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☒	Description : paged ...1... to paged ...H.....	
☒	Claim(s) : paged ...6... to paged ...70.....	
☒	Drawing(s) : paged ...1/2... to paged ...22/24.....	
☒	Abstract : paged ...1... to paged ...-.....	
DATE OF RECEIPT		

- 1 -

A FORMING METHOD OF A GLASS PRODUCT AND ITS DEVICE

The present invention relates to a forming method of a glass product such as a panel for a cathode ray tube (CRT) wherein a lump of glass (gob) in a molten state is dropped from an orifice (feeding port) to a female press-mold which is pressed by a male press-mold (plunger), and its device, particularly to a novel forming method of a glass product and its device with respect to a line wherein the female press-molds are successively set at a gob feeding stage, the gob is continuously fed and a glass product is successively removed after subjecting the gob to a press-forming step.

Conventionally, a method has normally been adopted in case of press-forming a glass product such as a panel for a CRT, wherein female press-molds are placed along a periphery of a rotatable disk-like table, gob is successively fed to the female press-molds placed on the table by dropping the gob from an orifice provided above the rotating table, the female press-molds are

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stage S1 (① in Figure 50) to which gob is continuously fed by a gob feeding device G, the female press-molds M which are set with respect to the gob feeding stage S1 are transferred by every pitch (m), and at a stage
5 wherein the female press-molds M fed with the gob are transferred to continuous press-forming stages S21 and S22 (④ and ⑤ in Figure 50), the press-forming step is simultaneously carried out by a press device P. Or, there is a method (see Japanese Examined Patent
10 Publication No. 44648/1989), wherein as shown in Figure 51, the female press-molds M on a disk-like turn table T are successively set with respect to gob feeding stages S11 and S12 (① and ② in Figure 51), the female press-molds M which are set in the gob feeding stages S11 and
15 S12 are transferred by every two pitches (2 m), and at the stage wherein the female press-molds M fed with the gob are transferred to two contiguous press-forming stages S21 and S22 (③ and ④ in Figure 51), the press-forming step is simultaneously carried out by the press
20 device P.

In the former type of device, although it is certainly possible to accelerate the timing for feeding the gob at the gob feeding stage S1, the time from when the gob touches the female press-mold M to when the
25 pressing step is started, differs between the respective press-forming stages S21 and S22. Accordingly, the moldabilities of glass products respectively molded by



Further, in molding a glass product, it is necessary to provide a gob feeding step, a press-forming step, a glass product removing step, a shell mold attaching step which maintains a mold forming shape by engaging a shell mold to a periphery of a bottom mold in the press-forming step, which is necessary for enabling the press-forming step by the female press-molds M, and a shell mold removing step for removing the shell mold from the bottom mold before removing the glass product which is necessary for enabling the glass product removing step. Since the female press-molds M are placed and transferred on the turn table T, the above respective steps should be laid out on a circular locus of the turn table T which is the transfer locus of the female press-molds M, the number of the female press-molds M or the bottom molds placed on the turn table T is uniquely determined by the size of the turn table T, and it is difficult to arbitrarily increase the number of the female press-molds M or the bottom molds in accordance with the necessity.

Therefore, the degrees of freedom in the design of the layout of the molding line of a glass product, and in the alteration in the layout are considerably restricted.

It is an object of the present invention to solve the above technical problems and to provide a forming method of a glass product and its device capable of promoting the molding efficiency of a glass product, preferably maintaining the uniformity of the molding quality of a



molds (M) after finishing the step of removing the press-formed glass product (GS) to the gob feeding stage (S1) from each of the closed loop molding lines (L1, L2); and

wherein, during the step of transferring one of the female press-molds (M) fed with the gob (GB) to the press-forming stage (S2) in a first one of the closed loop molding lines (L1, L2), the step of press-forming the gob (GB) is performed in a second one of the closed loop molding lines (L1, L2).

10 In the drawings:

Figure 1 is an explanatory diagram showing a forming method of a glass product and the construction of its device according to the present invention;

Figure 2 is an explanatory diagram showing the total construction of an example of a molding device for a panel of a CRT to which this invention is applied;

Figure 3 is an explanatory diagram showing the total construction of a mold transferring system which is employed in Examples;

20 Figure 4 is an explanatory diagram showing a support structure of a swirl type transfer device employed in Examples;

Figure 5(a) is an explanatory diagram showing a relation among a female press-mold, a pallet and a lifter, and Figure 5(b) is a diagram viewed in the direction of an arrow mark V in Figure 5(a);

Figure 6 is a plane view of a pallet employed in



Figure 17 is a diagram of a shell mold holding hand in Figure 16 viewed from the direction of an arrow mark XVII;

Figure 18 is an explanatory diagram showing a glass product removing device for a panel of a CRT employed in Examples;

Figure 19 shows timing charts indicating operational states of a female press-mold distributing device, a female press-mold returning device and a press-forming device in a molding device for a panel of a CRT employed in Example 1;

Figure 20 shows timing charts indicating operational states of linear transfer devices, a cross transfer device and a glass product removing device in a molding device for a panel of a CRT employed in Example 1;

Figure 21 is a schematic diagram showing the motional step (1) of a molding device for a panel of a CRT employed in Example 1;

Figure 22 is a schematic diagram showing the motional step (2) of a molding device for a panel of a CRT employed in Example 1;

Figure 23 is a schematic diagram showing the motional step (3) of a molding device for a panel of a CRT employed in Example 1;

Figure 24 is a schematic diagram showing the motional step (4) of a molding device for a panel of a CRT employed in Example 1;

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states of linear transfer devices, a cross transfer device and a glass product removing device in a molding device for a panel of a CRT employed in Example 2;

Figure 34 is a schematic diagram showing the motional
5 step (1) of a molding device for a panel of a CRT in Example 2;

Figure 35 is a schematic diagram showing the motional
step (2) of a molding device for a panel of a CRT in Example 2;

10 Figure 36 is a schematic diagram showing the motional
step (3) of a molding device for a panel of a CRT in Example 2;

Figure 37 is a schematic diagram showing the motional
step (4) of a molding device for a panel of a CRT in
15 Example 2;

Figure 38 is a schematic diagram showing the motional
step (5) of a molding device for a panel of a CRT in Example 2;

Figure 39 is a schematic diagram showing the motional
20 step (6) of a molding device for a panel of a CRT in Example 2;

Figure 40 is a schematic diagram showing the motional
step (7) of a molding device for a panel of a CRT in Example 2;

25 Figure 41 is a schematic diagram showing the motional
step (8) of a molding device for a panel of a CRT in Example 2;



Figure 51 is an explanatory diagram showing another example of a conventional molding method of a glass product.

As a device invention for realizing the
5 aforementioned method invention, as shown in Figure 1, an
invented forming device of a glass product includes, as a
prerequisite, a mold transferring system 1 for
transferring female press-molds M to respective
processing stages of S1, S2 and S4, a gob feeding means 2
10 for successively feeding gob GB to the female press-molds
M transferred to a gob feeding stage S1 at predetermined
time intervals, a press-forming means 3 for press-forming
the gob GB in the female press-mold M at a time point
wherein the female press-mold M fed with the gob GB is
15 transferred to a press-forming stage S2, and a glass
product removing means 5 for removing a glass product GS
from the female press-mold M which has been press-formed,
at a glass product removing stage S4. A plurality (for
instance, two) of the press-forming stages S2 are
20 provided surrounding around the single gob feeding stage
1. The mold transferring system 1 is provided along a
plurality (for instance, two sets) of closed loop molding
lines L1 and L2 which include the product removing stages
S4 corresponding to the respective press-forming stages
25 S2. The mold transferring system 1 comprises a female
press-mold distributing means for successively
distributing the female press-molds M fed with the gob GB



method invention includes, as a prerequisite, a gob feeding step of feeding the gob GB at predetermined time intervals, after successively setting the female press-molds M each consisting of the bottom mold MB and the shell mold MS that is engaged with a periphery of the bottom mode MB, a press-forming step of press-forming the gob GB after successively transferring the female press-molds M fed with the gob GB to the press-forming stage S2, a shell mold removing step for removing the shell mold MS from the female press-mold M at a shell mold removing stage S3 after finishing the press-forming step, a glass product removing step for removing the glass product GS from the bottom mold MB finished with the shell mold removing step, at the glass product removing stage S4, and a shell mold engaging step of engaging the shell mold MS to the bottom mold MB finished with the glass product removing step, at a shell mold engaging stage S5, before the female press-mold M is set at the gob feeding stage S1. A pair of the press-forming stages S2 are provided interposing the single gob feeding stage S1. Two sets of the closed loop molding lines L1 and L2 are provided wherein a series of steps comprising the press-forming step, the shell mold removing step, the glass product removing step and the shell mold engaging step, are independently performed. The female press-molds M fed with the gob in the gob feeding step, are alternately transferred to the press-forming stages S2 in

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removing the glass product GS from the bottom mold MB
that is removed of the shell mold MS, at the glass
product removing stage S4, and a shell mold engaging
means 6 for engaging the shell mold MS to the bottom mold
5 MB that is removed of the glass product GS, at the shell
mold engaging stage S5, before setting the female press-
mold to the gob feeding stage S1. The mold transferring
system 1 is provided along two sets of the closed loop
molding lines L1 and L2 each of which is provided with
10 the shell mold removing stage S3, the glass product
removing stage S4 and the shell mold engaging stage S5,
corresponding to the respective press-forming stage S2.
The mold transferring system 1 comprises the female
press-mold distributing means 11 for distributing the
15 female press-molds M alternately to a pair of the press-
forming stages S2 at the gob feeding stage S1, the female
press-mold returning means 12 for returning the female
press-molds M each consisting of the bottom mold MB and
the shell mold MS that has been engaged with the bottom
20 mold MB at the shell mold engaging stage, to the gob
feeding stage S1 alternately from the respective closed
loop molding lines L1 and L2, in corporation with the
female press-mold distributing means 11, the first mold
transferring means 13 for transferring the female press-
25 molds M or the bottom molds MB which are set in the
press-forming stage S2 and later stages in the closed
loop forming line L1, the second mold transferring means

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impairing it, which is, for instance, a means for vacuum-transferring the glass product GS, and the like.

Further, the designs of the shell mold removing means 4 and the shell mold engaging means 6 may pertinently be altered, so far as they can achieve their functions individually. However, in view of achieving the simplification of the device, it is preferable to design a means which is provided with the functions of both the shell mold removing means 4 and the shell mold engaging means 6. Further, it is preferable to provide a stage of exchanging the shell mold MS and the bottom mold MB, in consideration of the durability the female press-mold.

The glass product GS in this invention includes glass product which is manufactured by the press-forming operation, such as a panel or a funnel for a CRT, a glass table wear such as a dish and a cup, a glass vase, various glass bottles, or glass block. The invented method and device are widely applicable in press-forming the various kinds of glass products.

Further, the closed loop molding lines L1 and L2 can adopt various shapes such as a ring shape, a rectangular shape, a shape having linear portions and curved portions, and the closed loop molding line can flexibly constructed in accordance with the shape of a space in a facility.

Further, as the female press-mold distributing means 11 composing the mold transferring system 1, a transfer

female press-mold distributing means which employs a pair of the transfer members each of which independently distributes the female press-molds M to each of the closed loop molding lines L1 and L2.

5 Further, the female press-mold returning means 12 returns the female press-molds M in corporation with the distributing operation of the female press-molds M by the female press-mold distributing means 1. A new female press-mold M is returned to the gob feeding stage S1 from
10 one of the closed loop molding lines L1 and L2, during or after the distributing operation of the female press-molds M by the female press-mold distributing means 11.

In this case, in view of promoting the processing efficiency of the female press-mold returning means 12,
15 it is preferable to design the female press-mold returning means 12 such that two of the female press-mold returning means 12 are provided to the respective closed loop molding lines L1 and L2 to minimize a time loss in joining the female press-molds, or such that the female
20 press-mold M from one closed loop molding line is returned to the gob feeding stage S1 during the distributing operation of the female press-mold M to the press-forming stage S2 in the other closed loop molding line. As a specific embodiment of the latter design, a
25 pushing guide mechanism as the female press-mold returning means 12 is installed on a transfer member as the female press-mold distributing means 11, whereby,



distributing step, and performs the press-forming operation by the press-forming means 3.

In this case, the mold transfer controlling means 15 controls to drive the mold transferring means 13 and 14 in corporation with the step of distributing the female press-molds M by the female press-mold distributing means 11. As an embodiment of the driving control, all the mold transferring means 13 of the closed loop molding line to which the female press-mold M has been distributed, for instance, L1, may be moved pitch, and the transfer operation of the mold transferring means 14 of the other closed loop molding line, for instance, L2, may be stopped. Or, the respective mold transferring means 13 and 14 may partially be moved pitch by pitch in corporation with the step of distributing the female press-molds, and the respective mold transferring means 13 and 14 may temporarily stopped with respect to portions wherein the processings at the processing stages are necessary.

The applicants have already proposed prior arts wherein a glass product such as a panel for a CRT is manufactured by linearly transferring female press-molds between independent steps.

A prior art 1 (Japanese Unexamined Patent Publication No. 271927/1990), discloses that two press-forming devices are provided interposing one gob feeding device. However, a method and its specific means for distributing



successively setting female press-molds to a gob feeding stage;

feeding gob (GB) to the female press-molds (M) at the gob feeding stage at predetermined intervals;

5 successively transferring the female press-molds (M) fed with the gob to a press-forming stage;

press-forming the gob into a glass product at the press-forming stage; and

removing the press-formed glass product at a glass
10 product removing stage;

wherein a pair of the press-forming stages are provided surrounding the gob feeding stage;

wherein a pair of closed loop molding lines are provided each of which independently performs a series of
15 steps including the steps of press-forming the gob and removing the press-formed glass product;

wherein a female press-mold returning means is provided for alternately returning empty female press-molds finished with the step of removing the press-formed
20 glass product to the gob feeding stage from the pair of the closed loop molding lines;

wherein a dummy transferring step is provided between the step of transferring the female press-mold fed with the gob to the press-forming stage of a first one of the
25 closed loop molding lines and the step of transferring the female press-mold fed with the gob to the press-forming stage of a second one of the closed loop molding



wherein a pair of closed loop molding lines each independently performing a series of steps including a step of the press-forming and a step of removing the glass product, and a female press-mold distributing means
5 for transferring the female press-molds which are empty after finishing the glass product removing step from the pair of the closed loop molding lines alternately to the press-forming stages and alternately distributing the female press-molds to the press-forming means, are
10 provided; and

wherein a control device for selectively transferring the female press-molds whose number is smaller than a total number of processing stages of the press-forming stage and later stages at least by two or more.

15 These forming method and forming device further enhance the degrees of freedom in the forming device and the forming method of the aforementioned present invention, which is, for instance, suitable for manufacturing a large-size glass product.

20 In the forming device and the forming method of a glass product of the aforementioned present invention, a time interval from the moment of dropping the gob to the female press-mold to when the press-formed glass product is removed, is inevitably determined by the interval for
25 feeding the gob and the number of the processing stages from the gob feeding stage to the glass product removing stage.



quality of the glass per se (segregation of bubbles or foreign components contained in glass, etc.).

When the feeding amount of the glass matrix from the melting furnace in case of molding a glass product having the gob weight twice as much as that in the former example, the interval of feeding gob is doubled to 12 seconds and the time from the gob-feeding to the glass product-removing is approximately 130 seconds. Therefore, the temperature of the glass product at the glass product removing stage is too low which is apt to cause cracks.

Similarly, a time required for circulating the shell mold on the device is also prolonged, and a leaving heat quantity of the shell mold by the natural radiation is larger than a receiving heat quantity thereof. Therefore, the temperature of the shell mold undergoes a change at a lower level. Accordingly, cracks are apt to cause on the contact face between the glass at a high temperature and the shell mold at a low temperature.

To solve the above technical problem, the capacity of the melting furnace of glass is increased (normally the capacity is determined by the size of the melting furnace), or the layout of the forming device of a glass product is changed, and the number of the processing stages from the gob-feeding to the glass product removing is reduced, thereby controlling the time interval from the gob-feeding to the glass product removing to a



press-molds and the state of the female press-mold distributing means 11 restore to the same arrangement and the same state.

Further, a function is added to the forming device of a glass product realizing the forming method wherein only predetermined female press-molds can selectively be transferred at the respective mold transferring steps, by providing the mold-transfer controlling means 15 whereby the mold transferring means 13 and 14 are controlled to drive in corporation with the step of distributing the female press-molds M by the female press-mold distributing means 11, the transferring of the female press-mold M from the press-forming stage S2, at least in the step of distributing the female press-molds M, by the mold transferring means of the closed loop molding line, to which the female press-mold M has been distributed in the preceding distributing step, is stopped, and the press-forming is performed by the press-forming means 3.

First, an explanation will be given of the basic operation of a forming device of a glass product according to the present invention.

In Figure 1, in the mold transferring system 1, a plurality, for instance, a pair of the press-forming stages S2 are provided surrounding around the single gob feeding stage S1, along a plurality, for instance, a pair of the closed loop molding line L1 and L2, which include the glass product removing stages S4 corresponding to the

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having a pair of the closed loop molding lines L1 and L2.

The mold transferring system 1 is provided with a pair of press-forming stages S2 interposing the single gob feeding stage S1, and is provided along a pair of the closed loop molding lines L1 and L2 in each of which the shell mold removing stage S3, the glass product removing stage S4 and the shell mold engaging stage S5 are provided in correspondence with the press-forming stage S2. As shown in Figure 1, the respective means 11 through 15 composing the mold transferring system 1 operate as follows.

The female press-mold distributing means 11 alternately distributes the female press-molds M fed with the gob in the gob feeding stage S1 to the pair of the press-forming stages S2. Further, the female press-mold returning means 12 alternately returns the female press-molds M each of which consisting of the bottom mold MB and the shell mold MS that has been engaged with the periphery of the bottom mold MB in the shell mold engaging stage S5, to the gob feeding stage S1 from the respective closed loop molding lines L1 and L2.

Further, the first mold transferring means 13 transfers the female press-molds M or the bottom molds MB which are set in the press-forming stage S2 and later stages in the closed loop molding line L1, and the second mold transferring means 14 transfers the female press-molds M or the bottom molds MB which are set in the



performed. Accordingly, the timing of feeding the gob at the gob feeding stage S1 can substantially be determined by considering only the press-forming time at the press-forming stage S2, without considering the index time of the female press-mold M to the press-forming stage S2.

For instance, in case wherein the press-forming time is approximately 3 seconds and the index time is approximately 2 seconds, the molding efficiency of $60/3 = 20$ per minute in the present invention is provided, in contrast to the molding efficiency of the conventional technology of $\{60/(3+2)\} = 12/\text{minute}$.

Further, it is also possible that the mold transfer controlling means 15 controls to drive the first and second mold transferring means 13 and 14 in cooperation with the step of distributing the female press-molds M by the female press-mold distributing means 11, whereby only portions of the female press-molds M or the bottom molds MB which are selected by the mold transfer controlling means 15, are transferred in the respective transfer steps, and the one cycle is composed by the reciprocating steps of the female press-mold distributing means 11, the number of which is an odd number not less than 3.

For instance, in case of controlling to perform one cycle by 3 times of the reciprocating steps in one closed loop molding line, the stop time at the processing stages can be selected stepwisely by 1 through 3 reciprocating steps. Further, the range of selection in the number of



(A-side and B-side in the Example) of the respective processing stages of ST0 through ST16 and ST18 through ST22, are provided in closed loops.

In this Example, ST0 designates a press-forming stage
5 wherein a press-forming operation is performed with
respect to the gob in the female press-mold M, ST1 and
ST2, air forming stages wherein the press-mold panel is
shaped in a form along the female press-mold M by blowing
air, ST3, a shell mold removing stage wherein the shell
10 mold MS is removed from the female press-mold M, ST4
through ST9, cooling stages wherein the press-formed
panel is naturally cooled in the bottom mold MB which is
removed of the shell mold MS, ST10, a cross transfer
stage wherein the bottom mold MB in the cooling stage of
15 ST9 is transferred in the right angle direction, ST11, a
panel removing stage wherein the panel in the bottom mold
MB is automatically removed, ST12, a panel removing stage
wherein the panel is manually removed in starting the
operation, ST13, a shell mold engaging stage wherein the
20 shell mold MS is engaged with the bottom mold MB which is
finished with the removing of the panel, ST14, a mold
return waiting stage wherein the female press-mold M
temporarily waits before returning the female press-mold
M to the gob feeding stage ST17, ST15, a mold returning
25 stage wherein the female press-mold M is returned to the
gob feeding stage ST17, ST16, a dummy stage wherein a
pusher 133, mentioned later, waits, ST18, a shell mold



cooling stage ST9 and among the cross transfer stages ST10 through the mold waiting stages ST14, on the A-side and a B-side linear transverse device 33 which linearly transfers the female press-molds M or the bottom molds MB among the air forming stage ST1 through the cooling stage ST9 and among the cross transfer stages ST10 through the mold waiting stage ST14, on the B-side.

Further, a press-forming device 34 (see Figure 12) is installed at the press-forming stage ST0. A shell mold removing and engaging device 35 (see Figure 16) is installed between the shell mold removing stage ST3 and the shell mold engaging stage ST13. A panel removing device 36 (see Figure 18) is installed at the panel removing stage ST11.

15 Female press-mold

In this example, the female press-mold M comprises the bottom mold MB having a recess along the configuration of a panel which is an object of press-forming and the shell mold MS which attachably and detachably engages with a peripheral portion of the bottom mold MB and restrains the gob which is press-formed in the press-forming operation, from overflowing from the bottom mold MB, as particularly shown by Figures 5(a) and 5(b).

25 Further, the bottom mold MB is fixed on a pallet 50, and the female press-mold M or the bottom mold MB is transferred by the mold transferring system 30 integrally



outermost peripheral position of the swirl table 101. A pair of positioning inner pins 113 are installed on both sides of the open end of the cut-in slit 105 which is placed at the innermost peripheral position.

5 These positioning outer pins 111 and 112 and positioning inner pins 113 are vertically movably supported by vertical moving lifters 114 which are fixed to the swirl table 101 and each of which is composed of an air cylinder and the like (having the vertical stroke
10 of approximately 25 mm in this example), as shown in Figures 5 through 7, which engage with positioning holes 51 that are opened for the female press-mold on the both sides of the pallet 50 M in the width direction.

As shown in Figure 4, in the movable anvil 120
15 employed in this example, the support column 121 is fixed to a vertical lifter 122 such as an air cylinder or the like (having the vertical stroke of approximately 25 mm in this example), and is slidably guided along a support column 123 through a guide slider 124 to prevent falling-
20 down of the vertical posture of the support column 121.

As shown in Figure 8, a pair of pushing guide mechanisms 130 are installed on the swirl table 101, which returns a new female press-mold M transferred to the mold returning stage ST15 to the gob feeding stage
25 ST17.

In the pushing guide mechanism 130 of this example, a pair of guide rails 131 (see Figure 9) are laid along the

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numeral 148 designates a position binding slide mechanism which binds and slides the pusher supporting plate 147 along the pushing direction of the pusher 133, and 149, a slit opened at swirl table 101 in correspondence with the moving stroke of the link arm 146.

Press-forming device

As shown in Figure 12, in the press-forming device 34, the press mounting table 201 is provided on a fixed base 202 through a column 203 supporting a vertical motion of a hydraulic cylinder or the like, and the plunger 210 is provided above and corresponding to the press mounting table 201 through a vertical moving mechanism, not shown.

Linear transfer device

As shown in Figures 3, 13(a), 13(b) and 14, the linear transferring devices 32 and 33 employed in this example, each comprises an outer linear transfer device 301 which transfers the female press-mold M or the bottom mold MB from the air forming stage ST1 to the cooling stage ST9, an inner linear transfer device 302 which transfers the female press-mold M or the bottom mold MB from the cross transfer stage ST10 to the mold return waiting stage ST14, and a cross transfer device 303 which cross-transfers the bottom molds MB from the cooling stage ST9 to the cross-transferring stage ST10.

In this example, in the outer linear transfer device 301, a pair of travelling beams 313 which are extended in



travelling beam 313, the positioning pins 317 engage with the positioning holes 51 of the pallets 50 by lifting by the lifters 318, the pallets 50 are separated from the fixed anvil 316, the travelling beams 313 travel in this state, the female press-molds M or the bottom molds MB placed on the fixed anvil 316 at the respective processing stages ST are transferred to the succeeding processing stages ST, under this state, the positioning pins 317 are lowered by lowering by the lifters 318, firstly, the pallets 50 are placed on the fixed anvil 316, the positioning pins 317 are detached from the positioning holes of the pallets 50, and thereafter, the travelling beams 313 are retracted to their initial position. In this way, it is possible to select the female press-mold M or the bottom mold MB that is transferred in a certain transfer step, and to individually determine the stop time at the respective processing stages ST.

Further, the inner linear transfer device 302 is different from the outer linear transfer device 301 in its pitch between the respective processing stages ST and the transfer direction of the mold. However, the inner linear transfer device 302 is basically provided with components similar to those in the outer linear transfer device 301 except the layout of the crank drive mechanism 314. The components of the inner linear transfer device 302 which are similar to those in the outer linear



the guide bar 401, further, a shell mold removing unit 403 moves forwardly and backwardly between the shell mold engaging stage ST3 and the shell mold exchanging and removing stage 18, and a shell mold fitting unit 404 is
5 forwardly and backwardly moves between the shell mold engaging stage ST13 and the shell mold exchanging and fitting stage ST19.

In this example, in the shell mold attaching and detaching unit 402, a movable shoe 411 which slides along
10 the guide bars 401 is provided, a guide support 412 is provided to the movable shoe 411 which extends downwardly, a vertically moving arm 413 is slidably attached along the guide support 412 which can vertically move by the driving force of an air cylinder 414, and a
15 shell mold holding hand 415 is attached to the distal end of the vertically moving arm 413. Further, as shown in Figure 17, in the shell mold holding hand 415 in this example, a pair of movable hand members 418 are slidably attached to a hand mainbody 416 that is fixed to the
20 vertical moving arm 413 through sliders 417, the pair of movable hand members 418 are pertinently opened or closed in the approaching and departing direction by a ball screw mechanism 419 or the like, and the shell mold holding hand 415 is attached to or detached from the
25 shell mold MS.

Accordingly, in this shell mold attaching and detaching unit 402, the forward and backward movement of



504 and the vacuum suction and release motion of the vacuum chuck 505 corporate with each other, and the panels GS are alternately removed at the panel removing stage ST11, by the vacuum suction of the pair of the vacuum chucks 505. After one of the vacuum chucks 505 contacts the glass product (GS), it is lifted, swirled by the swirl motor 503 by 180 degrees, and lowered onto a conveyor, not shown. The other one of the vacuum chucks 505 successively performs the above operation.

10 Operation of the molding device of a panel

The panel forming device according to this example is controlled by a controller, not shown, in accordance with the operational timings in Figures 19 and 20.

In Figure 19, A gob at shear cut timing chart designates a timing wherein the gob is fed to the A-side, and B gob, a timing wherein the gob is fed to the B-side.

Further, with respect to the swirl table timing chart, a rise to right designate a swirl to the right direction, and a fall to left, a swirl to the left direction. Further, the up-and-down motions of the respective outer pins 111 and 112 and the inner pins 113 on the A-side and B-side, are shown by UP and DN.

Further, in the plunger A and the plunger B timing charts, the up-and-down movements of the plungers 210 at the press-forming stages ST0 on the A-side and the B-side, are shown by UP and DN.

Further, the female press-mold loading timing chart



the A-side and B-side transfer pins 338 by UP and DN.

Further, the timing charts of A (B)-side T/O swirl indicate the swirl movements of the swirl motor 503 of the panel removing device 36, the timing charts of A (B)-
5 side T/O up and down indicate the up-and-down movement of the vertically moving cylinder 504 by UP and DN, and the timing charts of A (B)-side T/O vacuum indicate the vacuum suction and release motion of the vacuum chuck 505. Further, in the timing charts of A (B)-side T/O up
10 and down and the A (B)-side T/O vacuum, the dotted lines designate the operation state on the counter side of the pair of vacuum chucks 505 for reference.

Figures 21 through 30 schematically show the operational states of the device in steps of No. 1
15 through No. 10 in the timing charts of Figures 19 and 20. The ○ mark at the press-forming stage ST0 indicates the press-forming is being performed.

According to these schematical diagrams, it is shown that in the step of transferring the female press-mold M
20 to the press-forming stage ST0 on the A-side, the press-forming is performed at the press-forming stage ST0 on the B-side, and at the same time, the next female press-mold M placed at the mold returning stage ST15 on the B-side is set to the gob feeding stage ST17.

25 Variational example

Figure 31 shows a variational example of the swirl transfer device 31 employed in Example 1.



side, and B gob, the timing wherein the gob is fed to the B-side.

Further, with respect to the timing chart of the swirl table, rise to the right designates right swirl, and fall to the left, left swirl. In the timing charts of the outer pins 111 and 112 and inner pins 113 on the A-side and B-side, the up-and-down movements are shown by UP and DN. Further, in the timing charts of plungers A and B, the up-and-down movements of the plungers at the press-forming stages ST0 on the A-side and the B-side are shown by UP and DN.

Further, in the chart of the female press-mold loading, the movement locus of the pusher in returning the female press-mold M from the mold returning stages ST15 on the A-side and B-side to the gob feeding stage ST17 is shown, and the movements of the pusher pins and the movable anvils on the A-side and the B-side are shown by the timing charts of 15A pusher pin, a 15A movable anvil, 15B pusher pin and 15B movable anvil, wherein the up-and-down movements are shown by UP and DN.

Further, in Figure 33, the timing charts of the swirl table, the outer pins and the inner pins on the A-side and the B-side are the same as in Figure 32. The timing charts of A-side and B-side S/T travelling show the forward and backward movements of the shell mold engaging and removing devices 35 on the A-side and the B-side. The timing charts of A-side and B-side S/T up and down



Further, the number of the female press-molds M is halved wherein the number is reduced compared with that in the case of Example 1 by 8 pieces, and it is understood that the female press-molds M are selectively transferred in one transfer step.

As stated above, according to the invention described in the aspects of the present invention corresponding to Claims 1, 3, 5 or 6, the following basic effect is achieved.

Firstly, the feeding of gob is performed by a single gob feeding stage as a prerequisite, and the female press-molds fed with the gob are successively distributed to a plurality of press-forming stages, in the step wherein the female press-mold is distributed to a press-forming stage, the press-forming is performed with respect to the gob in the female press-mold which is set in the other press-forming stage. Therefore, it is possible to set the timing for feeding the gob, by only considering the press-forming time in the press-forming stage, without considering the distributing time of the female press-mold, and further, it is possible to maintain constant the time from the timing of feeding the gob to the time of starting the press-forming.

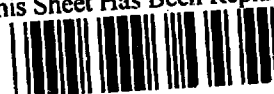
Accordingly, it is possible to promote the molding efficiency of a glass product by accelerating the timing for feeding the gob, while excellently maintaining the uniformity of the basic quality of the glass product.



respective processing stages can arbitrarily be determined, and the alternation of the transfer locus of the female press-mold or the bottom mold, or the enlarging of the respective processing stages can be
5 coped with simply by the change of layout such as in a walking beam. Accordingly, there is no considerable restrictions of the layout as in the conventional disk-like turn table system, wherein the respective processing stages are laid out along a circular locus on the turn
10 table, and the number of the female press-molds or the bottom molds which are set on the turn table is uniquely determined by the size of the turn table, and the degrees of freedom in the design of the layout of the molding line of a glass product and the alternation of the layout
15 can considerably be improved.

Particularly, according to the aspect of the invention with regard to Claim 5 or Claim 6, the above specific effect can certainly be achieved in a type of device wherein the female press-mold consists of the
20 bottom mold and the shell mold which is engaged with and removed from the periphery of the bottom mold, and in view of constructing a system having two sets of molding line, also considering attaching and detaching of the shell mold.

25 Further, according to the aspect of the invention with regard to Claim 2 or Claim 4, the female press-mold from one molding line is returned to the gob feeding



with regard to Claim 7, the female press-molds set at the gob feeding stage are alternately swirled to a pair of press-forming stage by the swirl transfer member as the female press-mold distributing means. Accordingly, in case wherein two routes of closed loop molding lines are arranged on both sides of the gob feeding stage, the space for distributing the female press-molds can be saved, and the two routes of closed loop molding lines can efficiently be installed.

Further, according to the aspect of the invention with regard to Claim 8, a female press-mold distributing means is adopted which comprises a pair of transfer members each of which transfers the female press-molds sets at the gob feeding stage to one of the pair of press-forming stages. Accordingly, it is possible to operate only one of the molding lines in case wherein the male press-mold of the press-forming means at the other molding line is exchanged, or in case wherein the mold transferring system of the other molding line is malfunctioned thereby further promoting the molding function in molding a glass product.

According to the aspect of the invention with regard to Claims 10 and 11, firstly, a dummy reciprocating transfer step or steps are provided between the transfer step wherein the female press-mold fed with the gob is transferred to the press-forming stage of one molding line, and the transfer step wherein the female press-mold

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while excellently maintaining the quality of the glass matrix in case wherein glass products having different gob weights are molded, since the feeding amount of the glass matrix from the melting furnace of glass can be
5 maintained constant by adopting the above construction.

Thirdly, the range of selecting of time wherein the female press-molds or the bottom molds are stopped at the respective processing stage, is widened, while the gob feeding interval is determined such that the feeding
10 amount of glass matrix is maintained constant.

Accordingly, a heat cycle can be determined wherein the temperature of the glass product or the mold is suitable for molding. On the other hand, the time chart for transferring the bottom mold and the shell mold at timing
15 can be determined, whereby such a heat cycle can be formed. Accordingly, it is possible to mold a glass product while excellently maintained the quality in the appearance of the glass product and in the dimensional accuracy.

20 Further, the degree of freedom in setting the time chart for transferring is enhanced, and the two routes of closed loop molding line are installed with respect to a single gob feeding stage. Accordingly, it is possible to further promote the molding function of a glass product
25 wherein glass product having different gob weights can simultaneously be molded at the respective molding lines.





wherein, during the step of transferring one of the female press-molds (M) fed with the gob (GB) to the press-forming stage (S2) in a first one of the closed loop molding lines (L1, L2), the step of press-forming the gob (GB) is performed in a second one of the closed loop molding lines (L1, L2).

2. The method of forming a glass product according to Claim 1, wherein, during the step of returning one of the female press-molds (M) to the gob feeding stage (S1) from the first one of the closed loop molding lines (L1, L2), the step of transferring one of the press-molds (M) from the gob feeding stage (S1) to the press-forming stage (S2) is performed in the second one of the closed loop molding lines (L1, L2).

3. A forming device of a glass product comprising:

a mold transferring system (1) for transferring female press-molds (M) to respective processing stages (S1, S2, S4);

a gob feeding means (2) for successively feeding the female press-molds (M) transferred to a gob feeding stage (S1) with gob (GB) at predetermined intervals;

a press-forming means (3) for press-forming the gob (GB) in the female-press mold (M) at a time point wherein the female press-mold (M) fed with the gob (GB) is transferred to a press-forming stage (S2); and

a glass product removing means (5) for removing a glass product (GS) from the female press-mold (M) at a





mold distributing means (11) whereby at least
transferring of the female press-mold (M) from the press-
forming stage (S2) by one of the mold transferring means
(13, 14) of one of the closed loop molding lines (L1, L2)
5 to which the female press-mold (M) has been distributed
at a preceding step of distributing the female press-
molds is stopped and the press-forming by the press-
forming means is performed.

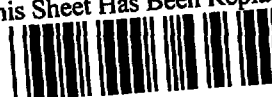
4. The forming device of a glass product according to
10 Claim 3, wherein the female press-mold returning means
(12) is attached to the female press-mold distributing
means (11) such that the female press-mold returning
means (12) moves in a direction different from a moving
direction of the female press-mold distributing means
15 (11) whereby a first one of the female press-molds (M)
returns to the gob feeding stage (S1) from a first one of
the closed loop molding lines (L1, L2) when a second one
of the female press-molds from a second one of the closed
loop molding lines (L1, L2) is being distributed to the
20 press-forming stage (S2).

5. A forming method of a glass product comprising the
steps of:

successively setting female press-molds (M) each
comprising a bottom mold (MB) and a shell mold (MS)
25 engaged with a periphery of the bottom mold (MB) to a gob
feeding stage (S1);

feeding gob (GB) to the female-molds (M) at the gob

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step of engaging the shell molds (MS) to the gob feeding stage (S1) from the respective closed loop molding lines (L1, L2); and

wherein, during the step of transferring one of the female press-molds (M) fed with the gob (GB) in a first one of the closed loop molding lines (L1, L2) to the press-forming stage (S2), the step of press-forming the gob (GB) is performed in a second one of the closed loop molding lines (L1, L2).

6. A forming device of a glass product comprising:

a mold transferring system (1) for transferring step by step female press-molds (M) each comprising a bottom mold (MB) and a shell mold (MS) engaged with a periphery of the bottom mold (MB) or the bottom molds (MB) to respective processing stages (S1 through S5);

a gob feeding means (2) for successively feeding gob (GB) to the female press-molds (M) transferred to a gob feeding stage (S1) at predetermined intervals;

a press-forming means (3) for press-forming the gob (GB) in the female press-mold (M) into a glass product (GS) at a time point wherein the female press-mold (M) fed with the gob (GB) is transferred to a press-forming stage (S2);

a shell mold removing means (4) for removing the shell mold (MS) from the female press-mold (M) at a shell mold removing stage (S3);

a glass product removing means (5) for removing the





distributing means (11);

a first mold transferring means (13) for transferring the female press-molds (M) or the bottom molds (MB) set in the press-forming stage (S2) and at later stages in a first closed loop molding line (L1);

a second mold transferring means (14) for transferring the female press-molds (M) or the bottom molds (MB) set in the press-forming stage (S2) and at later stages in a second closed loop molding line (L2);

and

a mold transfer controlling means (15) for controlling to drive the first and the second mold transferring means (13, 14) cooperating with a step of distributing the female press-molds (M) by the female press-mold distributing means (11) whereby at least transferring of the female press-mold from the press-forming stage (S2) of the first or the second mold transferring means (13, 14) of one of the closed loop molding lines (L1, L2) on a side to which the female press mold (M) has not been distributed in the step of distributing the female press-molds (M) is stopped and the press-forming by the press-forming means is performed.

7. The forming device of a glass product according to Claim 6, wherein the female press-mold distributing means (11) is comprising a swirling transfer member which swirls in an angular range between the gob feeding stage





press-forming the gob into a glass product at the
press-forming stage; and

removing the press-formed glass product at a glass
product removing stage;

5 wherein a pair of the press-forming stages are
provided surrounding the gob feeding stage;

 wherein a pair of closed loop molding lines are
provided each of which independently performs a series of
steps including the steps of press-forming the gob and
10 removing the press-formed glass product;

 wherein a female press-mold returning means is
provided for alternately returning empty female press-
molds finished with the step of removing the press-formed
glass product to the gob feeding stage from the pair of
15 the closed loop molding lines;

 wherein a dummy transferring step is provided between
the step of transferring the female press-mold fed with
the gob to the press-forming stage of a first one of the
closed loop molding lines and the step of transferring
20 the female press-mold fed with the gob to the press-
forming stage of a second one of the closed loop molding
lines; and

 wherein in said dummy transferring step, the female
press-mold transferring means is reciprocated by n (which
25 is an integer not less than 1) times without transferring
the empty female press-molds, the step of press-forming
is performed and the female press-molds whose number is





female press-molds to the press-forming means, are provided; and

wherein a control device for selectively transferring the female press-molds whose number is smaller than a
5 total number of processing stages of the press-forming stage and later stages at least by two or more.

12. A forming method of a glass product comprising the steps of:

successively setting female press-molds (M) to a gob
10 feeding stage (S1);

feeding gob (GB) to the female press-molds (M) at the gob feeding stage (S1) at predetermined intervals;

successively transferring the female press-molds (M) fed with the gob (GB) to a press-forming stage (S2);

15 press-forming the gob (GB) into a glass product (GS) at the press-forming stage;

removing the press-formed glass product (GS) at a product removing stage (S4); and

successively returning the female press-molds (M) to
20 the gob feeding stage (S1);

wherein the above series of steps except the step of feeding gob (GB) to the female press-mold (M), are carried out in each of a plurality of closed loop molding lines (L1, L2);

25 wherein a plurality of the press-forming stages (S2) in the closed loop molding lines (L1, L2) are provided surrounding the gob feeding stage (S1); and





wherein a plurality of the press-forming stages (S2) are provided to surround the gob feeding stage (S1) and which include a plurality of the glass product removing stages (S4) corresponding to the plurality of the press-forming stages (S2);

said mold transferring system (1) comprising:

a female press-mold distributing means (11) for successively distributing the female press-molds (M) fed with the gob (GB) in the gob feeding stage (S1) to the plurality of press-forming stages (S2);

a female press-mold returning means (12) for successively returning the female press-molds (M) to the gob feeding stage (S1) from the plurality of closed loop molding lines (L1, L2) in cooperation with the female press-mold distributing means;

a plurality of mold transferring means (13, 14) for transferring the female press-molds (M) set in the plurality of the press stages (S2) and later stages in the plurality of closed loop molding lines (L1, L2); and

a mold transfer controlling means (15) for controlling to drive the plurality of mold transferring means (13, 14) in cooperation with the step of distributing the female press-molds by the female press-mold distributing means (11) whereby at least transferring of the female press-mold (M) from the press-forming stage (S2) by one of the mold transferring means (13, 14) of one of the closed loop molding lines (L1, L2)





feeding stage (S1) from the respective closed loop molding lines (L1, L2);

wherein a pair of the press-forming stages (S2) are provided interposing the gob feeding stage (S1);

5 wherein a pair of the closed loop molding lines (L1, L2) are provided each of which independently performs the above series of steps except the step of feeding the gob (GB) to the female-molds (M); and

wherein, during the step of transferring one of the
10 female press-molds (M) fed with the gob (GB) in a first one of the closed loop molding lines (L1, L2) to the press-forming stage (S2), the step of press-forming the gob (GB) is performed in a second one of the closed loop molding line (L1, L2).

15 15. A forming device of a glass product comprising:

(1) a gob feeding means (2) for successively feeding gob (GB) to female press-molds (M) transferred to a gob feeding stage (S1) at predetermined intervals; and

(2) a pair of closed loop molding lines (L1, L2)
20 further comprising:

(a) a press-forming means (3) for press-forming the gob (GB) in the female press-mold (M) into a glass product (GS) at a time point wherein the female press-mold (M) fed with the gob (GB) is transferred to a press-
25 forming stage (S2), a pair of said press-forming stages (S2) surrounding the gob feeding stage (S1);

(b) a shell mold removing means (4) for removing





periphery of the bottom mold (MB) at the shell mold
engaging stage (S5) to the gob feeding stage (S1)
alternately from the respective closed loop molding lines
(L1, L2) cooperating with the female press-mold
5 distributing means (11);
a first mold transferring means (13) for transferring
the female press-molds (M) or the bottom molds (MB) set
in the press-forming stage (S2) and at later stages in a
first closed loop molding line (L1);
10 a second mold transferring means (14) for
transferring the female press-molds (M) or the bottom
molds (MB) set in the press-forming stage (S2) and at
later stages in a second closed loop molding line (L2);
and
15 a mold transfer controlling means (15) for
controlling to drive the first and the second mold
transferring means (13, 14) cooperating with a step of
distributing the female press-molds (M) by the female
press-mold distributing means (11) whereby at least
20 transferring of the female press-mold from the press-
forming stage (S2) of the first or the second mold
transferring means (13, 14) of one of the closed loop
molding lines (L1, L2) on a side to which the female
press mold (M) has not been distributed in the step of
25 distributing the female press-molds (M) is stopped and
the press-forming by the press-forming means is
performed.

