

DESCRIPTION

BIAXIAL STRETCH-MOLDING APPARATUS

Technical Field

This invention relates to a biaxial stretch-molding apparatus, and is in particular to a biaxial stretch-molding apparatus that can be constituted small and compact.

Background Art

A molding such as a PET bottle is molded by heating an extrusion-molded preform and then stretching it in biaxial stretch moldings. The biaxial stretch-molding apparatus for this is constituted to carry out molding processes on preforms by respective processing sections arranged along a carrying line as they are successively carried along the carrying line at a constant feed pitch. A biaxial stretch-molding apparatus of this type is disclosed, for example, in JP-B 1-17855.

The biaxial stretch-molding apparatus taught by this publication has a preform carrying line of rectangular loop, and block-shaped carrying units (preform carrier pallets) disposed on this line are successively fed at a constant feed pitch. The carrying units are equipped with insertion cores insertable into the openings of the preforms, and the preforms are carried by the carrying units with the insertions cores inserted into the opening thereof. Each carrying unit is driven to carry out a sequential operation such that it receives a preform, passes through a heating section and a stretch-molding section, delivers the molding to a recovery section, and then returns to the preform supplying section empty.

In the case of this type of biaxial stretch-molding apparatus which performs biaxial-stretching operation on preforms by transferring the preform carrier pallets carrying the preforms along the above-mentioned closed-type carrying line, there are problems to be solved as follows.

First, the preform carrier pallets are returned to a preform supplying section after passing through the heating section and stretch-molding section and then delivering the molding to the recovery section. Since the stretch-molding section is equipped with moldings that are separated and closed in the direction normal to the carrying line, it is required to secure a space for a stroke of the moldings, which makes the stretch-molding section to have the largest width among respective sections of the biaxial stretch-molding apparatus. Conventionally, the carrying

line is arranged on the same height and is a two-dimensional one, and therefore a part of the carrying line extending from the stretch-molding section to the preform supplying section bypasses the wide stretch-molding section along the laterally-outside thereof. This causes a defect in that the biaxial stretch-molding apparatus is large in size. In addition, the whole length of the carrying line also increases and, by that amount, it would take more time for circulating the preform carrier pallets along the carrying line and process speed of the apparatus would be decreased.

Second, each preform is loaded on the preform carrier pallet that are carried along the preform supplying section in a manner that the opening of the preform is loaded from the above to receive therein the insertion core of the preform carrier pallet. If the opening of the preform does not fully receive the insertion core, there is a possibility that rear-stage processes can not be carried out properly on the preform. There are two causes by which the preforms are not properly inserted. One is just an insufficient insertion of the preform, and the other is deformation of the opening of the preform preventing proper insertion of the preform. However, no mechanism for distinguishing these causes has been proposed.

Third, in the stretch-molding section, a blow-air blowing nozzle core and a stretching rod are inserted into the preform carried on the preform carrier pallet to perform biaxial stretch molding of the preform. If the movements of the core and rod can be carried out effectively, then performance of the apparatus can be improved and is preferable.

Disclosure of Invention

An object of this invention is to realize a biaxial stretch-molding apparatus which is constituted small and compact by making a carrying line thereof as short as possible.

The other object of this invention is to realize a biaxial stretch-molding apparatus which has a mechanism for distinguishing deformation of preforms loaded on preform carrier pallets from insertion insufficiency thereof.

Another object of this invention is to realize a biaxial stretch-molding apparatus which has a mechanism for carrying out the movements of blow-air blowing nozzle core and stretching rod of a stretch-molding section in an effective manner.

In order to achieve the above objects, in a biaxial stretch-molding apparatus which has a preform supplying section, a preform heating section, a

recovery section for recovering a molding, a closed-loop carrying line passing through these sections successively, and preform carrier pallets carried along the carrying line; the carrying line for the preform carrier pallets is made to be a three-dimensional structure to minimize the length of the carrying line, whereby realizing smallness and compactness of the apparatus as well as improvement of performance thereof.

More specifically, as the carrying line in this invention, one is adopted that comprises a first carrying-line passage for carrying the preform carrier pallet on which a preform is loaded via the preform heating section and the biaxial stretch-molding section, and a second carrying-line passage for carrying the preform carrier pallet after a molding is unloaded toward the preform supplying section by bypassing an upper or lower side of the biaxial stretch-molding section. Thus, a part of the carrying line is arranged at the lower or upper side of the biaxial stretch-molding section, so that the whole length of the carrying line can be decreased compared with that of the conventional two-dimensional carrying line.

When the carrying line is arranged so as to include a carrying-line passage passing through the lower side of the biaxial stretch-molding section, it is possible to provide a molding removing means which removes a molding from the preform carrier pallet whose insertion core is inserted into an opening of the molding by making use of lowering operation of the preform carrier pallet from the recovery section toward the carrying-line passage. This type of molding removing means may be a simple mechanism for grasping only the opening of a molding. Namely, the molding removing means grasps the opening portion of a molding from both sides thereof so that the molding is automatically removed from the preform carrier pallet because only the preform carrier pallet itself is lowered.

While, in the biaxial stretch-molding apparatus, on a portion of the first carrying-line passage passing through the heating section, the preform carrier pallets are carried in a manner that they are arranged in a row along the carrying direction, and each preform carrier pallet is carried through the heating section at a feed pitch equal to the length of the preform carrier pallet in the carrying direction. In this case, it is preferable to provide a feed means for enlarging a feed pitch of each preform carrier pallet when delivered to the biaxial stretch-molding section from the heating section compared with a feed pitch thereof along the heating section. With this configuration, since a feed pitch of each preform carrier pallet is enlarged in the biaxial stretch-molding section, large diameter moldings can be formed in the biaxial stretch-molding section. While, the preforms are carried in

the heating section at a narrow feed pitch, so that the number of the preforms in the heating section is increased, whereby heating efficiency can be improved and the required length of the carrying line in the heating section can be decreased. Hence, the apparatus can be made small and compact.

On the other hand, the biaxial stretch-molding section of the biaxial stretch-molding apparatus of this invention is constituted to have a drive means which conducts insertion of the blow-air blowing nozzle core into the opening of the preform independent from insertion of the stretching rod thereinto. With this configuration, the stroke of the blow-air blowing nozzle core (generally along the vertical direction) can be greatly reduced, by which a required time for travelling the blow-air blowing nozzle core is reduced and process efficiency is improved.

Further, the biaxial stretch-molding apparatus of this invention is provided with a press means located between the preform supplying section and the heating section for pressing the preform against the insertion core. By the press means, it is able to load the preform on the preform carrier pallet properly.

As the press means, one is preferable to have a position sensor for detecting the height of the preform after pressing. Since such preforms as having a deformed opening cannot be pressed in the insertion core, these defective preforms that are deformed can be distinguished by detecting the height of each preform after pressing.

Brief Description of Drawings

Figure 1 is schematic diagram showing the overall structure of a biaxial stretch-molding apparatus of this invention.

Figure 2 is a schematic side view of the biaxial stretch-molding apparatus of this invention.

Figure 3 is a schematic plan view of the biaxial stretch-molding apparatus of Figure 2.

Figure 4 is schematic sectional view of the biaxial stretch-molding apparatus of Figure 2.

Figure 5 is a perspective view of a preform carrier pallet in the biaxial stretch-molding apparatus of Figure 2.

Figure 6 is an explanatory view showing a feed mechanism for feeding a heated preform into a biaxial stretch-molding section in the biaxial stretch-molding apparatus of Figure 2.

Best Mode for Carrying Out the Invention

With reference to the drawings, a biaxial stretch-molding apparatus of this invention will now be explained.

Figure 1 is a schematic diagram showing an overall structure of a biaxial stretch-molding apparatus of this example, while Figures 2 to 4 are a schematic side view, a schematic plan view, and a schematic sectional view thereof, respectively. Further, Figure 5 is a perspective view of a preform carrier pallet used in the biaxial stretch-molding apparatus, and Figure 6 is an explanatory view showing a feed mechanism for feeding a heated preform into a biaxial stretch-molding section.

Referring now to Figures 1 to 4, the biaxial stretch-molding apparatus 1 of this example comprises a preform supplying section 2 for supplying preforms, a preform heating section 3, a biaxial stretch-molding section 4 for biaxial stretch-molding of a heated preform P1, a recovery section 5 for recovering a molding P2, a closed-shaped carrying line 6 passing through the respective sections successively, and a plurality of preform carrier pallets 7 which are carried along the carrying line 6.

The carrying line 6 is a rectangular closed loop as shown by a thick line in Figure 3 wherein the carrying direction of the preform carrier pallets 7 are denoted by an arrow. In this example, the carrying line 6 includes a first carrying-line passage 62 along which the preform carrier pallet 7 carrying the preform P is carried passing through the preform heating section 3 and the biaxial stretch-molding section 4 (this rout being from point A to point B in Figure 8), and a second carrying-line passage 64 along which the preform carrier pallets 7 after a molding P is removed are carried via the lower side of the biaxial stretch-molding section 4 toward the preform supplying section 2 (this rout being from point C to point D in Figures 1 and 3). As can be seen from Figures 1 and 4, the second carrying-line passage 64 is arranged to pass the lower side of a blow-mold closing mechanism 41 of the biaxial stretch-molding section 4.

The carrying-line passages 62 and 64 are ones extending horizontally, and there is provided an ascending carrying-line passage 61 extending from the lower side of the second carrying-line passage 64 to the upper side of the first carrying-line passage 62 at the preform supplying side of these passages (this route being from point D to point A in Figures 1 and 3). While, a descending carrying-line passage 63 is formed at the molding recovering side of these passages 62, 64, which extends from the upper side of the first carrying-line passage 62 to the lower side of the second carrying-line passage 64 (this route being from point B to point C in

Figures 1 and 3).

As described above, the preform carrying line 6 of the biaxial stretch-molding apparatus 1 of this example is constituted three-dimensionally not two-dimensionally. Thus, compared with the conventional case where the preform carrying line is arranged in the two-dimensional manner bypassing the blow-mold closing mechanism 41 of the biaxial stretch-molding section 4, the size of the apparatus, especially its lateral size, can be greatly reduced. Thus, it is possible to constitute the biaxial stretch-molding apparatus small and compact. Also, since the whole length of the preform carrying line can be greatly reduced, the cycle time for circulating the preform carrier pallets 7 along the carrying line 6 can also be greatly reduced, thereby improving process efficiency of the apparatus.

On the other hand, as shown in Figure 5, the preform carrier pallet 7 comprises rectangular body 71, a rotational shaft 72 rotatably penetrating through the body 71 in the vertical direction, a preform insertion core 73 formed coaxially on the upper end of the rotational shaft 72, and an external gear 74 formed on the projected lower-end side portion of the rotational shaft 72. A through hole 75 is formed at the center of the rotational shaft 72 and the insertion core 73. The lower side of the through hole 75 is designed to receive therein a blow-air blowing nozzle core, and a stretching rod can be inserted into a preform P1 loaded on the preform carrier pallet 7 via the through hole 75 as mentioned below.

The preform carrier pallet 7 is supplied with the preform P from the side of the preform supplying section 2 when it reaches point D. More specifically, the preform P on standby in a condition that its opening faces upward is grasped of its opening portion by a turning gripper 22 which is able to turn around an axial line 21. Then, turning of the gripper 21 around the axial line 22 by 180 degrees makes the opening of the grasped preform P face downward and load on the preform carrier pallet 7 waiting at point D in a manner that the insertion core 73 of the preform carrier pallet 7 is inserted into the opening of the preform P.

The preform carrier pallet 7 with the preform P thus loaded is moved in Y-coordinate direction and at the same time elevated in Z-coordinate direction by a two-dimensional carrying mechanism 61A, to thereby reach point A. The preform carrier pallet 7 after reaching point A is pushed horizontally in the direction of X coordinate by a pushing rod 61B and is delivered to the first carrying-line passage 62 from the two-dimensional carrying mechanism 61A.

The first carrying-line passage 62 has a pair of rails 62a and 62b, on which the rectangular body 71 of the preform carrier pallet 7 slides. The preform carrier

pallet 7 after riding on the rails is intermittently moved along the carrying-line passage at each time when the pallets 7 are pushed one by one by means of the above-mentioned pushing rod 61B. In other words, a feed pitch of the pallets 7 along this carrying-line passage 62 is defined by the length of the pallets measured along the carrying direction, and the pallets 7 arranged in a row are intermittently carried as a whole at this feed pitch.

A press mechanism 8 is provided at a position adjacent to point D of the first carrying-line passage 62, which presses the preform P downward. The press mechanism 8 presses the preform P against the insertion core 73 of the pallet 7 for the second time. The press mechanism 8 has a position sensor 8a for detecting the height of the preform 7 after pressing. The preform P is properly inserted into the pallet 7 by the press mechanism 8 and is carried toward the heating section 3 of next stage. In case where the preform P is not properly inserted into the pallet 7 even by the press mechanism 8, the preform P remains high above the normal state, which is detected by the position sensor 8a. In this case, the preform P is judged to be a defective one having a deformed opening or the like, which is displayed or informed. Accordingly, insufficient insertion of the preforms can be avoided, and at the same time defective preforms can also be detected.

Next, the heating section 3 is equipped with a heater located along on one side of the first carrying-line passage 62 for heating preforms. The preform P is carried through the heating section 3 while being rotated by a rotating mechanism 62A which has a drive pulley, a driven pulley and a timing belt arranged between these pulleys. The gear 74 of the pallet 7 is engaged with the timing belt and driven to rotate thereby, so that the pallet rotational shaft 72 connected integrally with the gear 74 is rotated and the preform 7 loaded on the insertion core 73 on the upper end of the shaft is also rotated.

The preform P1 after heated and passed through the heating section 3 while being rotated is cooled for a prescribed period of time to become a temperature suitable for molding. Then, it is transferred into the biaxial stretch-molding section 4. In this example, there is provided a feed mechanism 9 which feeds the pallets 7 carrying heated preforms P1 one by one into the biaxial stretch-molding section 4. The feed mechanism 9 is one that feeds the pallets 7 into the biaxial stretch-molding section 4 one by one at a feed pitch wider than a feed pitch in the heating section 3.

As shown in Figure 6, the feed mechanism 9 has a pair of grippers 91, 92 arranged along the carrying direction at a distance equal to a feed pitch L2. These

grippers are constituted to travel reciprocally along the carrying direction at a feed pitch L2 together with each other. The pallet 7 is carried at a feed pitch L1 passing through the heating section 3 to reach point A1, where it is grasped by the gripper 92. In this condition, the downstream-side gripper 91 is located at a molding point A2 in the biaxial stretch-molding section 4.

After biaxial stretch molding of the preform, the grippers 91, 92 travels forward in the carrying direction at a feed pitch L2. As a result, the pallet 7 grasped by the upstream-side gripper 92 reaches point A2 for biaxial stretch-molding, while the pallet 7 loaded with a molding and grasped by the downstream-side gripper 91 reaches point B as shown by a solid line in Figure 6. The feed mechanism 9 repeats such reciprocal movement to deliver the pallet 7 which is fed so far at a feed pitch L1 into the biaxial stretch-molding section 4 at a wider feed pitch L2.

Since the feed pitch in the biaxial stretch-molding section 4 is wide as mentioned above, such containers as having a large diameter of barrel portion can also be molded irrespective of a feed pitch in the heating section 3. While, since the feed pitch in the heating section 3 is narrow, the length of the heating section 3 along the carrying direction can be decreased and the number of preforms within the heating section can be increased, whereby heating efficiency of the heating section can be improved. Accordingly, the heating section can be shortened in size along the carrying direction, so that the biaxial stretch-molding apparatus can be made small in size by that amount.

The biaxial stretch-molding section 4 of this example has a set of molds 42, a blow-mold closing mechanism 41 of these molds, a blow-air blowing nozzle core 43 insertable into an opening of the preform, a stretching rod 44 insertable into the opening of the preform, and a drive mechanism 45 for carrying out insertion operations of the blow-air blowing nozzle core 43 and stretching rod 44.

In molding operation, the heated preform P1 is moved to point A2 and a pair of molds 42 are closed by means of the blow-mold closing mechanism 41. Thereafter, the blow-air blowing nozzle core 43 is moved upward and is connected to the through hole 75 of the pallet 7, and then air blowing operation into the preform P1 is started. At the same time, the stretching rod 44 is also moved upward and inserted into the preform passing through the pallet through hole 75. Biaxial stretch molding is carried out by means of air blowing and insertion of the stretching rod 44. In this example, since the blow-air blowing nozzle core 43 having a short stroke in the vertical direction is driven separately from driving of

the stretching rod 44 having a long stroke in the vertical direction, the time period that is required for moving the blow-air blowing nozzle core 43 vertically can be largely reduced compared with the conventional case wherein the blow-air blowing nozzle core is moved vertically at a long stroke together with the stretching rod, whereby process efficiency can be improved.

The molding P2 that is obtained by biaxial stretch-molding as mentioned above is moved to point B by the above-mentioned feed mechanism 9, where the pallet 7 is delivered to a two-dimensional carrying mechanism 63A.

After the pallet 7 is delivered to the two-dimensional carrying mechanism 63A, a turning gripper 5A of the molding recovery section 5 grasps the neck portion of the molding P2 loaded on the pallet 7. Then, the two-dimensional carrying mechanism 63A moves the pallet 7 downward (in Z-coordinate direction), by which the insertion core 73 of the pallet 7 is pulled out from the opening of the molding P2. Thereafter, the turning gripper 5A turns and the molding P2 is recovered. As described above, according to this example, an removing mechanism for removing the molding P2 from the pallet 7 is realized by making use of descending operation of the two-dimensional carrying mechanism 63A. Hence, the molding P2 can be recovered by a simple mechanism.

The two-dimensional carrying mechanism 63A carries the empty pallet 7 after moved downward to a starting point C of the second carrying-line passage 64. (Namely, it carries the pallet in Y-coordinate direction.) After reaching point C, the pallet 7 is pushed in X-coordinate direction from the two-dimensional carrying mechanism 63A by means of a push rod 63B, which, in turn, rides on a pair of carrying belts 64a and 64b defining the second carrying-line passage 64. With the carrying belts, the pallet 7 is carried toward the preform supplying section 2 through the lower side of the mold closing mechanism 41 of the biaxial stretch-molding section 4.

Thereafter, each pallet 7 is moved along the carrying line 6 repeatedly as mentioned above to conduct biaxial stretch molding of preforms loaded thereon.

(Other embodiments)

In the above example, the biaxial stretch-molding section 4 has a set of molds which is, so called, a one-cavity mold type. Instead, the section 4 may have molds, for example, of two-cavity mold type. In this case, as the feed mechanism 9, one can be adopted to feed two pallets 7 at each time, wherein there is provided a mechanism for widening the distance between the two pallets in responsive of feed

operation of the pallets.

Industrial Applicability

As explained in the foregoing, in the biaxial stretch-molding apparatus according to this invention, the carrying line for the preform carrier pallets is arranged three-dimensionally, so that the apparatus as a whole can be made small and compact.

Moreover, according to this invention, making use of the lowering operation of the preform carrier pallets along the three-dimensionally arranged carrying line, a molding is removed from the preform carrier pallet, and therefore the preform removing mechanism can be made simply in structure.

Further, since the preforms are delivered to the biaxial stretch-molding section from the heating section at a feed pitch that is wider than a feed pitch at which the preforms are carried through the heating section, it is possible to form moldings of large diameter, and at the same time to increase the number of the preforms within the heating section, whereby heating efficiency can be improved.

Furthermore, in the biaxial stretch-molding section, the blow-air blowing nozzle core is driven to move separately from the driving of the stretching rod, so that the driving operation of the blow-air blowing nozzle core can be carried out more efficiently than in the case where the blow-air blowing nozzle core is driven together with the stretching rod.

In addition, according to this invention, there is provided a press mechanism for loading the preforms on the preform carrier pallets securely, and the position sensor is provided with this mechanism. With this configuration, it is possible to distinguish defective preforms having a deformed opening accurately.



CLAIMS

1. A biaxial stretch-molding apparatus comprising a preform supplying section, preform heating section, a biaxial stretch-molding section for biaxial stretch molding of heated preforms, a recovery section for recovering moldings, a closed-loop type carrying line passing through the above sections successively, and preform carrier pallets which are carried along the carrying line, characterized in that
the carrying line includes a first carrying-line passage for carrying the preform carrier pallet loaded with the preform via the preform heating section and the biaxial stretch-molding section, and a second carrying-line passage for carrying the preform carrier pallet after a molding is removed therefrom to the preform supplying section in a manner bypassing an upper or lower side of the biaxial stretch-molding section.
2. A biaxial stretch-molding apparatus according to claim 1, wherein the second carrying-line passage is arranged at a position lower than that of the first carrying-line passage and passes through a lower side of a blow-mold closing mechanism of the biaxial stretch-molding section.
3. A biaxial stretch-molding apparatus according to claim 2, wherein the carrying line further includes a third carrying-line passage for receiving the preform carrier pallet from the first carrying-line passage at a side of the recovery section, moving it downward and delivering it to the second carrying-line passage,
further comprising a molding removing means for removing a molding from the preform carrier pallet by making use of lowering operation of the preform carrier pallet at the third carrying-line passage.
4. A biaxial stretch-molding apparatus according to any one of claims 1 to 3, wherein the preform carrier pallets are carried along a portion of the first carrying-line passage passing through the heating section in a manner arranged in a row in a carrying direction and at a feed pitch that is defined by a length of the preform carrier pallet in the carrying direction.
5. A biaxial stretch-molding apparatus according to claim 4, further comprising a feed means for widening a feed pitch at which the preform carrier pallets are delivered to the biaxial stretch-molding section from the heating section,





compared with a feed pitch at which the preform carrier pallets are carried along the heating section.

6. A biaxial stretch-molding apparatus according to any one of claims 1 to 5, wherein the biaxial stretch-molding section has a blow-air blowing nozzle core which is inserted into the preform through an opening thereof, a stretching rod which is inserted into the preform through the opening thereof, and a drive means for carrying out insertion operations of the blow-air blowing nozzle core and the stretching rod independently from each other.

7. A biaxial stretch-molding apparatus according to any one of claims 1 to 6, wherein a press means is provided between the preform supplying section and the heating section for pressing the preform against the preform carrier pallet.

8. A biaxial stretch-molding apparatus according to claim 7, wherein the press means has a position sensor for detecting a height of the preform after being pressed, whereby a defective preform is distinguished on the basis of a detected height.

