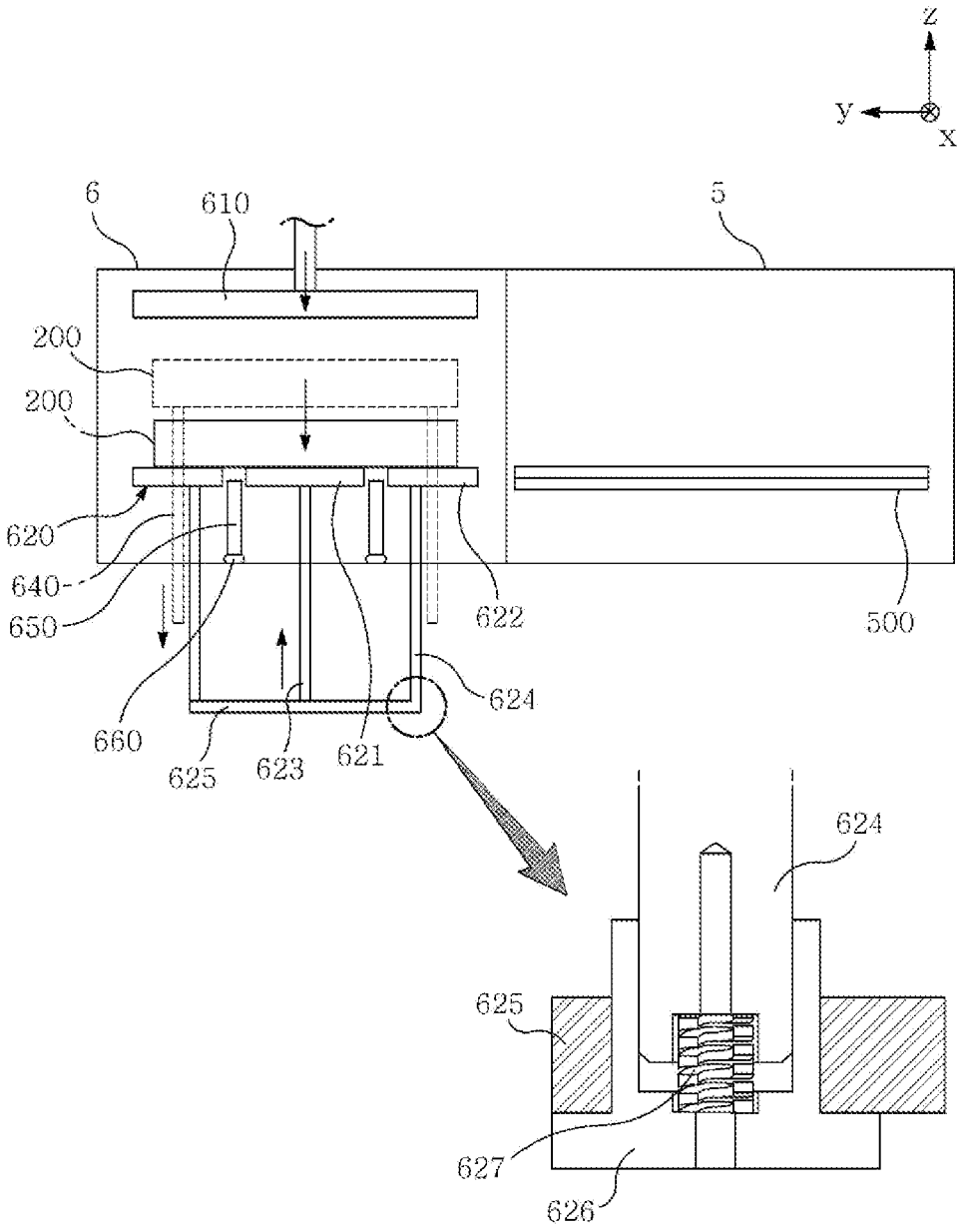

z
y
x
6
610
5
200
200
620
640
650
622
500
624
660
625
623
621
624
625
627
626

FIG. 4

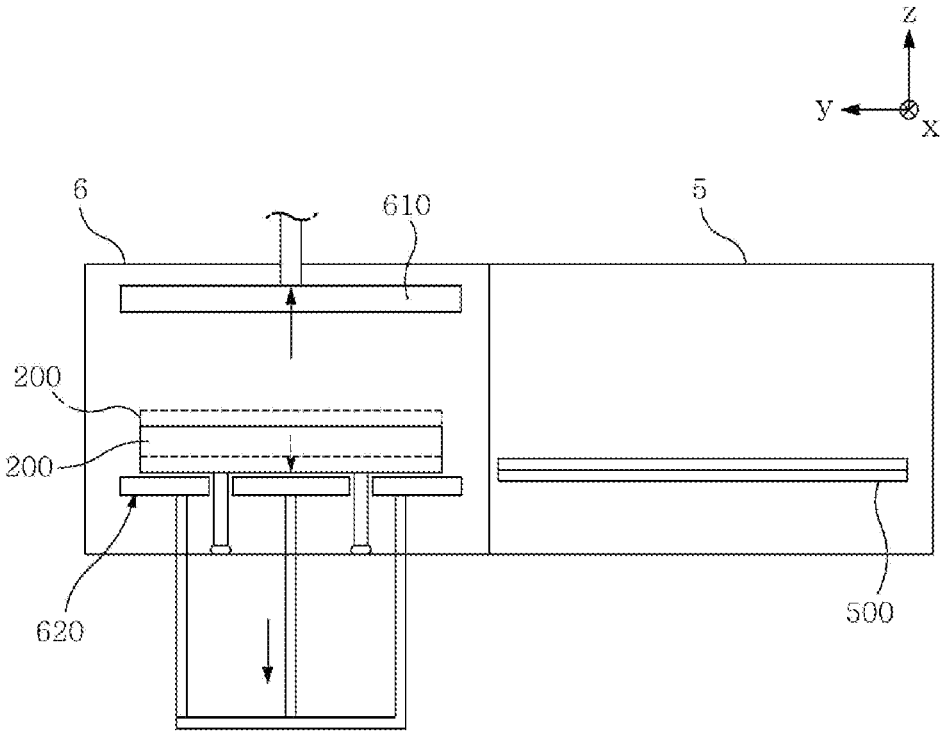


FIG. 5

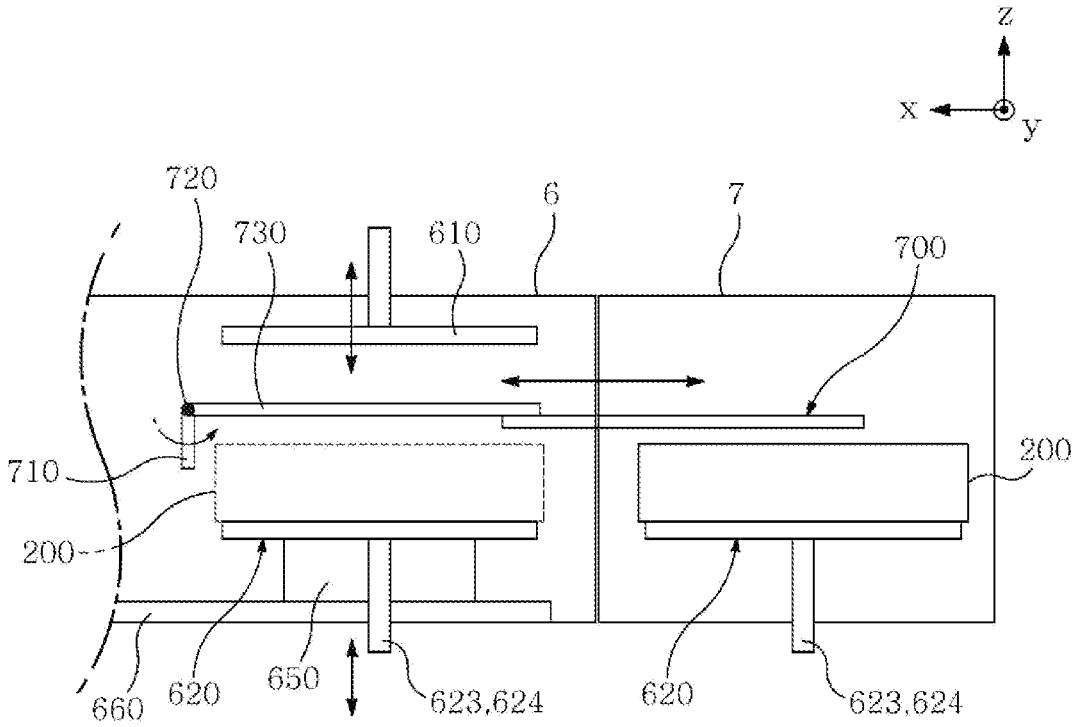

z
x
y
720
730
610
6
7
700
710
200
200
660
620
650
623,624
620
623,624

FIG. 6

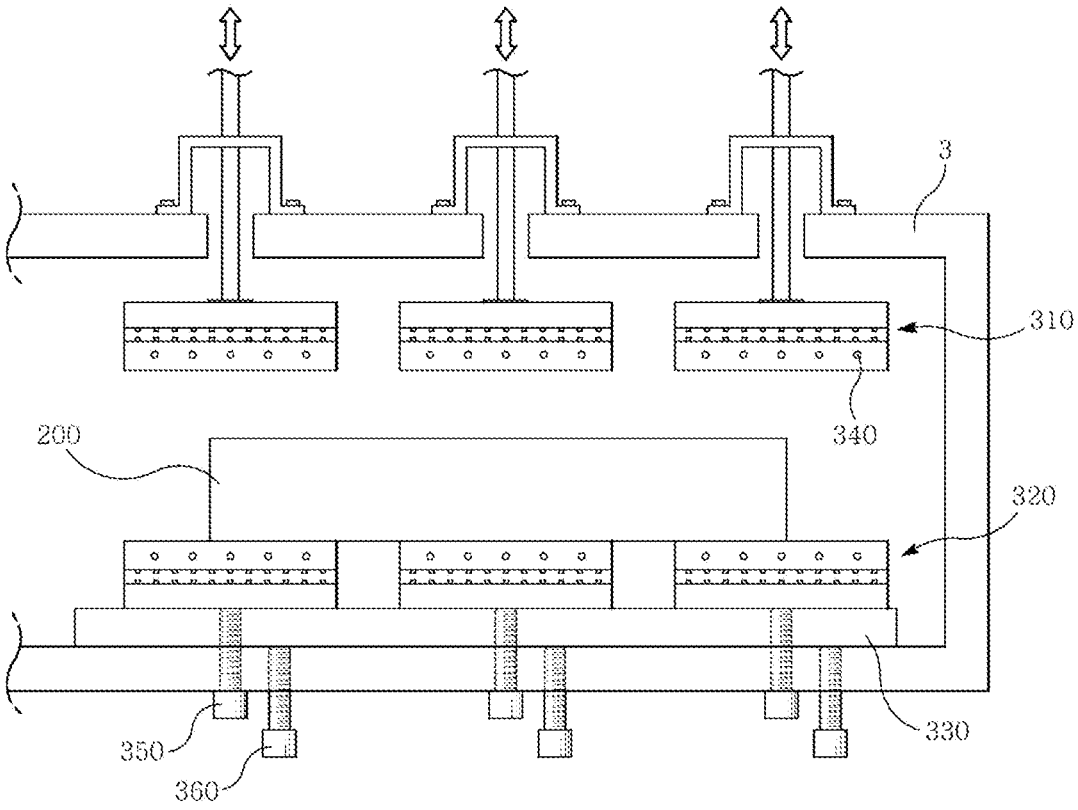
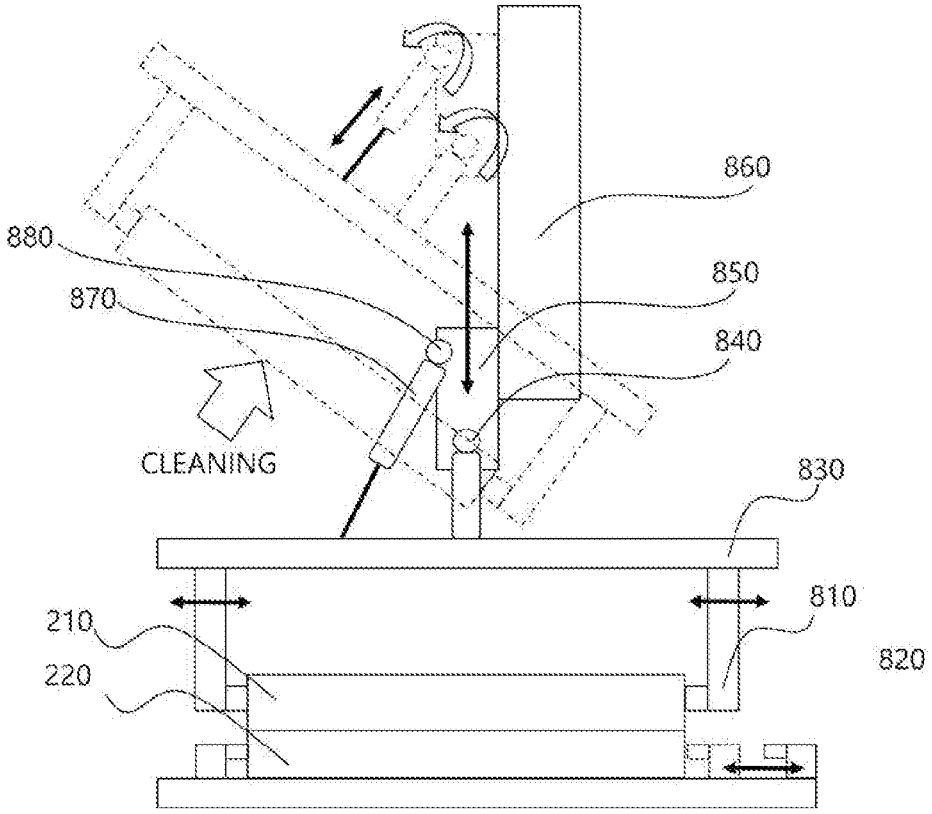


FIG. 7



WIDE AREA FORMING DEVICE

CROSS REFERENCE TO RELATED APPLICATION

The present application claims priority to Korean Patent Application No. 10-2019-0155048, filed Nov. 28, 2019, the entire contents of which is incorporated herein for all purposes by this reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present disclosure relates generally to a forming device that is configured for forming a wide area object.

2. Description of the Related Art

Wide area glass having a curved portion is widely used for a front window or a back cover of a mobile or a display device. The glass having the curved portion may be used as a lens of a camera.

An object to be formed may be heated and pressed in a wide area mold unit to form a desired 3-dimensional (3D) shaped glass or a desired 3D shaped lens.

SUMMARY

Accordingly, the present disclosure is intended to propose a wide area forming device using a mold unit with a wide area or a great weight.

In order to achieve the above objective, according to one aspect of the present disclosure, there is provided a wide area forming device. The wide area forming device includes a vertical transfer means configured to raise and lower a mold unit and a horizontal transfer means configured to transfer the mold unit in a horizontal direction, when the mold unit receiving an object to be formed is transferred from a first position to a second position, wherein the vertical transfer means and the horizontal transfer means may be configured to be alternately brought into contact with a lower portion of the mold unit at the first position or the second position.

The wide area forming device of the present disclosure may include a mold unit having an upper mold and a lower mold in which an object to be formed may be received between the upper mold and the lower mold, wherein, while the upper mold is raised from the lower mold and then pivots, a molding surface of the upper mold or the lower mold may be cleaned.

The wide area forming device of the present disclosure may include a mold unit configured to receive an object to be formed; and a main chamber comprising an upper block and a lower block, the upper block being configured to press the mold unit for forming the object to be formed and the lower block configured to support the mold unit, wherein a plurality of upper blocks may face one mold unit.

The transfer unit of the present disclosure can transfer the wide area mold unit between blocks by raising the mold unit. When the mold unit is transferred along a first direction, which is a transfer direction of the mold unit, the mold unit may be fundamentally prevented from contacting/sliding with the lower block.

Accordingly, when each bock or the mold unit may be repeatedly used under a severe condition in the high-temperature main chamber, abrasion or generation of foreign matter can be prevented.

Non-contact transfer of the wide area mold unit may be advantageous for preventing abrasion or generation of foreign matter. Furthermore, the countermeasure may be required to prevent collision or interference between the transfer means at a point where transfer directions vertically cross.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objectives, features, and other advantages of the present disclosure will be more clearly understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a plan view showing a wide area forming device according to the present disclosure;

FIGS. **2** to **4** are side view showing a state in which a mold unit is transferred from a middle discharge portion to an external cooling portion according to the present disclosure;

FIG. **5** is a front view showing a state in which the mold unit is transferred from the external cooling portion to an outlet according to the present disclosure;

FIG. **6** is a section view showing an upper block and a lower block of a main chamber according to the present disclosure; and

FIG. **7** is a view showing operation of a cleaning portion according to the present disclosure.

DETAILED DESCRIPTION

Hereinbelow, referring to FIGS. **1** to **7**, a wide area forming device according to the present disclosure may include a main chamber **3**.

In the following description, an object to be formed may include a camera lens, glass having a curved portion, cover glass for a watch, dashboard glass for a vehicle, glass covering various measuring devices, sapphire, a light transmitting plate, a front window and a back cover for a mobile device or a display device. Portion or all of the object to be formed may be formed to have a curved surface and a 3D shape.

Hereinbelow, a first direction may be an x-axis direction, a second direction may be a y-axis direction, and a third direction may be a z-axis direction. A forward transfer direction may be a positive x-axis direction, and a reverse transfer direction may be a negative x-axis direction. A transfer direction of a middle discharge portion **5** or an auxiliary cooling portion may be a positive y-axis direction or a negative y-axis direction. A height direction may be the third direction or the z-axis direction.

The main chamber **3** may include an upper block **310** that is brought into contact with an upper side of a mold unit **200** and a lower block **320** that is brought into contact with a lower side of the mold unit **200**. For convenience of transferring the wide area mold unit **200**, an input chamber **2** may be installed in an entrance side of the main chamber **3**, and a discharge chamber **4** may be installed in a discharge side of the main chamber **3**.

The input chamber **2**, the main chamber **3**, and the discharge chamber **4** may be arranged in a row in the first direction. In order to insert the mold unit **200** into the input chamber **2**, a preliminary inlet **1** may be provided perpendicularly to the main chamber **3** with the input chamber **2** as the center. In the preliminary inlet **1**, the object to be formed in an initial state may be inserted into the mold unit **200**. In the preliminary inlet **1**, the object to be formed is inserted

between an upper mold **210** and a lower mold **220**, and the upper mold **210** and the lower mold **220** may be assembled to each other.

The mold unit **200**, in which forming has been completed, may be discharged in the discharge chamber **4**. The middle discharge portion **5** may be provided perpendicularly to the main chamber **3** with the discharge chamber **4** as the center. In a reverse direction of a transfer direction of the main chamber **3**, an external cooling portion **6** to which the mold unit **200** is transferred may be provided in parallel to the main chamber **3**. The middle discharge portion **5** may be a passage that connects the discharge chamber **4** to the external cooling portion **6**. A transfer direction from the discharge chamber **4**, the middle discharge portion **5**, toward the external cooling portion **6** is the second direction, and a transfer direction from the external cooling portion **6** toward an outlet **7** is the negative X-axis direction. The transfer direction may be bent by 90 degrees with the external cooling portion **6** as the center. The vertical transfer means and the horizontal transfer means may be provided at a junction where the middle discharge portion **5** and the external cooling portion **6** cross each other.

The mold unit **200**, which has been slowly cooled in the external cooling portion **6**, is disassembled in the outlet **7**, and the object to be formed may be taken out from the mold unit **200**. After the object to be formed is taken out from the outlet **7**, the mold unit **200** may be transferred to a cleaning portion **8**. The cleaning portion **8** may clean a molding surface of the mold unit **200**.

FIG. **7** is a view showing configuration of the cleaning portion **8** in detail. The cleaning portion **8** may be configured as follows. A lower mold arm **820** clamps the lower mold **220** and may be movable for the purpose. An upper mold arm **810** may move or pivot centering around a cleaning jig **830**, and may clamp the upper mold **210**. The upper mold **210** clamped by the cleaning jig **830** may be adjusted to a height and an angle suitable for cleaning while being raised and lowered or pivoting.

A sliding portion **850** may be raised and lowered the upper mold arm **810**. The sliding portion **850** may move in a straight line along a support **860**. A pivot portion **840** may pivot the upper mold arm **810** or the cleaning jig **830**. The upper mold arm **810** or the cleaning jig **830** may pivot around the pivot portion **840**.

The sliding portion **850** may be raised from the upper mold arm **810** by which the upper mold **210** is clamped so that the upper mold **210** may be separated from the lower mold **220**. When the upper mold **210** is separated from the lower mold **220**, the object to be formed may be taken out from the cleaning portion **8**.

The upper mold arm **810** may pivot around the pivot portion **840** and the molding surface of the upper mold **210** may be cleaned. Foreign matter may be removed from the molding surface by rubbing the molding surface with a brush.

Linear movement and rotational movement of the cleaning jig **830** may be performed by extension and contraction of a cylinder **870**. Accordingly, the pivot portion **840**, the cylinder **870**, and a cylinder fixed point **880** may be provided. The extendable cylinder **870** may be provided between the sliding portion **850** and the support **860**. The pivot portion **840** and the cylinder fixed point **880** may be installed to be spaced apart from each other by a predetermined distance. When the cylinder **870** is extended, the cleaning jig **830** by which the upper mold **210** is clamped may pivot around the pivot portion **840**. When the sliding portion **850** moves along the support **860**, the cleaning jig **830** by which the upper mold **210** is clamped may be raised and lowered.

Referring FIGS. **1** to **6**, the mold unit **200** may include the lower mold **220** facing the lower block **320** and the upper mold **210** facing the upper block **310**.

The main chamber **3** may include at least one of a preheating unit provided for heating the mold unit **200** to a preheat temperature, a forming unit provided for heating the mold unit **200** to a forming temperature and pressing the mold unit **200** to form a curved surface of the object to be formed, and a cooling unit provided for cooling the mold unit **200** in which the forming has been completed. The upper block **310** or the lower block **320** may be provided in at least one of the preheating unit, the forming unit, and the cooling unit.

The wide area mold unit **200** has a great weight or a wide area and requires a special transfer means for preventing abrasion or generation of foreign matter during transfer, and the upper block **310** or the lower block **320** also needs a specially designed configuration.

Referring to FIGS. **1** and **6**, the main chamber **3**, the input chamber **2**, and the discharge chamber **4** may be arranged in a row along the first direction. The mold unit **200** may be transferred in a straight line along the first direction. The input chamber **2** may be installed at the entrance side of the main chamber **3**. The discharge chamber **4** may be installed at the discharge side of the main chamber **3**.

In order to preheat, form, and cool the wide area mold unit **200**, the upper block **310** and the lower block **320** may advantageously have a structure consisting of a plurality of upper blocks **310** or a plurality of lower blocks **320**, rather than a structure consisting of a single upper block **310** or a single lower block **320**. Considering the weight and the high temperature state, the structure consisting the plurality of upper blocks or the plurality of lower blocks is good for maintaining flatness due to bending or thermal deformation. Preferably, the plurality of upper blocks **310** and the plurality of lower blocks **320** may face the single mold unit **200**. The upper block **310** or the lower block **320** may have a heater **340**, and may have a passage for cooling water. The mold unit **200** may be heated or cooled by contact conduction.

In order to adjust flatness of the lower block **320**, a means to apply an external force may be required for each of the lower blocks **320**. A pull bolt **350** and a push bolt **360** may be positioned between the lower block **320** and a bottom surface of the main chamber **3**. The pull bolt **350** or the push bolt **360** may face a common cooling plate **330** to which each of the lower blocks **320** is connected.

The pull bolt **350** may pull the lower block **320** toward the bottom surface. The push bolt **360** may push the lower block **320** from the bottom surface. Bending or flatness of the lower block **320** may be adjusted by fastening the pull bolt **350** or the push bolt **360**.

Meanwhile, non-contact transfer of the wide area mold unit **200** may be advantageous to prevent abrasion or attachment of generation of foreign matter. Furthermore, a countermeasure may be required to prevent collision or interference of the transfer means at a point where transfer directions cross each other perpendicularly. The means for preventing collision between the transfer means and for allowing the mold unit **200** to be transfer without sliding, at the point where the transfer directions cross each other, such as the preliminary inlet **1**, the input chamber **2**, the discharge chamber **4**, the middle discharge portion **5**, the external cooling portion **6**, but excluding the main chamber **3**.

When the mold unit **200** in which the object to be formed is received is transferred from a first position to a second position, the present disclosure may separately have the vertical transfer means and the horizontal transfer means.

The vertical transfer means may raise and lower the mold unit **200** in a vertical direction. The horizontal transfer means may transfer the mold unit **200** in a horizontal direction. The vertical direction is the third direction, and the horizontal direction may be the first direction or the second direction.

The vertical transfer means and the horizontal transfer means may be alternately brought into contact with a lower portion of the mold unit **200** at the first position or the second position. For example, at the first position, the vertical transfer means raises the mold unit **200**, and the horizontal transfer means may approach the lower portion of the mold unit **200**. When the vertical transfer means is lowered, the mold unit **200** is placed on the horizontal transfer means, and when the horizontal transfer means moves, the mold unit **200** may be horizontally transferred from the first position to the second position. The vertical transfer means and the horizontal transfer means may alternately transfer the mold unit **200** without collision at the cross point.

Referring to FIG. **2**, the mold unit **200** is placed on a telescopic plate **500** at the middle discharge portion **5**. The telescopic plate **500** may extend from the middle discharge portion **5** toward the external cooling portion **6**.

An upper cooling plate **610** or a lower cooling plate **620** that are provided in the external cooling portion **6** may be brought into contact with the mold unit **200** and may cool the mold unit **200**. The upper cooling plate **610** may be raised and lowered relative to the upper mold **210**. The lower cooling plate **620** may have a structure in which the lower cooling plate is divided into a plurality of portions for avoiding collision or interference occurring on a transfer path. The lower cooling plate **620** may include a main cooling plate **621** and an auxiliary cooling plate **622**. The main cooling plate **621** may be connected to a main cooling plate shaft **623**. The auxiliary cooling plate **622** may be connected to an auxiliary cooling plate shaft **624**. The main cooling plate shaft **623** and the auxiliary cooling plate shaft **624** may be connected to each other by a connection shaft **625**.

A spring **627** may be inserted between the connection shaft **625** and the auxiliary cooling plate shaft **624**. When the connection shaft **625** is raised, the main cooling plate **621** may be brought into contact with a center portion of the mold unit **200**. The auxiliary cooling plate shaft **624** elastically biased by the spring **627** when the connection shaft **625** is raised may be brought into contact with an outer portion of the mold unit **200**. Accordingly, contact performance is improved and cooling performance may be improved.

The spring **627** may be inserted between the connection shaft **625** and the auxiliary cooling plate shaft **624**. A spring fixing bolt **626** may be fastened to the connection shaft **625** or the auxiliary cooling plate shaft **624** so as to fix the spring **627**.

The telescopic plate **500** may extend from the middle discharge portion **5** corresponding to the first position toward the external cooling portion **6** corresponding to the second position while being loaded with the mold unit **200**. In order to prevent collision between the lower cooling plate **620** of the external cooling portion **6** corresponding to the second position and the telescopic plate **500**, the lower cooling plate **620** may be in a lowered state by the connection shaft **625**.

In order to return the telescopic plate **500** in the second position to an initial position thereof or to the first position, a means for raising the mold unit **200** loaded on the telescopic plate **500** is required. A raising and lowering pin **640** may be raised and lowered through a hole or a groove formed on the telescopic plate **500**. When the raising and lowering pin **640** is raised, the mold unit **200** may be spaced apart from the telescopic plate **500**. The telescopic plate **500** may be return to the initial position thereof or the first position.

Referring to FIG. **3**, after the telescopic plate **500** is returned to the initial position or the first position, the lower cooling plate **620** may be raised to a height at which the lower cooling plate **620** may support the mold unit **200**. The raising and lowering pin **640** loaded with the mold unit **200** may place the mold unit **200** on the lower cooling plate **620** while being lowered. While the upper cooling plate **610** is lowered, the upper cooling plate **610** may be in contact with an upper portion of the mold unit **200**, thereby improving the cooling performance.

Referring to FIG. **4**, the mold unit **200** may be transferred in the negative first direction in the external cooling portion **6**. A shuttle block **650** may be installed as the horizontal transfer means. When the upper cooling plate **610** is raised and the lower cooling plate **620** is lowered, the mold unit **200** may be seated on the shuttle block **650**. The lower cooling plate **620** may be configured to be divided into the main cooling plate **621** and the auxiliary cooling plate **622**, and the shuttle block **650** may be positioned in a gap between the main cooling plate **621** and the auxiliary cooling plate **622**. The shuttle block **650** may reciprocate along a linear guide **660** in the first direction. The shuttle block **650** may not need to be raised and lowered. The auxiliary cooling plate **622** may act as to the vertical transfer means and the shuttle block **650** may act as the horizontal transfer means.

Referring to FIG. **5**, the mold unit **200** may be transferred from the external cooling portion **6** to the outlet **7**. A pusher unit **700** that extends and contracts may be installed as the horizontal transfer means. The pusher unit **700** may include a pusher extension part **730** extending and contracting along the transfer direction and a pusher **710** pivoting around an end of the pusher unit **700**. The pusher **710** may pivot around a pusher pivot portion **840**, **720**.

The pusher extension part **730** may extend and approach to one side of the mold unit **200** with the pusher **710** in a folded state. While the pusher **710** is unfolded and the pusher extension part **730** contracts, the pusher **710** pulls the one side of the mold unit **200**, so that the mold unit **200** may be transferred to the lower cooling plate **620** in the outlet **7**.

As described above, the vertical transfer means and the horizontal transfer means are configured to prevent collision between the vertical transfer means and the horizontal transfer means and to minimize sliding contact of the mold unit **200**.

What is claimed is:

1. A wide area forming device comprising:

a vertical transfer means configured to raise and lower a mold unit and a horizontal transfer means configured to transfer the mold unit in a horizontal direction, when the mold unit receiving an object to be formed is transferred from a first position to a second position; and

a raising and lowering pin passing through a hole or a groove provided in a telescopic plate on which the mold unit is placed, wherein the raising and lowering pin is configured to raise and lower the mold unit,

wherein the vertical transfer means and the horizontal transfer means are configured to be alternately brought into contact with a lower portion of the mold unit at the first position or the second position, and wherein, while the mold unit is loaded on the telescopic plate, the telescopic plate extends from a middle discharge portion corresponding to the first position toward an external cooling portion corresponding to the second position.

2. The wide area forming device of claim **1**, wherein a length of the telescopic plate is configured to extend and contract while the mold unit is placed thereon.

3. The wide area forming device of claim **1**, further comprising:

a pusher extension part configured to extend and contract along a transfer direction of the mold unit;

a pusher configured to pivot around the pusher extension part; and

a pusher pivot portion rotatably connecting the pusher to the pusher extension part,

wherein, while the pusher is folded, the pusher extension part extends, and

the pusher extension part approaches to one side of the mold unit when the pusher extension part extends.

4. The wide area forming device of claim **1**, further comprising:

a pusher configured to extend and contract in a transfer direction of the mold unit, and a pusher configured to pivot around a pusher extension part,

wherein, while the pusher is unfolded and the pusher extension part contracts, the pusher pulls one side of the mold unit when the mold unit is transferred.

5. A wide area forming device comprising:

a mold unit having an upper mold and a lower mold in which an object to be formed is received between the upper mold and the lower mold, wherein, while the upper mold is raised from the lower mold and then pivots, a molding surface of the upper mold or the lower mold is cleaned;

a lower mold arm configured to clamp the lower mold;

an upper mold arm configured to clamp the upper mold;

a sliding portion configured to raise and lower the upper mold arm; and

a pivot portion configured to pivot the upper mold arm,

wherein the sliding portion raises the upper mold arm clamping the upper mold to separate the upper mold from the lower mold, and

the upper mold arm pivots around the pivot portion and the molding surface of the upper mold or of the lower mold is cleaned.

6. The wide area forming device of claim **5**, wherein the upper mold arm is movably mounted on a cleaning jig,

the pivot portion is positioned at a rotational center point of the cleaning jig,

the pivot portion is provided in the sliding portion,

the sliding portion is raised and lowered relative to a support, and

a cylinder is provided between the sliding portion and the cleaning jig and configured to extend and contract therebetween.

7. A wide area forming device comprising:

a mold unit configured to receive an object to be formed; and

a main chamber having:

a plurality of upper blocks configured to press the mold unit for forming the object to be formed and facing the mold unit;

a plurality of lower blocks configured to support the mold unit; and

a plurality of pull bolts and a plurality of push bolts positioned between the plurality of lower blocks and a bottom surface of the main chamber, the plurality of pull bolts configured to pull the plurality of lower blocks in a direction toward the bottom surface of the main chamber, the plurality of push bolts configured to push the plurality of lower blocks from the bottom surface of the main chamber, wherein bending or flatness of the plurality of lower blocks are adjusted by fastening at least one of the plurality of pull bolts and the plurality of push bolts.

8. The wide area forming device of claim **7**, further comprising:

a preliminary inlet that is located at a position in which the object to be formed is inserted into the mold unit,

wherein the main chamber extends in a first direction,

the preliminary inlet extends in a second direction,

the first direction and the second direction are perpendicular to each other, and

the mold unit having an upper mold and a lower mold in which the object to be formed is inserted between the upper mold and the lower mold from the preliminary inlet, and the upper mold and the lower mold are assembled with each other.

9. The wide area forming device of claim **7**, further comprising at least one of:

an input chamber provided at an inlet side of the main chamber;

a discharge chamber provided at a discharge side of the main chamber;

an external cooling portion configured to cool the mold unit;

a middle discharge portion connecting the discharge chamber to the external cooling portion;

an outlet that is located at a position through which the object to be formed, which has been formed, is taken out from the mold unit;

a cleaning portion configured to clean the mold unit; and

a preliminary inlet that is located at a position through which the object in an initial state is inserted into the mold unit,

wherein the input chamber, the main chamber, and the discharge chamber are arranged in order in a first direction,

the preliminary inlet or the middle discharge portion is arranged in a second direction that is perpendicular to the first direction, and

the external cooling portion is provided in parallel to the main chamber.

10. The wide area forming device of claim **7**, further comprising: a vertical transfer means and a horizontal transfer means provided at a point where a direction in which the mold unit is transferred is bent from a straight line inside or outside the main chamber,

wherein the vertical transfer means is configured to raise and lower the mold unit and the horizontal transfer means is configured to transfer the mold unit in a horizontal direction.

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