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(54) Title: BOTTLE FORMING UNIT AND TRANSPORTABLE BOTTLING PLANT

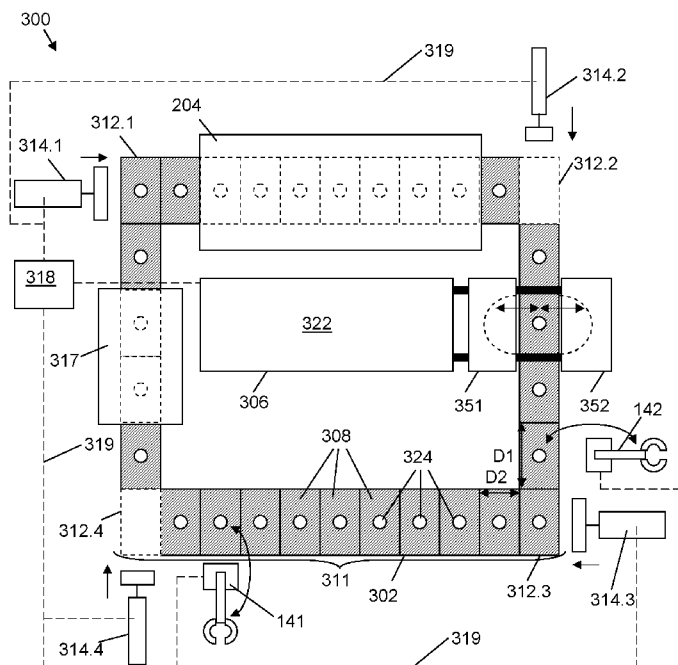


FIG. 7

(57) Abstract: Bottle forming unit (300) comprising a furnace (204) for heating preforms, a moulder (306) for moulding the heated preforms into bottles, and a transporter (302) for moving the bottles and/or the preforms. The transporter (302) comprises a plurality of movable preform/bottle carriers (308) in a loop. The loop has at least four corners. The transporter (302) comprises at least four advancers (314), arranged for moving a carrier (308) positioned at a corner away from that corner. At least two carrier positions at diagonally opposed corners of the loop are vacant and a controller (318) controls the advancers for simultaneously moving carriers (308) positioned at the diagonally opposed corners of the loop.



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BOTTLE FORMING UNIT AND TRANSPORTABLE BOTTLING PLANT

FIELD OF THE INVENTION

The invention relates to a bottle forming unit for forming bottles from bottle preforms. The invention also relates to a transportable bottling plant. The invention further relates to a method of forming bottles from bottle preforms.

BACKGROUND OF THE INVENTION

Bottling plants, in particular transportable bottling plants adapted for producing drinkwater bottles, are known from WO 2011/095464 A1 and US 2011/0302881.

The bottle blowing unit described in US 2011/0302881 comprises a transporter arranged for moving carriers for carrying bottles or preforms along a semi-circular loop that has two corners. The semi-circular loop described in US 2011/0302881 is useful. However, the semicircular loop may be improved in view of an aim for efficient usage of space when a bottle forming unit is placed in a container.

WO 2011/095464 discloses a transporter of a bottle forming unit arranged for consecutively moving carriers from carrier positions at corners of a rectangular loop, with time intervals between such consecutive movements.

DEFINITIONS

As used herein, with a "standard 20-foot freight container" is meant a container compliant with the dimensional requirements

for an ISO 668 standard 20-foot freight container. The height of such a freight container is typically 8 or 8.6 feet.

As used herein, with "drinking water or potable water" is meant water that is pure enough to be consumed or used with low risk of immediate or long term harm.

As used herein, with "freshwater" is meant naturally occurring water on the Earth's surface in ice sheets, ice caps, glaciers, bogs, ponds, lakes, rivers and streams, and underground as groundwater in aquifers and underground streams. Fresh water is generally characterized by having low concentrations of dissolved salts and other total dissolved solids.

As used herein, with "bottle" is meant to include all kinds of hollow article suitable for use as a recipient, irrespective of its size and dimensions, in particular the relative proportions of a body part, provided for receiving a content, which may be any liquid or fluent product, and a neck part, delimiting an access opening for the filling, i.e. the placing of the content inside the body part, and typically also for the emptying, i.e. for extracting the content from the body part. The term "bottle" in a more narrow meaning is meant to include the recipients more commonly addressed as bottles, i.e. whereby the neck part is distinctly narrower than the body part, but also pots of which the neck part is hardly narrower than the body part.

As used herein, with "bottling plant" is meant to include any plant in which a bottle (as defined above) is produced from a preform and subsequently filled with a liquid or fluent product, including but not limited to water, sodas, wine, vegetable oils such as cooking oil, mineral oils such as motor oil, detergents, cleaning products, soft drinks, foods such as sauces, powders, such as milk powder, coffee powder, herbs or spices, chemical and pharmaceutical products, etc.

SUMMARY OF THE INVENTION

It is an aim of the invention to provide an improved bottle forming unit which may enable a higher bottle production rate.

This aim is achieved with the bottle forming unit of the first claim.

According to an aspect, there is provided a bottle forming unit for forming bottles from bottle preforms, the bottle forming unit comprising a furnace for heating the bottle preforms and a moulder for moulding the heated preforms into bottles, the bottle forming unit further comprising a transporter for moving the bottles and/or the preforms, wherein the transporter comprises a plurality of movable carriers arranged for carrying the preforms and/or bottles, and comprises guiding elements for guiding the movable carriers, the guiding elements defining a loop of carrier positions where a carrier can be positioned, along which loop the carriers can be transported, the loop being provided for moving the carriers through the furnace and for moving the carriers from the furnace into the moulder, said loop having at least four corners, preferably at most four corners, at which a carrier position is provided, wherein the transporter comprises at least four advancers, an advancer being arranged for moving a carrier positioned at a corner away from that corner, wherein an amount of carriers and an amount of carrier positions are adjusted so that at least two, and preferably at most two, carrier positions along the loop are free of a carrier, said at least two carrier positions in use being positioned at diagonally opposed corners of the loop. The transporter may be provided with a controller for controlling the advancers. The controller may be arranged for simultaneously moving, by means of the advancers, carriers positioned at at least two diagonally opposed corners of the loop from those corners. Thus, the controller may be arranged for moving a carrier away from one of the corners by means of an advancer simultaneously with moving another carrier away from another one of the corners by means of an advancer, said another one of the corners being arranged in the loop diagonally opposed to said one of the corners.

As the loop has at least four corners, a freedom for choosing a shape of the loop may be improved compared to a known semicircular loop. Thus, the loop may be arranged in a freight container more efficiently than the known semicircular loop. By moving, by means of the

advancers, simultaneously carriers positioned at at least two diagonally opposed corners of the loop from those corners, a speed of moving carriers along the loop may be increased, compared to subsequent advancement of carriers.

5 The term “simultaneously moving” may be interpreted broadly. Hence, optionally, simultaneously moving a first carrier and a second carrier may mean that at least part of the movement of the first carrier takes place at the same time as at least part of the movement of the second carrier, i.e. the movements at least partly overlap each other.
10 However, optionally, the term “simultaneously moving” may be interpreted more strictly. Then, at least 50%, preferably at least 80%, of a movement time of the first carrier takes place at the same time as movement of the second carrier.

 For a loop having at least four corners, the
15 inventors realised that a production rate of bottles can be increased by using two or more empty positions in the carrier system instead of one empty carrier position. This makes it possible to advance, e.g. push, two rows of carriers simultaneously instead of advancing, e.g. pushing, one row of carriers consecutively. Thus, the controller may be arranged for making two or more
20 simultaneous translational movements of a row of carriers, instead of sequential translational movements of one single row of carriers after movement of another single row of carriers. Thus, time needed for activating an advancer may be saved and an increased production rate may be achieved.

25 Thus, the controller may be arranged to operate the advancers so that two advancers located at diagonally opposed corner positions of the loop operate substantially simultaneously. By such operating, the two advancers by their operation may vacate carrier positions at at least two diagonally opposed corners.

30 In an embodiment, the loop has the form of a rectangle. The semi-circular loop of US 2011/0302881 implies that the carriers may have to turn somewhat with every step in every pass along the curved

part of the semi-circular loop. This may impose a limitation on a speed which the carriers may be given relative to their guiding elements, as well as on a minimum radius of the curved part of the semi-circular loop. This may represents a production rate limitation. Such limitation may become in particular relevant for relatively large bottles. Hence, the limitation may be more important for relatively large bottles having a volume of e.g. 5 liter, as compared to smaller bottles having a volume of e.g. 1, 1,5 or 2 liter, as a carrier need to be larger for a larger bottle.

In an embodiment, at least one part of the loop, preferably each part of the loop, is substantially parallel to another part of the loop. Such may e.g. be achieved in a loop that has the form of a rectangle. Preferably, the loop is closed in itself. Preferably, the loop is substantially horizontal. Preferably, the carriers are similarly shaped. Preferably, for all carriers, one and the same side of the carriers is movably connected to guiding elements.

Preferably, the transporter comprises an advancer at each of the at least four corners of the loop. Preferably, each advancer is provided for advancing the carrier positioned at the corner over at least a single carrier position, e.g. a single carrier position or two carrier positions. Preferably, at each corner an advancer is provided for moving a carrier positioned at said corner away from that corner.

In an embodiment, the amount of carriers and the amount of carrier positions are adjusted so that, in use, by advancing the carrier positioned at a corner away from that corner, a file of carriers abutting the carrier positioned at said corner is moved away from that corner and towards a next corner. Preferably, the amount of carriers and the amount of carrier positions are adjusted so that, in use, by advancing the carrier positioned at a corner of the at least four corners away from that corner, a file of carriers substantially abutting the carrier positioned at said corner is moved away from said corner towards a next corner located downstream of said corner. As a result of the advancing, a leading carrier of said file of carriers may optionally be positioned at said next corner. Preferably, the controller is

arranged to advance the carrier positioned at the next corner after advancing the carrier positioned at the corner located upstream of said next corner.

5 In an embodiment, the controller is arranged to operate the advancers so that the two advancers of each set of advancers positioned at diagonally opposed corner positions of the loop are operated substantially simultaneously. As a result, a production rate of bottles may e.g. be further increased. Preferably, the two advancers of each set by their operation vacate carrier positions at at least two diagonally opposed corners, e.g. corners where the two advancers are positioned.

10 In an embodiment, the carriers, and preferably the carrier positions, have a first dimension and further have, measured in a direction transverse to the first dimension, a second dimension that is smaller than the first dimension. The transporter is preferably arranged for transporting the carriers in a transportation direction through the furnace with the second dimension aligned with the transportation direction through the furnace. The transporter is preferably arranged for transporting the carriers in a transportation direction through the moulder with the first dimension aligned with the transportation direction through the moulder. As a result, an amount of carriers in the furnace per unit of length along the loop in the furnace may be larger than an amount of carriers in the moulder per unit of length along the loop on the side of the moulder. Hence, optionally, an amount of preforms positioned in the furnace may be increased. Hence, optionally, a more gradual heating of preforms in the furnace may be achieved. Alternatively, the carriers may have similar dimension in a transportation directions of the carrier and transverse to a transportation direction of the carrier.

25 Preferably, only one of the corners is provided along a part of the loop in between the furnace and the moulder. As a result, heated preforms may enter the moulder relatively quickly after leaving the oven. Hence, optionally, cooling of the heated preforms may be reduced.

30 Preferably, the moulder is a blow-moulder, more preferably a blow-stretch moulder. A blow-stretch moulder may combine well with a bottle forming unit. The stretching may diminish a size and/or weight of

a driving unit needed for the blowing. A reduced weight and/or size of the transportable bottle blowing unit may be appreciated when transporting the transportable bottle blowing unit.

5 In an embodiment, the moulder comprises a driving unit for driving the moulder, wherein the driving unit is positioned inside the loop. Such positioning may yield a rather economical use of space, in particular when the bottle forming unit is placed in the container. Preferably, the mould is provided with a plurality of mould parts. Preferably, the driving unit is arranged for opening and closing the mould by moving the mould parts
10 with respect to each other.

In an embodiment, the furnace may comprise a hot air exhaust conduit leading from the furnace towards the outside of the bottling room and provided with an induced draft fan for withdrawing hot air from a heating compartment of the furnace in which the preforms are heated.

15 In an embodiment, the bottle forming unit may comprise a bottle marking device located adjacent to the transporter at a carrier position downstream of the moulder. Such an arrangement has the advantage that the bottles can be marked while still on the transporter of the bottle forming unit, which is convenient since a stable position of the bottles is
20 desired for the marking step. As will be explained herein, the marking step can be added into the bottle forming unit without increasing the size of this unit, so space can be saved.

An additional exhaust conduit may be provided leading from the carrier position at the bottle marking device, i.e. where the
25 marking step occurs, to the hot air exhaust conduit, the additional exhaust conduit being provided for withdrawing fumes created upon marking the bottles by means of the bottle marking device, which may for example be a laser device. Such an arrangement has the advantage that the fumes created upon marking the bottles can be withdrawn from the bottle forming unit via the
30 hot air exhaust conduit which has the induced draft fan, i.e. without additional effort.

In an embodiment, the bottle forming unit is transportable and is positioned inside a freight container. Properties of the container may comply with properties of standardised shipping containers or, in other words, standardised freight containers. For example, a size and/or strength of the container may be similar to a size and/or strength of standardised shipping container. E.g., a height of the container may be typically approximately 8 feet or approximately 8.6 feet.

According to an aspect of the invention, there is provided a transportable bottling plant comprising a bottle forming unit.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be further elucidated by means of the following description and the appended drawings.

Figure 1 shows a perspective view of a bottling plant according to a preferred embodiment of the invention, integrated into a 20-foot freight container, with the container doors at the back side taken away.

Figure 2 shows a view onto the back side of the bottling plant of figure 1.

Figure 3 shows another perspective view of the bottling plant of figure 1, with the container doors at the front side taken away.

Figure 4 shows a schematic view of a preferred floor plan for a bottling plant according to the invention.

Figure 5 shows a schematic view of another preferred floor plan for a bottling plant according to the invention.

Figure 6 shows a schematic view of a preferred air supply and discharge system for a bottling plant according to the invention.

Figure 7 shows a schematic view of a preferred embodiment of a bottle forming unit, for use in a bottling plant according to the invention.

Figure 8 schematically explains operation of a transporter of the bottle forming unit of figure 7.

Figure 9 shows a schematic view of a preferred system, for use in a bottling plant according to the invention, for drying a wet circuit of the bottling plant.

5 Figure 10 shows a schematic view of another preferred embodiment of a bottle forming unit, for use in a bottling plant according to the invention.

DETAILED DESCRIPTION

10 The present invention will be described in the following with respect to particular embodiments and with reference to certain drawings but the invention is not limited thereto but only by the claims. The drawings described are only schematic and are non-limiting. In the drawings, the size of some of the elements may be exaggerated and not drawn on scale for illustrative purposes. The dimensions and the relative dimensions do not
15 necessarily correspond to actual reductions to practice of the invention.

Furthermore, the terms first, second, third and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. The terms are interchangeable under appropriate
20 circumstances and the embodiments of the invention can operate in other sequences than described or illustrated herein.

Moreover, the terms top, bottom, over, under and the like in the description and the claims are used for descriptive purposes and not necessarily for describing relative positions. The terms so used are
25 interchangeable under appropriate circumstances and the embodiments of the invention described herein can operate in other orientations than described or illustrated herein.

The term “comprising”, used in the claims, should not be interpreted as being restricted to the means listed thereafter; it does
30 not exclude other elements or steps. It needs to be interpreted as specifying the presence of the stated features, integers, steps or components as referred to, but does not preclude the presence or addition of one or more

other features, integers, steps or components, or groups thereof. Thus, the scope of the expression "a device comprising means A and B" should not be limited to devices consisting only of components A and B. It means that with respect to the present invention, the only relevant components of the device are A and B.

In what follows, preferred embodiments of bottling plants according to the invention are described which may be tailored for supplying bottles filled with drinking water. However, with minor modifications, the bottling plants may be used for filling bottles with other liquid or fluent products, including but not limited to water, sodas, wine, vegetable oils such as cooking oil, mineral oils such as motor oil, detergents, cleaning products, soft drinks, foods such as sauces, powders, such as milk powder, coffee powder, herbs or spices, chemical and pharmaceutical products, etc. The principles described below are also applicable to such bottling plants.

The preferred embodiments are mainly described in the context of a standard 20-foot freight container. However, it is remarked that the principles described below are also applicable to transportable bottling plants in general, e.g. integrated into a 30-foot, 40-foot or other freight container, and many principles such as for example the furnace air supply, the bottle forming unit and the system for drying the wet circuit are even applicable to non-transportable bottling plants.

Firstly, a preferred lay-out or floor plan of a transportable bottling plant will be described with reference to figures 1-5.

According to the invention, a preferred embodiment of which is shown in figures 1-4, a transportable bottling plant is provided which is incorporated into a 20-foot freight container 100, which is preferably a standard 20-foot freight container. The internal volume of the container 100 is divided into separate rooms, one of which being a bottling room 107. A preform feeder 118, a bottle forming unit 300 and a bottle filling and closing unit 119 are mounted in the bottling room 107. The preform feeder 118 is provided for feeding preforms to the bottle forming unit 300. The

bottle forming unit 300 comprises a heater or furnace for heating the preforms and a moulder for moulding the preforms into bottles by making use of pressurized air. The filling and closing unit 119 comprises a filling unit for filling the bottles with a liquid/fluent product and a closing unit for closing the bottles with caps.

An air compressor 113, an air conditioning unit 115 and possibly also a power generator 111 are mounted inside the internal volume but outside the bottling room 107. The air compressor is provided for supplying pressurized air to at least the bottle forming unit 300. The air conditioning unit 115 is provided for conditioning the air present in the bottling room 107. The power generator 111, if present, is provided for generating electric power for the units of the transportable bottling plant, but is not essential – the units may also be powered by connection to e.g. an electricity network if this is available, in which case the power generator may be omitted. For this purpose, a power socket (not shown) may be provided for example in the first technical room 108, to which all units are electrically connected.

According to the invention, a preferred embodiment of which is shown in the figures, the internal volume (separate from the bottling room) comprises at least a first 108, second 109 and third technical room 110, separated and sealed from each other. The first technical room 108 is adapted for mounting the power generator 111 (i.e. the first technical room provides sufficient space for a power generator capable of supplying sufficient power, e.g. having minimal dimensions of $L \times W \times H = 0.9 \times 2.3 \times 1.0$ meter). The air conditioning unit 115 is mounted in the second technical room 109 and the air compressor 113 is mounted in the third technical room 110.

In embodiments according to the invention, the freight container may be provided with personnel access 120 to the bottling room 107 separate from personnel access to the first technical room 108 and preferably also separate from personnel access to the second 109 and/or to the third technical room 110.

In embodiments according to the invention like the one shown in figure 4, the first technical room 108 may be provided at one short side 102 of the freight container and the second technical room 109 may be provided at the opposite short side 101 of the freight container. An additional advantage can thus be obtained that the power generator exhaust and fresh air intake of the air-conditioner are located as far as possible from each other (the opposite side of the freight container), minimizing the risk of ingress of fumes or exhaust gases via the air-conditioner system into the bottling room 107.

In embodiments according to the invention, like the ones shown in figures 4 and 5, the first technical room 108, the second technical room 109 and the bottling room 110 may be separated from each other by separation walls 105, 106 which span the entire width and height of the freight container. These rooms are located one after the other in longitudinal direction of the freight container, with the technical rooms preferably at the short sides 101, 102 of the freight container though this is not essential – all technical rooms 108, 109, 110 may also be arranged at the same short side of the freight container albeit with preferably separate accesses via the standard container doors and preferably other doors in the container sides 103, 104. As shown, e.g. the first 108 and third technical rooms 110 may be located above each other and may together take up substantially the entire width and height of the freight container. As shown, e.g. the second technical room 109, may alone take up substantially the entire width and height of the freight container.

In embodiments according to the invention, like the one shown in the figures, personnel access 120 to the bottling room and hatches 121, 122 for supplying the preforms, the bottle caps and the lock 123 for discharging filled bottles may be provided on the same side of the freight container, preferably a long side 103 of the freight container 100. It is customary that a tent is placed at the personnel access to the bottling room, to reduce the risk of dirt entering the bottling room when the plant is used in open air. An additional advantage can thus be obtained by locating all

accesses for personnel to the bottling room on one side of the freight container, i.e. inside the same tent.

In the embodiment shown in figure 4, the power generator 111 and the bottle forming unit 300 may be mounted adjacent to each other on opposite sides of the first separation wall 105. In other embodiments according to the invention, the power generator and the bottle forming unit 300 may be mounted in the freight container with at least one other unit of the bottling plant mounted between them, preferably the bottle forming unit 300 being located in a corner of the bottling room 107 which is opposite the part of the bottling room adjacent to the first technical room 108, where the power generator 111 is mounted, i.e. in a corner at the second separation wall 106. This can be achieved by switching the technical rooms in the floor plan of figure 4, as shown in figure 5. Preferably the bottle forming unit 300 is further located in the corner of the bottling room 107 which is opposite the part of the bottling room wall closest to the internal combustion engine, which is typically the heavier part of the power generator 111 as compared to the electrical generator part. The inventors have found that the bottle forming unit 300 and the combustion engine of the power generator are usually the heaviest pieces of equipment which need to be fitted into the freight container. By moving these two equipment items further apart, preferably as far apart as possible, the weight distribution of the freight container comprising the bottling plant is improved, which facilitates handling during transport and increases safety.

In embodiments according to the invention, one or more windows, preferably with hatches 121, 122, may be provided at the side of the container adjacent to the recipient 117 of the preform feeder 118 and/or a cap recipient 131 of a cap feeder 132, which feeds bottle caps to the filling and closing unit 119, and/or a handle recipient (not shown) of the filling and closing unit 119. This hatch or hatches are provided for user supply of the “consumables”, i.e. the plastic bottle preforms, bottle caps, bottle handles and/or labels, from outside the bottling room 107. A lock 123 is preferably provided at the side of the container adjacent to the filling and closing unit

119, for passing filled and closed bottles towards the outside of the bottling room. As a result of these hatches and the lock, operation of the transportable bottling plant as a "closed box" may be obtained, which means that operators do not have to enter the bottling room while the plant is in operation to supply the consumables and to remove the filled and closed bottles. This brings the advantage that hygiene may be enhanced, as the risk of contamination by the operator or consumable packaging entering the bottling room is minimised. These hatches and the lock are preferably provided at the same container side of the freight container, such that the operator does not need to move far between the points of supply of the preforms, the bottle caps, the handles and the labels, and the point where the filled bottles are leaving the freight container. It is preferred that these hatches and lock are provided close to, and more preferably at the same side of, a door 120 through which the operator has access to the bottling room, for intervention such as in case of emergency. Preferably these access facilities, hatches and lock are provided at one of the longer sides of the freight container, such that a shelter or tent may be provided at that side, preferably over the total length thereof, for providing protection for the operator as well as any storage of consumables and/or filled bottles. Such shelter may also reduce the risk of contamination of the bottle room when the access or any hatch needs to be opened.

The inventors prefer to arrange the equipment in the container 100 such that the technical rooms 108-110 are located at the shorter sides of the freight container, with full fledged doors on both sides such that full access is provided for servicing the equipment mounted in those technical rooms, but also for assembly of the bottling plant ancillary equipment, and/or for disassembly and possible replacement of a particular equipment items which became faulty. With the bottling room 107 in between the two technical rooms 108, 109, an access door 120 may readily be located in one of the longer sides 103 of the freight container at a location from where all equipment items in the bottling room may be easily accessible and even serviceable with a minimum of space which needs to be reserved inside the bottling room 107.

With the improved lay-out according to figures 1-4, as well as the alternative lay-out of figure 5, the following division into hygiene/safety levels is achievable, wherein level 1 has the lowest and level 5 the highest hygiene requirements and each level may mean a separate room/compartment in the container:

- Level 1: power generator 111;
- Level 2: compressor 113, air dryer 114;
- Level 3: product treatment, buffering and/or processing facilities (e.g. freshwater polishing or purification, ...) 116, centralised product (e.g. freshwater) feeding and discharging system 129;
- Level 4: air conditioner 113, chiller;
- Level 5: bottling room 107.

The chiller is provided for cooling a chilling agent which may be supplied to the mould parts and the perform necks in the oven, for cooling these parts during use.

In embodiments according to the invention, like the one shown in the figures 1-4, the freight container 100 may be provided with personnel access to the bottling room 107 separate from personnel access to the first technical room 108 and preferably also separate from personnel access to the second 109 and/or to the third technical room 110. This access arrangement further improves the separation of the activities in the technical rooms with those in the bottling room, and thus further facilitates the maintenance of the desired high hygienic standards in the bottling room.

In embodiments according to the invention, like the one shown in the figures 1-4, the first technical room 108 may be provided at one short side 102 of the freight container, the second technical room 109 preferably being provided at the opposite short side 101 of the freight container. The inventors have found that this is a very convenient layout, convenient not only for assembling the bottling plant, but also for servicing the equipment in the various technical rooms or spaces of the freight container.

In embodiments according to the invention, like the one shown in the figures 1-4, the power generator 111 comprises an

internal combustion engine which is provided with direct or indirect air cooling, whereby the hot air outlet of the air cooling is provided in the freight container wall, preferably the air intake of the engine air cooling being provided inside the first technical room 108. The inventors have found that it is even more desirable to mount a power generator which is driven by an internal combustion engine in a technical room separate from the space containing the air compressor and the space containing the air conditioning unit. Both the latter pieces of equipment would be sensitive to any exhaust gasses leaking from the internal combustion engine and/or any lubricating oil particles or aerosols which may be emitted by the engine. Also the heat from the power generator may affect the air compressor and the air conditioning system.

In this embodiment, the bottling plant may further contain a fuel tank 125, whereby the inventors prefer to mount the fuel tank in the first technical room 108 or in a fourth technical room provided as part of the freight container 100, preferably in the first technical room, and even more preferably underneath the basis supporting the power generator 111. The fuel tank 125 for the internal combustion engine of the power generator 111 may be preferably provided underneath a forklift compatible base and preferably attached thereto, for easy removal from the first technical room. The inventors have found that this location of the tank is the best place as part of the freight container for mounting the fuel tank, providing the least risk for contamination of the sensitive parts of the bottling plant and its ancillary equipment with any fumes or aerosols from the fuel, such as during filling the fuel tank.

In embodiments according to the invention, like the one shown in the figures 1-4, the bottling plant according to the present invention may further comprise a water treatment unit 116 which is preferably mounted in a space different from the first technical room 108, preferably the water treatment unit being mounted in the second technical room 109. The provision of a water treatment unit provides the capability to use a broader range of fresh water sources as raw material to the bottling plant. The inventors prefer to mount this water treatment plant in the second technical room 109, as its presence does not jeopardize the operation thereof, nor does

the air conditioning unit 115 possibly jeopardize the operation of the water treatment unit.

In embodiments according to the invention, like the one shown in the figures 1-4, the bottling plant further comprises means for maintaining a pressure in the bottling room which is above the pressure of the atmosphere surrounding the freight container, preferably at least 0.5 mm H₂O and optionally at most 3.5 mm H₂O above the surrounding atmosphere (i.e. about 5 Pa to about 35 Pa overpressure or gauge). The overpressure brings the advantage that the risk for contamination of the bottling room from the outside is strongly reduced, and that compliance with the international regulation on hygiene may be more readily maintained.

In this embodiment, the inventors prefer that the means for maintaining the pressure in the bottling room is at least partially provided by the air conditioning unit 115, preferably the air conditioning unit being provided with a first air intake for recycling air from the bottling room 107 and a second air intake from outside the bottling room 107 for bringing in fresh air, preferably from inside the second technical room 109. The inventors have found that this is a very convenient method of providing an overpressure in the bottling room 107, in particular because the air conditioning unit is mounted in a technical room separate from the power generator, and any fresh air intake by the air conditioning unit may readily occur in the second technical room itself. The air coming into the second technical room may readily be filtered on its way into the second technical room, with a large area filter which brings only a negligible pressure drop.

In the embodiment shown in figures 1-4, the filling and closing unit 119 comprises product inlet and outlet piping connected to product inlet and outlet connectors which are provided in one of the sides of the container, in particular in a centralised product infeed and discharge system behind hatch 129 in the container wall part of the second technical room 109, so that they are accessible from outside the bottling room. The product inlet connector may be provided for feeding the product with which the bottles are to be filled. The product inlet and outlet connectors together

may also be used to create a closed loop for a cleaning product (clean-in-place system). So by means of the product inlet and outlet connectors accessible from outside the bottling room, both the product supply during operation and the supply and discharge of cleaning product during cleaning may be effected from outside the bottling room. This brings the advantage that hygiene may be further enhanced, as the risk of contamination by operators entering the bottling room is minimised in view of the fact that there is no need for an operator to enter the bottling room for the supply of either the product with which the bottles are to be filled or of any cleaning product, nor for the disposal of any waste from the cleaning step. This further brings the advantage that any contact between the product and electrical components, such as for example fuses in the electrical cabinet (not shown) which may for example be located in the bottling room 107 or, preferably, in one of the technical rooms 108-110, preferably the second technical room 109, can be avoided, which can make it easier to obtain an explosion proof plant 100 if required, suitable for example for bottling with a combustible or flammable product.

In another embodiment, the filling and closing unit 119 comprises a system for treatment of the product with chemicals before filling the bottles, the product treatment system optionally comprising a chemicals supply piping connected to a chemicals inlet connection provided in one of the sides of the container, for example behind the same hatch 129, so that it is accessible from outside the bottling room. So by means of the chemicals inlet connection accessible from outside the bottling room, the supply of chemicals for the treatment of the product in the product treatment system may be effected from outside the bottling room. This brings the advantage that hygiene may be enhanced, as the risk of contamination by operators entering the bottling room is minimised in view of the fact that there is no need for an operator to enter the bottling room for the supply of the chemicals for the product treatment.

The bottle forming unit 300 may be provided with a cooling circuit for circulating a cooling liquid through parts of the bottle

forming unit, in particular at least one and preferably both halves of the bottle mould. A cold source or a chilling device for cooling the cooling liquid may be located in the second technical room 109..

5 The present invention may operate with any suitable thermoplastic for moulding bottles. The list of suitable thermoplastics is too long to enumerate, but the more appropriate thermoplastics are also the more common ones, such as polyvinyl chloride, polyethylene, polypropylene, and polyesters, in particular polyethylene terephthalate (PET), which is preferred. The person skilled in the art may readily adapt the bottling plant to
10 the thermoplastic which is selected, such as adapting the desired preheat temperature range to for instance the glass transition temperature of the selected material. Furthermore, the bottling plant can also be adapted for operation with preforms in biodegradable materials, such as polylactic acid (PLA) or other.

15 The transportable bottling plant shown in figures 1-4 is integrated into a container 100, in particular a standard ISO 20 ft container. In this way, the plant is adapted for being quickly transported to a place of need, which can for example be a place struck by a calamity, a remote place where military operations take place (e.g. desert), a stationary
20 bottling plant which has insufficient capacity to meet the demand, or other.

The container 100 has a front side 101 opposite a back side 102, which form the shorter sides of the container, and two opposite lateral sides 103 and 104, which form the longer sides of the container. The container 100 has separation walls 105 and 106 which divide
25 the interior of the container into a bottling room 107, and at least a first technical room 108, a second technical room 109 and a third technical room 110. The bottling room 107 contains all the electrically powered units for manufacturing closed and filled drinking water bottles starting from a supply of consumables, in particular plastic bottle preforms, bottle caps, possibly bottle
30 carrying handles and labels, and a supply of drinking water. The first technical room 108, shown in figure 1, contains the electric power generator 111 for

generating the power to be consumed by most of the other equipment items of the bottling plant and ancillaries.

Above the first technical room may be provided an extra separate compartment, representing the third technical room 110, separated from the first technical room by means of an extra floor 112. This floor may then be provided with seals such that the third technical room is sealed from the first technical room when the doors of freight container are closed. The first and the third technical rooms may be provided with individual air intakes, preferably provided with respective air filters, see e.g. filter 126 in the side wall of the container, or filters through the container doors (not shown). Waste heat from the power generator may be pushed out of the first technical room, preferably also out of the freight container via grid 127 in the side wall of the container, by means of a cooling fan, optionally through a "radiator" in which a liquid for cooling the internal combustion engine of the power generator is relieved of its excessive heat before being returned to the engine. This fan provides extra draught in the first technical room, possibly in addition to the draught which may be provided by the air intake of the internal combustion engine, if this engine takes its combustion air from the first technical room itself. This brings the advantage that the air for the combustion is already filtered a first time when entering the first technical room, so that the combustion air filter of the engine itself may be provided simpler and smaller and/or that the operating reliability of the engine is improved, in particular in highly dusty environments.

The third technical room 110 contains air compressor 113 for supplying pressurised air, which compressor preferably is a two-stage three cylinder reciprocating compressor. The third technical room may further comprise the compressed air dryer 114 for cooling the air from the compressor, in case of a multistage air compressor the cooler may comprise an intercooler for cooling the air from the first compressor stage, separating any condensed water from it, and returning it to the second compressor stage. When the compressor has more than two stages, corresponding additional intercooling may be provided. The air from the last compressor stage is

preferably also cooled before further treatment and storage. This brings the advantage that extra humidity may be condensed and separated off, such that it becomes easier in a later stage to achieve the desired low dew point required for complying with the regulations of compressed air for the production of food and stimulants. Separating off condensed water is preferably performed by means of an electronically level-controlled condensed removal apparatus ("ECO-Drain"). Further treatment of the compressed air may comprise at least one and preferably all, of one or more pre-filtration, fine filtration, microfiltration and after-filtration steps for separating solid particles and aerosols including oil-aerosols of various sizes at appropriate places in the process, a step for the reduction of the dew point of the air to 4°C or below, preferably by means of a refrigerated dryer, an activated carbon adsorption step for further scavenging undesired components, such as oil vapours, and these steps not necessarily being in this sequence. The compressed air dryer 114 may be provided with a fan pushing the hot environment air from the cooler through a grid in the outer wall of the technical room, preferably also the wall of the freight container, and provide for additional air draught in the technical room.

The second technical room 109 contains the air conditioning system 115 for conditioning/cooling the air in the bottling room 107. It has, in the embodiment of figure 3, a fresh air intake through filter 128 in the side wall of the container and an air discharge 130 through the ceiling of the container. The inventors have found that it is very important that the atmospheric conditions in the bottling room remain relatively constant. Primarily the bottle forming step is very sensitive to being fed preforms of which the bodies are heated uniformly and at a temperature in the correct range. When excessive temperature deviations occur in the preform at the moment of forming the bottle, the process may fail in many aspects. The plastic of the bottle may lose its transparency, and an opaque bottle may be formed. The bottle may have mechanical weak spots, show cracks or even burst. The neck of the bottle should not be exposed to the same temperature, but preferably remains shielded and cool during the preheating step. This is

because when heated it may deform such that the bottle cap does not fit anymore and the bottle cannot be sealed properly, such that the hygienic quality of its content cannot be maintained. The inventors have found therefore that a correct sizing and a correct functioning of the air conditioning unit 115 is important for a flawless operation of the bottling plant. The inventors have also found that it is desirable to avoid as much as possible external influences which may affect the conditions in the bottling room. The influences to be avoided as much as possible include influences with a continued effect, but even more important influences which are temporary and unpredicted, because these are more difficult to cope with by the air conditioning unit. This is a strong additional reason for eliminating reasons for operator entry into the bottling room during operation. It is a prime reason why the consumables are preferably fed through hatches 121, 122, which may be closed and sealed when not needed, and also a reason for providing a lock 123 through which the filled bottles leave the bottling room.

The front side 101 and back side 102 of the container are preferably provided with conventional container doors (not shown) by means of which the two or more technical room may be closed off for the purposes of transportation.

By the division of the freight container into the bottling room 107 and the technical rooms 108, 109, 110, conditions may be achieved in the bottling room 107 which comply with international regulations on hygiene, safety, heat and noise.

The air compressor 113 may for example be provided for supplying pressurised air within a range of for example 15-25 bar (though other values may be used as well), which implies that the plant may readily be used for making bottles up to 5 litre and even higher from suitable preforms, and this at acceptable production speeds. The bottling plant of figure 1 can for example be used for making 1, 1.5 or 2 litre bottles, or any volume from 0,25 up to 5 litre or even larger. In particular, for each bottle size a different mould is used, and a handle applicator is usually not used for the

smaller bottles because the smaller bottles typically do not need to be provided with a handle.

As a result of the improved lay-out, the bottling plant can be made suitable for operation in relatively extreme atmospheric conditions (e.g. 55°C and 85% humidity). The more efficient use of space and the provision of the separate technical rooms provide sufficient space for ancillary equipment of sufficient power.

The separation wall 105 between the first technical room, optionally including the third technical room, and the rest of the freight container may provide both a thermal and an acoustic isolation, such as between the bottling room 107 and the technical room 108. The wall preferably comprises a rockwool plate of 80 or 100 mm, such as for example the "Marine Slab 55" available from manufacturer Rockwool Technical Insulation NV. The inventors have found that this insulates the "hot" ancillary equipment, i.e. the internal combustion engine and the air compressor, from the bottling room 107. By the extra thermal insulation, the duty requirements for the air conditioning unit may be reduced, its operation becomes more reliable, and its power consumption can be reduced. The wall or floor 112 separating the first and the third technical rooms does not need to be insulated for sound nor for heat transfer, as both technical rooms contain "hot" equipment.

The separation wall 106 between the second technical room 109 and the bottling room 107 does not need the same insulation thickness. The second technical room 109 does not contain "hot" ancillary equipment, nor equipment which is very noisy. A minimum of thermal insulation, similar to what is foreseen in the other walls of the bottling room excluding separation wall 105 is sufficient. This brings an extra improvement of space utilization.

The air conditioning system of the bottling plant of the present invention may be of the split type having a separate condenser unit 115 in the second technical room and an evaporator unit (not shown) inside the bottling room 107. Alternatively, the air conditioning system could

also be a unitary system, mounted in the same compartment of the second technical room as the condenser unit 115 with then a grid towards the bottling room 107. The inventors have found, by bringing the cool air outlet of the air conditioning unit close to the bottle forming unit 300, that it is easier to accurately control the temperatures of the preforms, including the neck but evenly important the temperatures of the different zones of the preform body, and that the operating reliability of the bottle forming unit is thereby significantly improved. This brings an important contribution to an improved operating reliability of the overall bottling plant.

Generally, the following units are provided in the bottling room 107: a preform feeder 118 for feeding and orienting the plastic bottle preforms, a first transferring device 141, a bottle forming unit 300 for forming plastic bottles from the preforms and a filling and closing unit 119. The units may be organised around one large closed loop transporting unit, such as described in WO 2011/095464 A1, which may be arranged in a double file as shown or in a single file along the loop, which reduces the footprint of the bottling plant. Preferably however, the filling and closing unit 119 is a separate unit from the bottle forming unit 300, so that it is at all times avoided that any product comes into contact and could contaminate the carriers of the bottle forming unit and hygiene can be improved. The filling and closing unit 119 can for instance use a carousel for passing the bottles from one position up to the next. The bottle forming unit and its preheat unit may then operate around a smaller closed loop transporting unit, such as for instance described in US 2011/0302881 A1. This separation of the two operational steps may also provide more freedom in the layout of the equipment to be arranged in the bottling room. In the case of separated operation, a second transferring device 142 is provided for removing the formed bottles from the bottle forming unit 300 and for feeding these to the filling and closing unit 119. Together, these units provide a unit for every step in the bottling process, so that the bottling plant is able to run substantially without manual intervention. This also contributes to hygiene as no

continuous presence of an operator in the bottling room is required. In the following, the units will be described in more detail.

The preform feeder 118 is similar to the one described in US 2011/0302881 A1 or WO 2011/095464, and comprises a recipient 117 for receiving and buffering plastic bottle preforms. The recipient 117 may be accessible via a first hatch 121 provided in the side wall 103 of the container. This first hatch 121 preferably has a door which pivots around its bottom side, and by opening ends up in a slanted position so that it may form a slide towards the recipient. The operator may readily throw in preforms from outside the bottling room 107. By emptying onto the slide boxes of preforms which have remained sealed until just before, high hygienic standards may be maintained with respect to the cleanliness of the fed preforms. The preforms present in the recipient may then be picked up by a conveyor belt and fed to an ordering unit. The ordering unit may then arrange the preforms with their neck pointing upwards onto a slide/hopper, on which the preforms are transported towards the bottle forming unit 300.

The first transferring device 141 may preferably comprise a 180° rotatable arm with a gripping mechanism, by means of which the preforms are picked up one by one at their neck and placed upside down, i.e. with their neck pointing downwards onto preform/bottle holders or "carriers" of the bottle forming unit 300. Turning the preforms upside down at this stage has the advantage that any dirt present in the preforms would be allowed to drop out. Alternatively the preforms may be dropped into position on a carrier, such as described in WO 2044/095464, but the drawback of such arrangement is that any strange object inside the preform is unable to drop out, and will remain in the preform and in the bottle which is formed therefrom.

The preform/bottle holders may also be called the "carriers". Typically about at their centre point, they comprise a mandrel, herein also called "holders 324" upon which the preform is placed by the first transferring device 141. The mandrel may be provided with an insert entering the preform neck, through which later the heated preform may be stretched

and the bottle may be formed by blowing. Because of the pressure involved in the blowing, a seal may preferably be provided between the preform neck and the mandrel insert, typically a rubber seal, preferably a rubber o-ring. The inventors have found that it may be difficult to have the first transferring device 141, when it places the preforms onto the mandrel insert, also assure that the preform is pushed down sufficiently far over the mandrel insert in order to assure a good seal between the neck and the mandrel insert. The inventors therefore prefer to add an additional step, whereby the preform, after it has been placed on the mandrel over the mandrel insert, is pushed down further over the mandrel insert such that the seal is assured.

Of the bottle forming unit 300, one suitable embodiment is already shown in detail in figure 4 of US 2011/0302881 A1, which comprises an array of preform/bottle holders which are coupled in a semi-circular chain. The inventors have found that an improved space utilization may be obtained with the bottle forming unit 300 as shown in enclosed figure 7 comprising an array of preform/bottle holders which are coupled in a rectangular chain. The preform/bottle holders are preferably pushed stepwise from one position to the next by pushing apparatuses appropriately located around the chain or carriers, and guided by guiding elements which define the path of the chain. The semi-circular chain of US 2011/0302881 A1 may need not more than two advancers, one pushing the carriers along the straight part of the semi-circle, the second one pushing the carriers along the semi-circular part of the chain. The rectangular chain shown in enclosed figure 7 may need at least 4 advancers, one located at each corner for pushing the carriers into and further along the side downstream of the corner.

The rectangular transporter 302 of the preferred embodiment of the bottle forming unit 300 shown in figure 7 will be described further below in more detail.

When placed on their carrier as part of the chain, and after pushing the preforms well over the mandrel inserts to assure they are correctly in position and well sealing around the mandrel inserts, the

preforms are moved into heater 205 for heating up the preforms to the extent that the material of the bodies of the preforms becomes mouldable.

The heating may be performed with any suitable type of heating elements. Suitable are for instance the electrically driven heating rods described in WO 2011/095464. With such heating rods, most of the heat transfer to the preforms occurs by convection.

The inventors however have found that the heat transfer by convection is more difficult to control and maintains a significant risk for non-uniform heating of the preforms. The inventors prefer to use a radiation heated oven or furnace for heating the preforms, e.g. by means of heating lamps. The inventors have found that this means of heating allows a better control of the heat distribution over the various zones of the preform body, which should be heated as uniformly as possible with the temperatures all in a prescribed range, a range which depends on the thermoplastic which is selected for the preform. The inventors have found that it is also easier to shield the preform necks from radiation heat, without requiring extra cooling of the necks in order to keep them below the desired temperature so that the risk for problems during the forming step, or downstream, may be minimised. The inventors prefer to monitor and control the preform heating in multiple zones, in order to achieve the desired uniform heating. These lamps may be longitudinal in shape and may be arranged on one side or on both sides of the preforms moving through the radiation furnace, parallel to the direction of movement, stacked vertically one above the other. Each lamp heats one heating zone, and the heating zones are thus preferably arranged vertically one above the other. The inventors prefer to control the power fed to the individual lamps, preferably to the lamp heating one particular zone in accordance with the temperature measured on the preform body part inside that zone. This temperature measurement is preferably done by Infrared (IR) temperature measurement.

The mandrels are preferably provided rotatable relative to the carriers which support them, and are more preferably rotated such that also the preforms rotate around a vertical axis during their path

through the radiation furnace. The rotation of the preforms may be provided by any suitable means, but the inventors prefer to have mandrels provided with a gearwheel, similar to what is shown in Fig. 4 of WO 2011/095464 A1, the teeth of which grip into a chain or into other suitable element for receiving the teeth. The chain or other suitable element may be provided stationary inside the heating furnace, or may if desired be made to move in order to provide continuous rotation of the preform during the preheat, and to provide further control over the speed at which the preforms are rotating during their path through the furnace. With a stationary element receiving the teeth of the gearwheel, the preforms rotate in steps, with intermittent periods without rotation. This increases the risk for non-uniform heated preforms and hence a risk for faulty bottles and bottling plant malfunction. The inventors prefer to have the preforms move continuously, and preferably at a sufficiently high rate such that the effects of the stepwise movement of the carriers through the furnace is reduced and preferably becomes negligible.

During the path through the furnace, the inventors prefer to keep the preform necks significantly cooler than the bodies. The prime purpose of this is to avoid deformation of the neck during the bottle forming step, and malfunctioning of the downstream equipment. The inventors have found that with radiation heating it is easier to keep the preform necks cool, typically simply by properly placed heat shields. This is even simpler and easier with appropriate control of the air flow through the heating furnace and also with the preforms turned upside down.

The heater is preferably located at one straight part of the rectangular chain of transporter 302, typically along one of the longer sides of the rectangle. With radiation heating, the inventors prefer to use heating lamps of standard size. The heating power of the lamps, the speed at which the preforms may move through the heating furnace, the temperature which the preform should have before being formed into a bottle, the length of the lamps, the number of them arranged optionally in series, all together determine the minimum length of the furnace, and hence the minimum length of that side of the rectangular chain.

The second transferring device 142 preferably comprises a 180° rotatable arm with a gripping mechanism, by means of which the bottles are picked up from the carriers one by one at their neck, turned over and placed upright, i.e. with their neck pointing upwards, if desired
5 onto a transporter device 124 which passes through the filling and closing unit 119 up to lock 123.

The filling of the bottle is preferably performed in two steps: a prefilling step in which 70-80% of the bottle is filled, followed by a second finishing filling step, wherein the remaining 20-30% is filled and the
10 bottle is filled to the desired height and/or volume. The two-step filling reduces the risk of overflow during the filling, and hence allows better housekeeping and thus also higher hygienic standards in the bottling room. It also reduces the need for operator intervention for cleaning up spilled liquid from the bottling room.

The filling and closing unit 119 preferably comprises a glass housing in which UV lamps (not shown) are provided for treatment of the drinking water, air, caps and bottles, and in which the filling operation takes place and the caps are screwed onto the bottles. Such UV
15 treatment and the filling and closing operation are known from stationary bottling plants and therefore need no further description here. The filling and closing unit 119 has a cap feeder 132 which feeds the caps from a cap recipient 131 into the closed filling and capping unit 119. The cap recipient is accessible via a second hatch 122 in the side 103 of the container, so that no operator is required to enter the bottling room in order to supply caps to the
20 cap recipient 131. The filling and closing unit 119 may further have a handle recipient for feeding bottle carrying handles to a handle applicator (not shown). The filled and closed bottles exiting the closed filling and capping unit 119 on the transporter device 124 then may pass a labeller (not shown) for applying a label to the bottle and optionally also printing a code identifying lot
25 number and date onto the bottle. The finished bottles may be transferred from the transporter device 124 inside the bottling room through lock 123 in the
30

side of the container, towards an accumulation device (not shown) outside the bottling container for further handling operations.

5 With respect to figure 6, a preferred air supply and discharge system for a bottling plant according to the invention will now be described.

As mentioned above, the bottle forming unit 300 is mounted in the bottling room 107 of the bottling plant 100. The bottle forming unit comprises a furnace 204 for heating the thermoplastic bottle preforms in a heating compartment 205, a bottle former (herein also called
10 "moulder") for forming the heated preforms into bottles and transporting means for transporting the bottle preforms fed to the transporting means by the preform feeder 118 through the heating compartment 205 and into the bottle former and further transporting the formed bottles to the bottle filling and closing unit 119 and/or a second transferring device 142 for transferring
15 the bottles to a separate bottle filling and closing unit 119.

The furnace 204 preferably comprises a fresh air inlet conduit 206 leading from the outside of the bottling room 201 to the heating compartment 205 for leading fresh air from the outside of the bottling room 201 to the heating compartment 205. The fresh air inlet conduit
20 preferably opens to an inlet behind a hatch 219 (see figure 3).

As shown, the fresh air inlet conduit 206 leads from the outside of the freight container 100 to the furnace 204, more in particular to the heating compartment 205, for leading fresh air from the outside of the freight container 213 to the furnace 204, more in particular the
25 heating compartment 205. Although the fresh air conduit 206 could also lead from for example one of the technical rooms 108-110, this is less desirable as in such configuration there is an increased risk that undesired substances enter the heating compartment.

As can be seen in figure 6, preferably, the
30 bottling plant 100 further comprises a filter 210 for filtering the fresh air taken in through the fresh air inlet conduit 206. Although such a filter decreases the risk that unwanted objects enter the heating compartment 205, the filter 210 is

not critical and may be omitted. Also, the preferred type of the filter 210 may depend on, for example, the environment wherein the freight container is positioned and/or the nature of the air which is conducted through the inlet conduit 206.

5 To provide fresh air to the heating compartment 205, a forced draft fan 208 is provided. Although the forced draft fan 208 may be omitted, in which case the fresh air enters the heating compartment 205 through the inlet conduit 206 by, for example, diffusion, the forced draft fan 208 preferably is provided to improve or to control the provision of fresh air to
10 the heating compartment 205.

Preferably, as shown in figure 6, the furnace 204 also comprises a hot air exhaust conduit 207 leading from the furnace 204 towards the outside of the bottling room 201, so for leading hot air from the furnace 204 to outside the bottling room 201. This allows that typically no hot
15 air from the heating compartment is enters into the bottling room 107, which could possibly decrease the hygienic conditions in the bottling room and/or be an extra burden for the air conditioning. As shown in figure 6, the hot air exhaust conduit 207 preferably leads from the furnace 204, more in particular from the heating compartment 205, to the outside of the freight container 100,
20 preferably through an outlet behind a hatch 220 in the side wall 104. This is however not critical for the invention and the hot air exhaust conduit 207 may also lead from the furnace 204, more in particular from the heating compartment 205, to one of the technical rooms 108-110 of the freight container.

25 As shown in figure 6, the furnace preferably comprises an induced draft fan 209 for withdrawing hot air from the heating compartment 205. Although the induced draft fan 209 may be omitted, in which case the hot air leaves the heating compartment 205 through the exhaust conduit 207 by, for example, diffusion or convection, the induced
30 draft fan 209 preferably is provided to improve or to control the withdrawal of hot air from the heating compartment 205, especially when the induced draft fan 209 and the forced draft fan 208 are provided together.

As shown in figure 6, the fresh air inlet conduit 206 may be provided with a pressure relief valve 212 for relieving any excessive fresh air from the conduit towards an outlet 218 towards the bottling room 107. The pressure relief valve 212 may also be connected to an outlet to release the excess air to outside the bottling room 107.

The pressure relief valve 212 may for example be a gravity controlled pressure relief valve with a counterweight for controlling its opening. However alternative systems based on, for example, springs, electronics, etc. may also be used.

By evacuating the hot air inside the furnace and replacing it with cooler air from outside the bottling room, it is possible to heat up the preforms mainly by radiation and less by convection. Thus, a more stable preform heating process can be ensured.

It has been found that close control of the temperatures inside the furnace depends on a sufficient and steady air flow through the furnace, as the air flow is also the preferred way for furnace energy to leave the air conditioned bottling room. The volume of air needed for extracting the amount of energy has been found to be significant. The inventors have found that providing the fresh air inlet conduit 206 brings the advantage that the volume of hot air discharge from the preform heating furnace does not, or to a lesser extent, need to be replaced with air from inside the bottling room 107. It has been found that the quality requirements of the air drawn into the furnace are less critical than those governing the bottling room atmosphere. It may be important that the air drawn into the furnace is for example dust-free, but its humidity and/or its temperature are typically unimportant or at least of a minor relevance as long as not excessively low or high.

By providing the forced draft fan 209 for providing fresh air to the heating compartment 209, one can better control the flow of air through the furnace. This can further bring the advantage of a possibility to size the two fans 208, 209 larger, such that the air flow through

the furnace 204 can be higher and the temperature inside the furnace can be better controlled.

5 The furnace may comprise control means (not shown) configured to control the induced draft fan 209 and the forced draft fan 208 such that the amount of hot air withdrawn from the heating compartment 205 is smaller than or equals the amount of fresh air provided to the heating compartment. Such a configuration allows to further improve control of the air inside the bottling room as it can be prevented that air inside the bottling room is drawn into the furnace and through the exhaust such that, 10 for example, the overpressure inside the bottling room could be decreased.

As shown in figure 6 and described above, the overpressure inside the bottling room 107 is maintained by the air conditioner 115, which takes air from an air inlet 215 in the bottling room and another air inlet 216 outside the bottling room, e.g. in the second technical room 109 and 15 supplies conditioned air at overpressure through an outlet 217 in the bottling room 107. By providing the separate fresh air inlet conduit 206 with forced draft fan 208 towards the furnace, multiple air pressure stages can be achieved, with in particular overpressure of the bottling room 107 with respect to the environment and further overpressure inside the bottle forming unit 300 with respect to the bottling room 107. Especially with filter 210 present, this 20 can further improve hygiene of the bottle forming process.

With reference to figures 7 and 8, a preferred embodiment of the bottle forming unit 300 will now be described. Movement of the various components is indicated by means of arrows.

25 The bottle forming unit 300 comprises a furnace 204 for heating the bottle preforms. The term "furnace" may be interpreted widely and may comprise various devices, e.g. a device as described herein, for increasing a temperature of the body of a preform. A furnace may herein also be indicated by using the terms "heating furnace", "oven", or "heater".

30 The bottle forming unit 300 further comprises a moulder 306 for moulding the heated preforms into bottles. The moulder preferably is a blow-stretch moulder, which may be regarded as a type of

blow-moulder. A blow-stretch moulder may be preferred because it may enable forming relatively large bottles from relatively small preforms, as a result of the combined action of stretching and blowing. Furthermore, a blow-stretch moulder may be relatively compact. Because part of the extension of a preform into a bottle may be achieved by means of the stretching, a blowing pressure may be reduced. Thus, a size and/or power consumption of a part of a driving unit for driving the moulder may be reduced. Hence, a blow-stretch moulder may combine well with a bottle forming unit for forming bottles from bottle preforms that is to be positioned inside a transportable container, where relatively few space is available for placing the bottle forming unit and/or where a decrease in power consumption may be appreciated.

The moulder 306 comprises a driving unit 322 for driving, i.e. opening and closing the two mould halves 351, 352 of the moulder. When the mould is open, a formed bottle may be released from the mould and simultaneously a heated preform may be transported into the mould. Such driving unit may e.g. comprise a hydraulic, pneumatic or electric drive. Preferably, the driving unit 322 is positioned inside a loop 311 along which the carriers 308 can be transported, so that the space inside this loop is used efficiently. The driving unit may need to sustain relatively strong forces, because the mould needs to be kept closed in spite of the pressure of the blowing air inside the mould. The driving unit therefore is preferably relatively powerful and/or sturdy, and therefore may be relatively heavy and/or relatively voluminous. The inventors have found that fitting at least the driving unit, or at least part of the driving unit, inside the loop 311 may bring a reduction of the footprint of the transportable bottle forming unit when placed in the container.

The bottle forming unit further comprises the transporter 302 arranged for moving the bottles and/or the preforms. The transporter may alternatively be indicated herein by the term "transporting unit" or "transporting means". The transporter 302 comprises a plurality of movable carriers 308. The carriers 308 are arranged for carrying the preforms and/or the bottles. Thereto the carriers 308 are each provided with at least one holder 324 arranged for holding a preform or a bottle. Thus, each carrier

308 may be arranged for carrying at least one preform or bottle. The carriers 308 preferably have a substantially rectangular shape, preferably with rounded corners, though other shapes are possible. The holders 324 are preferably arranged for holding the preforms and/or bottles at a neck of the preforms and/or bottles. The holders 324 are preferably arranged for holding the preforms and/or bottles with the neck of the preforms and/or bottles directed downwards. On their way towards the furnace 204, the preforms preferably undergo an additional step to push them firmly onto the holders 324, herein also called "mandrels", and are preferably subject to UV light for sterilisation in UV light box 317. Preferably, in the furnace, the necks for the preforms are substantially shielded from heat supplied by the furnace. The furnace may e.g. be provided with heat shields and/or heating elements positioned to achieve such shielding. As a result, the necks may remain substantially undeformed during forming of a bottle from a preform. The transporter 302 further comprises guiding elements for guiding the movable carriers 308 along the loop 311. Such guiding elements (not shown) may e.g. comprise a rail to which the carriers may be movably mounted and along which the carriers may be transported, or guides between which the carriers may be transported.

The guiding elements define the loop 311 of carrier positions where a carrier may be positioned. The loop 311 as shown has four corners 312.i ($i=1,\dots,4$). However, in other variations of the embodiment, the loop may have more than four corners, e.g. six or eight corners with then e.g. hexagonal or octagonal carriers.

In figure 7, a rectangular loop is shown. A loop 311 having the form of a rectangle may combine well with positioning the transporter inside a container, in particular in a container having standardised outer dimensions corresponding to a standard shipping container, or, in other words, a standard freight container. However, alternatively, the loop may have another shape. For example, instead of being substantially straight corresponding to a rectangular shape, a part of the loop in between two corners may be curved. However, if such curvature is lacking, a speed with

which the carriers can be moved may be increased. Movement along a substantially straight part of the loop may give lower friction forces between carriers and the guiding elements, and/or between neighbouring carriers, as compared to a loop wherein the carriers have to turn as they move along curved parts of the loop. Additionally, by having substantially straight loop parts, a longer life time of carriers, a lower need for lubrication, and/or a lower probability of early replacement of damaged carriers may be achieved. As illustrated in figure 7, the loop 311 is provided for moving the carriers 308 through the furnace 204, for moving the carriers from the furnace 204 to the moulder 306, and for returning the carriers from the moulder 306.

The loop may be provided for moving the carriers through the furnace 204 over a part of the loop that extends from one corner 312.1 of the loop to a next corner 312.2 of the loop, located directly downstream of said one corner. This distance is defined by at least the length of the furnace 204 along the loop. Thus, for a rectangular loop having two short sides and two long sides, the furnace may optionally be arranged along a long side and the moulder may be arranged along a short side, while the short side is preferably kept as short as possible taking into account the size of the moulder and the capability to remove the formed bottles from the carriers by means of the second transferring device 142 along that same short side.

The transporter 302 comprises at least four advancers 314.i ($i=1,\dots,4$). In an embodiment, an advancer may be formed as a pusher. An advancer may e.g. comprise a piston having a plunger or may comprise another pushing element. An advancer 314 is typically arranged for moving a carrier 308 positioned at a corner 312.i away from that corner 312.i, as shown in figures 8A-D. The carriers 308 are, in use, pushed stepwise from one carrier position to a next carrier position by means of the advancers. The rectangular loop shown in figures 7 and 8 needs four pushers, one located at each corner for pushing the carriers into and further along a part of the loop downstream of the corner towards a next corner.

Figure 8A schematically shows the transporter 302 in a situation where carrier positions at a first set of two diagonally opposed corners 312.2, 312.4 are free of a carrier 308. Figure 8C schematically shows the transporter 302 in a situation where carrier positions at a second set of two diagonally opposed corners 312.1, 312.3 are free of a carrier 308. The number of carriers 308 the number of carrier positions may be adjusted so that at least two, and preferably at most two, i.e. preferably exactly two, carrier positions along the loop 311 are free of a carrier 308. Said at least two carrier positions may in use be positioned at diagonally opposed corners of the loop 311. Thus, at least two free, or, in other words, vacated, carrier positions may be positioned at diagonally opposed corners of the loop 311.

In use, by advancing a carrier 308 positioned at a corner 312.i of the at least four corners away from that corner 312.i, a file of carriers 308 substantially abutting the carrier positioned at said corner 312.i is moved away from that corner 312.i and towards a next corner 312.j located downstream of said corner 312.i ($i = 1, \dots, 4$ and $j = 2, 3, 4, 1$). Thus, as a result of the advancing, a trailing carrier of said file of carriers 308 is moved into said next corner 312.j. Instead of the term "file", the term "row" may generally be used.

Figures 8B and 8D show the transitional stages between figures 8A and 8C, with each time the file of carriers 308 being advanced halfway between the corners 312.i.

The transporter 302 is provided with a controller 318, arranged for controlling the advancers 314.i. The controller is arranged for controlling the moment of advancing of the advancers 314. The controller is drawn in figure 7 together with data transmission lines 319, arranged for communicating controlling signals from the controller to the advancers, and possibly for receiving a feedback signal from the advancers to the controller. Such feed-back signals may e.g. relate to a position of the advancer, in particular to a position of a plunger and/or piston of the advancer.

As explained by figures 8A-D, the controller may be arranged for simultaneously moving, by means of the advancers, carriers 308 positioned at the diagonally opposed corners of the loop from those corners. In that way, the time of advancing may be decreased compared with a situation wherein no advancers operate simultaneously. As a result, the production rate of the bottle forming unit may be increased. Thus, the controller 318 may be arranged to operate the advancers 314.i so that two advancers located at diagonally opposed corner positions of the loop operate substantially simultaneously. As a result of such operation, the two advancers vacate carrier positions at the diagonally opposed corners, i.e. at the corners where the advancers are located. The controller 318 is further arranged for advancing the carrier 308 positioned at the next corner 312.j subsequent to advancing the corner positioned at the first corner 312.i, so that alternating operation of the advancers 314.1 and 314.3 together alternating with 314.2 and 314.4 together may be achieved.

As shown in figure 7, the controller 318 may further have transmission lines 319 towards the moulder 306 and the first and second transferring devices 141, 142 of which the first is arranged for placing preforms onto the carriers and the second is arranged for removing formed bottles from the carriers. Thus, the controller 318 is capable of controlling operation of these components so that their operations occur at standstill of the respective carriers 308. Note though that the advancing of the carriers through the furnace 204 may occur simultaneously, or substantially simultaneously, with a bottle forming step in the moulder 306 and a formed bottle removal step at the second transferring device 142. Likewise, advancing the carriers 308 through the mould may occur simultaneously, or substantially simultaneously, with a step of placing a preform on a carrier by the first transferring device 141.

As shown in figure 7, the carriers 308 may have a first dimension D1 and a second dimension D2, the first dimension D1 being larger than the second dimension D2. The first dimension and the second dimension may be measured in mutually transverse directions. Preferably, the

first dimension D1 is sufficiently large for allowing space for blown bottles on subsequent carriers. Preferably, the second dimension D2 is sufficiently large for allowing space for preforms on subsequent carriers, but is shorter so that the time of the preforms in the furnace is maximised. This may enable a gradual and/or uniform heating of the preforms in the furnace 204. More in general, a number of preforms per unit of length along the loop in the furnace may be larger than a number of bottles per unit of length along the loop on the side of the mould.

The inventors therefore prefer to keep a path from the moulder 306 to the point of removal of the bottle, i.e. to second transferring device 142, as short as possible. The inventors therefore prefer to move the carriers relatively fast on the path from the moulder up to bottle removal, yet they prefer to move the carriers at a lower speed during their path through the furnace. This may be achieved by providing the carriers 308 with the first dimension D1 and the second dimension D2 as described above. In preferably as few moving steps as possible, preferably in at most four steps (i.e. with at most three carrier positions in between), more preferably at most three steps (i.e. with at most two carrier positions in between) and even more preferably in two steps (i.e. with only one carrier position in between), the heated preforms are moved from a position just outside the furnace to a position suitable for blowing a bottle, namely the position in between the mould halves 351, 352.

The formed bottle is preferably removed from its carrier as soon as possible after it is formed, i.e. after as few steps as possible removed from the position of the carrier during the forming step, i.e. the "forming position". The inventors have found that removal of the bottle from the carrier may be provided from the position which is only two steps downstream of the forming position. The removal from this position allows improving the space utilization of the bottle forming unit 300.

With one empty corner position in a rectangular loop, four advancers would have to operate consecutively. Then, each advancer would have to wait before starting advancing until an advancer

located directly upstream has performed and finished its action so that a vacated position is created. These actions by the advancers, and the advancers returning into their original position, takes time. Such consecutive operation requires a time corresponding at least with a time required for an
5 advancers to execute one advancement summed for all advancers. This would impose a production rate limitation for the bottle forming unit and/or for the entire bottling plant.

 The inventors have found that two empty corner locations along the rectangle may be provided at diagonally opposed corners.
10 The inventors have found that in an arrangement having at least four corners and with two empty corner positions along the loop, the two advancers at diagonally opposite corners may operate simultaneously, optionally in concert with the two other advancers also operating simultaneously. With this operating sequence, the speed of movement of the carriers along the loop
15 may be significantly increased. This may lead to a significantly increased production rate of blown bottles, and hence also of filled bottles. E.g. with the two empty corner positions, the bottle forming unit 300 can achieve a production rate of approximately 1800 bottles per hour.

 The inventors prefer to leave the heated
20 preforms on their mandrels and move them altogether into a suitable position for forming the bottle using the mould.

 Thus, a loop enabling an improved space utilization compared to US 2011/0302881 may be combined with an improved production rate of bottles compared to WO 2011/095464. Such combination
25 may be appreciated in view of a limited space available in a container, e.g. a standard 20 foot freight container.

 In an alternative embodiment, the transporter of the bottle forming unit may also be composed of carriers comprising each time two preform/bottle holders, as known from WO 2011/095464, but with two
30 open positions in the rectangle, so with the same operation as shown in figures 7 and 8, and preferably also with the preforms held upside down. In such arrangement, the carriers are rectangular and oriented such that the two

preforms move parallel to each other through the furnace 204, i.e. in two rows, and in one row on the side of the mould 351-352. In such arrangement, the mould may be arranged for forming two bottles simultaneously and also the preforms may be placed two by two simultaneously on the carriers and the bottles may be removed two by two from the carriers. Alternatively in such arrangement, the advancing of the carrier file on the side of the mould 351-352 may also occur in two substeps with a standstill halfway, so that the same mould 351-352 and second transferring device 142 as shown in figure 7 may be used, i.e. for handling the preforms/bottles one by one.

With reference to figure 9, a preferred embodiment of an arrangement for removing the liquid/fluent product from the product circuit of the bottling plant will be described.

The bottling plant 100 shown in figure 9 comprises a product inlet 400 for connecting a product supply for supplying the product to the bottling plant, a product circuit 410 comprising a plurality of conduits and components fluidly connecting the product inlet to at least one product outlet nozzle 409 (preferably two, see above) in the filling unit 119 at which the product is filled into the bottles, and an arrangement 411-415 for drying the product circuit after a period of operation of the bottling plant 100. In particular, this arrangement for removing residual product from the product circuit comprises at least one valve, in the embodiment shown four valves 411-414, with each time a connector for connecting a pressurized air conduit of a pressurized air conduit system, via which the product circuit 410 is connectable to a pressurized air supply 415 for forcing the residual product from the product circuit by means of pressurized air. In particular, the valves 411-414 are normally closed during the filling operation. After a period of operation, e.g. as soon as the filling operation is stopped and will not be resumed for a longer period of time, e.g. at the end of a day, the valves 411-414 are opened, so that pressurized air is released into the product circuit 410, preferably at many locations, in the embodiment shown four locations, so that the residual product is forced from the product circuit 410. In this way, rest product is removed and any bacteria growth in the product circuit during a

period of standstill may be suppressed. The use of pressurized air over e.g. steam has the advantage that wear to the components of the product circuit 410 may be minimized and that the risk of a dead bacteria film remaining inside the product circuit may be minimized.

5 Furthermore, the use of pressurized air over e.g. steam has the advantage that the need for a separate unit to generate the steam is avoided, as the pressurized air supply 415 may conveniently comprise the air compressor 113 which is readily present on the transportable bottling plant for providing the pressurized air for the bottle blowing process.
10 This pressurised air is of high quality, which further reduces the risk of wear to the components of the product circuit.

As mentioned above, the air compressor may be arranged for supplying pressurized air at a pressure within the range of 15-25 bar, which may be reduced to a pressure within the range of 2-10 bar,
15 preferably 4-6 bar upon injection into the product circuit. As mentioned above, the air compressor 113 may be provided with the air dryer 114 for drying the pressurized air to a dew point for example below 5°C, preferably below 4°C. This can help to ensure sufficient removal of the residual product, e.g. water, from the product circuit to avoid bacteria growth during idle periods. In the
20 case of water, a time period of e.g. about 2 minutes can be sufficient for removing the residual water as desired.

In particular, as shown in figure 9, the product circuit 410 may comprise, in succession from the product inlet 400 to the at least one product outlet nozzle 409, the following components: an infeed
25 pump 401 for pumping in the product, a flow meter 402, at least one filter stage 403, 404 for filtering the product, a buffer tank 405 for buffering the product, a UV treatment unit 406 for subjecting the product to UV treatment, a dosing pump 407 for dosing the product towards the product outlet nozzle and another flow meter 408. For example, in case the bottling plant 100 is used for
30 water, the filter stages 403, 404 and the UV treatment are used for obtaining potable water from freshwater and the flow meter 402 may be used for controlling a chlorine adding device, to add a correct dosage of chlorine to the

freshwater. This filtering and treatment process is well known in the art and therefore needs no further description here.

As mentioned above, the product inlet 400 may be part of a centralised product infeed and discharge system provided in an outside wall part of the freight container, behind hatch 129.

The bottling plant 100 may be provided with an inlet and an outlet for circulating a cleaning product through the product circuit, which may for example be the product inlet and outlet of the centralised product infeed and discharge system, behind hatch 129. A heating device (not shown) may be provided at the product inlet for heating the cleaning product, so that its efficiency (e.g. the speed and/or the effectiveness of the cleaning operation) can be improved. Subsequent to the cleaning step, rinsing product (e.g. water or an alternative rinsing product) may be circulated through the product circuit for the purposes of rinsing the product circuit. The heating device, which may be provided at the product inlet, may also be used during this rinsing step to heat the rinsing product, so that subsequent drying of the product circuit may be facilitated (as the product circuit is brought to a higher temperature before drying).

With reference to figure 10, another preferred embodiment of the bottle forming unit 360 will now be described, which is in many respects similar to the bottle forming unit 300 of figures 7 and 8. Like parts have been indicated with the same reference numbers and will not be described again in detail for the sake of brevity. The bottle forming unit 360 differs in the following aspects from the bottle forming unit 300.

The moulder 306 is the bottle forming unit 360 is fitted with mould halves 361, 362 for blowing bottles of oval shape, such as for example bottles for holding detergents. In order to ensure that the circular preforms expand correctly into the desired oval shape, additional preheaters 364 are provided at the carrier position right before the mould, for additionally preheating the sides of the preform facing the mould halves 361, 362 and facilitating expansion of the preform material in the direction parallel to the mould halves.

For this type of bottles, it is often a requirement that the bottle screw cap, which is in this case usually of the type having a snap closing part hingedly connected to a base part, is always placed in the same direction on the bottle. To this end, it is customary to provide a recess in the support ring of the preform neck, so that the preforms and in particular the screw-thread on the necks can always be oriented in the same way on the carriers before they are expanded to become the oval bottles. The orienting of the preforms is in the embodiment of figure 10 performed at the carrier position just outside the oven 204, by means of an orienting device 363. This orienting device is provided for rotating the holder 324, for example by acting on a gear provided on the carriers 308, and is equipped with a sensing element for sensing the recess on the preform. This principle, and suitable orienting devices are known in the art and therefore need not be further described here. Of course, the orienting device 363 may also be provided at other carrier positions between the furnace and the mould, for example in the corner position 312.2, or in case the preforms are not rotated in the oven (the necessity of which may depend on the heating principle used) the orienting device 363 may be even located at other carrier positions along the transporter 302.

It is remarked that the addition of the orienting device 363 and the additional preheaters 364 does not require a larger transporter 302 or more carrier positions as compared to the bottle forming unit 300 of figure 7.

The bottle forming unit 360 of figure 10 further comprises a bottle marking device 365 located adjacent to the transporter 302 at a carrier position downstream of the mould, for example the carrier position just after the mould. In this way, the bottles can be marked (i.e. provided with a mark containing e.g. a date and time of production, a product code, ...) while still on the transporter 302 of the bottle forming unit 360, which is convenient since a stable position of the bottles is desired for the marking step. It is remarked that the addition of the marking device 365 also does not

require a larger transporter 302 or more carrier positions as compared to the bottle forming unit 300 of figure 7, so space can be saved.

5 An additional exhaust conduit may be provided leading from the carrier position at the bottle marking device 365, i.e. where the marking step occurs, to the hot air exhaust conduit, the additional exhaust conduit being provided for withdrawing fumes created upon marking the bottles by means of the bottle marking device 365, which may for example be a laser device. Such an arrangement has the advantage that the fumes created upon marking the bottles can be withdrawn from the bottle forming
10 unit via the hot air exhaust conduit which has the induced draft fan, i.e. without additional effort.

A transportable containerized plant as described herein may provide a solution to reduce operating, personnel, fuel and transportation costs. It can be used for several applications:

- 15
- Military: safe & less vulnerable to hostile activities.
 - Human Aid for refugee camps and remote areas: simple logistics to provide drinkable water.
 - Disaster relief for fast supply of drinkable water.
 - Commercial applications: a transportable containerized plant can be
20 used e.g. as back-up for a permanent plant; in case the latter has insufficient capacity, in case of break down or maintenance or to produce a new product without jeopardizing the production continuity of the permanent plant.

The advantages in the commercial field are
25 numerous. In order to market products, companies are looking to start as soon as possible, giving the competition no time to enter the market. A containerized plant is a fast solution. The containerized bottling plant has an extremely short installation and start-up period, it can be prepared for immediate shipment worldwide and it is a plug-and-play system. The risk on
30 investment is low as compared to the risks involved with stationary plants because the bottling plant is transportable to other regions in case of local problems. The risk on quality problems is low since damage of products is

inferior when products are bottled and/or packed locally compared to long distance transport. A containerized plant is an economic logistical solution since the costs are inferior when a product is bottled and/or packed locally compared to long distance transport. Also, import taxes can be diminished in many occasions.

CLAIMS

1. Bottle forming unit (300) for forming bottles from bottle preforms, the bottle forming unit comprising a furnace (204) for heating the bottle preforms and a moulder (306) for moulding the heated preforms into bottles, the bottle forming unit further comprising a transporter (302) for moving the bottles and/or the preforms, wherein the transporter comprises a plurality of movable carriers (308) arranged for carrying the preforms and/or bottles, and comprises guiding elements for guiding the movable carriers, the guiding elements defining a loop (311) of carrier positions where a carrier can be positioned, along which loop the carriers are transportable, the loop being provided for moving the carriers through the furnace and for moving the carriers from the furnace into the moulder, said loop having at least four corners (312), preferably at most four corners, at which a carrier position is provided, wherein the transporter comprises at least four advancers (314), each advancer being arranged for moving a carrier positioned at a corner away from that corner, wherein an amount of carriers and an amount of carrier positions are adjusted so that at least two, and preferably at most two, carrier positions along the loop are free of a carrier, said at least two carrier positions in use being positioned at diagonally opposed corners of the loop, wherein the transporter is provided with a controller (318) for controlling the advancers, wherein the controller is arranged for simultaneously moving, by means of the advancers, carriers positioned at at least two diagonally opposed corners of the loop from those corners.
2. Bottle forming unit according to claim 1, wherein the loop has the form of a rectangle.
3. Bottle forming unit according to claim 1 or 2, wherein the loop is substantially horizontal.
4. Bottle forming unit according to one of claims 1-3, wherein the transporter comprises an advancer (314) at each of the at least four corners (312) of the loop (311), each advancer being provided for

advancing the carrier positioned at the corner over at least a single carrier position.

5 5. Bottle forming unit according to claim 4, wherein the amount of carriers and the amount of carrier positions are adjusted so that in use, by advancing the carrier positioned at a corner away from that corner, a file of carriers abutting the carrier positioned at said corner is moved away from that corner and towards a next corner.

10 6. Bottle forming unit according to claim 5, wherein the amount of carriers and the amount of carrier positions are adjusted so that in use, by advancing the carrier positioned at a corner of the at least four corners away from that corner, a file of carriers substantially abutting the carrier positioned at said corner is moved away from that corner and towards a next corner located downstream of said corner so that, as a result of the advancing, a leading carrier of said file of carriers is positioned at
15 said next corner.

7. Bottle forming unit according to claim 6, wherein the controller is arranged to advance the carrier positioned at the next corner after advancing the carrier positioned at the corner located upstream of said next corner.

20 8. Bottle forming unit according to one of claims 1-7, wherein the controller (318) is arranged to operate the advancers (314) so that the two advancers of each set of advancers positioned at diagonally opposed corner positions of the loop are operated substantially simultaneously, wherein the two advancers of each set by their operation
25 vacate carrier positions at at least two diagonally opposed corners (312).

9. Bottle forming unit according to one of claims 1-8, wherein at each corner an advancer (314) is provided for moving a carrier (308) positioned at said corner (312) away from that corner.

30 10. Bottle forming unit according to one of claims 1-9, wherein the carriers, and preferably the carrier positions, have a first dimension (D1) and further have, measured in a direction transverse to the first dimension, a second dimension (D2) that is smaller than the first

dimension, wherein the transporter is arranged for transporting the carriers in a transportation direction through the furnace (204) with the second dimension aligned with the transportation direction through the furnace, and wherein the transporter is arranged for transporting the carriers in a transportation direction through the moulder (306) with the first dimension aligned with the transportation direction through the moulder.

11. Bottle forming unit according to one of claims 1-10, wherein only one of the corners is provided along a part of the loop in between the furnace and the moulder.

12. Bottle forming unit according to one of claims 1-11, wherein the moulder is blow-moulder, preferably a blow-stretch moulder.

13. Bottle forming unit according to one of claims 1-12, wherein the moulder comprises a driving unit (322) for driving the moulder, wherein the driving unit is positioned inside the loop (311).

14. Bottle forming unit according to claim 13, wherein the mould is provided with a plurality of mould parts (351, 352), wherein the driving unit (322) is arranged for opening and closing the mould by moving the mould parts with respect to each other.

15. Bottle forming unit according to one of claims 1-14, wherein the furnace (204) comprises a hot air exhaust conduit (207) leading from the furnace (204) towards the outside of the bottling room (107) and provided with an induced draft fan (208) for withdrawing hot air from a heating compartment (205) of the furnace (204) in which the preforms are heated.

16. Bottle forming unit according to claim 15, wherein the bottle forming unit comprises a bottle marking device (365) located adjacent to the transporter (302) at a carrier position downstream of the moulder (306), an additional exhaust conduit being provided leading from the carrier position at the bottle marking device to the hot air exhaust conduit (207), the additional exhaust conduit being provided for withdrawing fumes created upon marking the bottles by means of the bottle marking device.

17. Bottle forming unit according to one of claims 1-16 positioned inside a freight container (100).

18. Transportable bottling plant (100) comprising a bottle forming unit (300) according to one of claims 1-16.

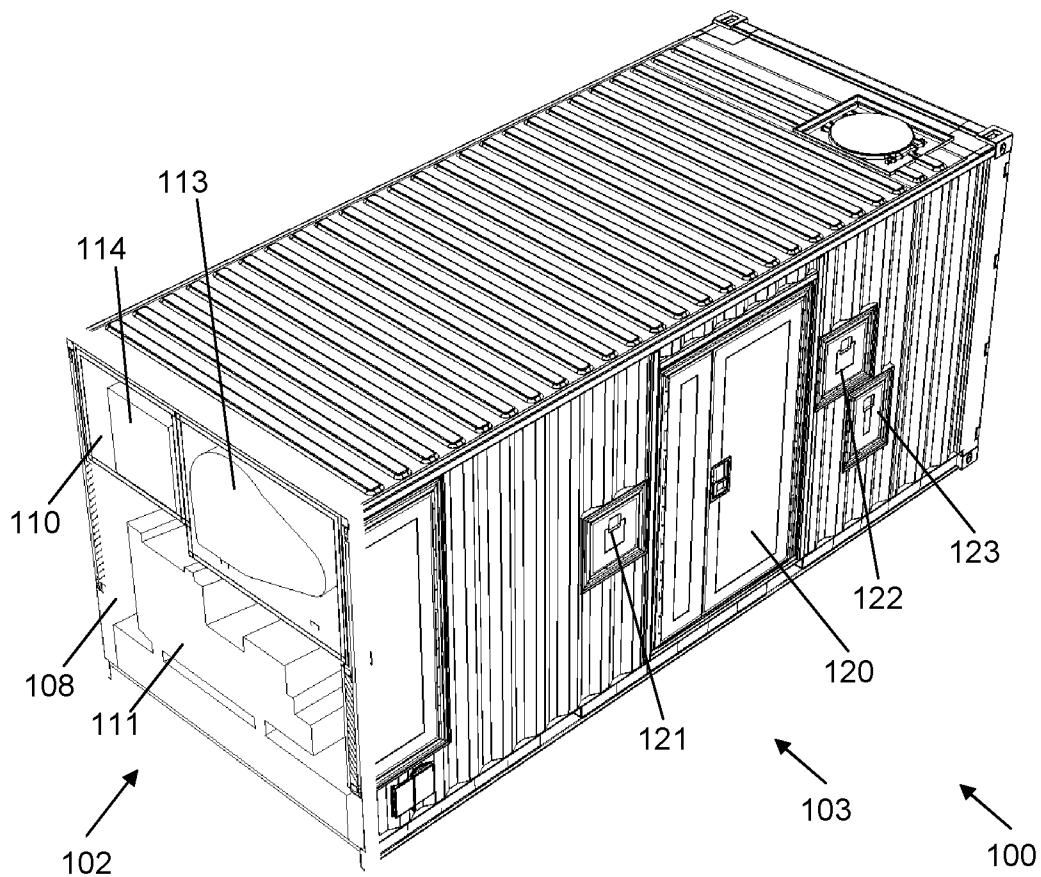


FIG. 1

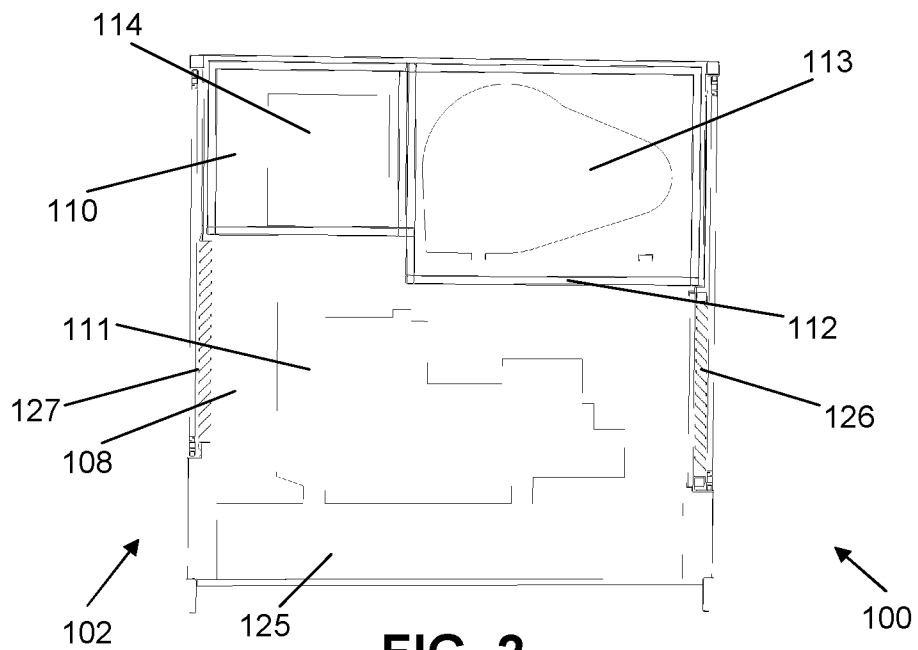
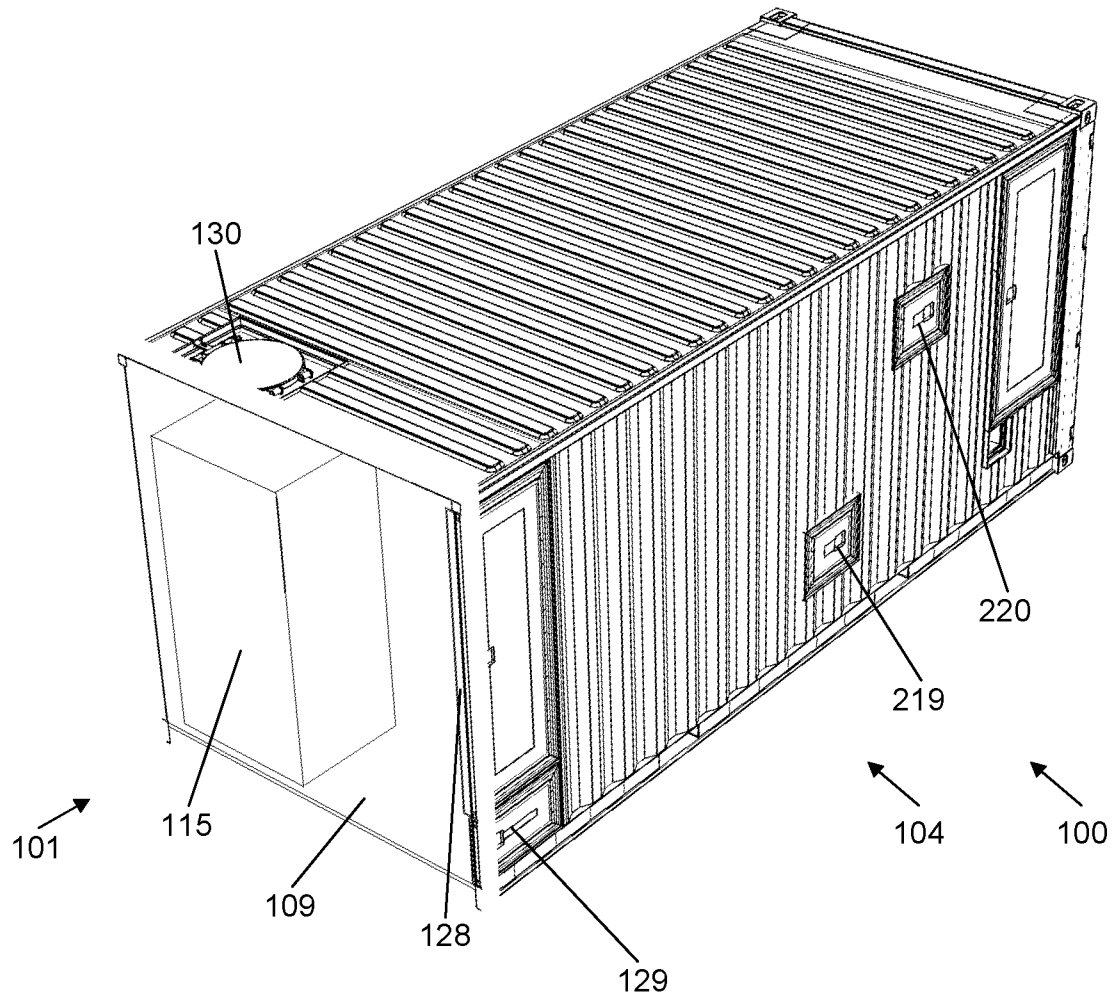
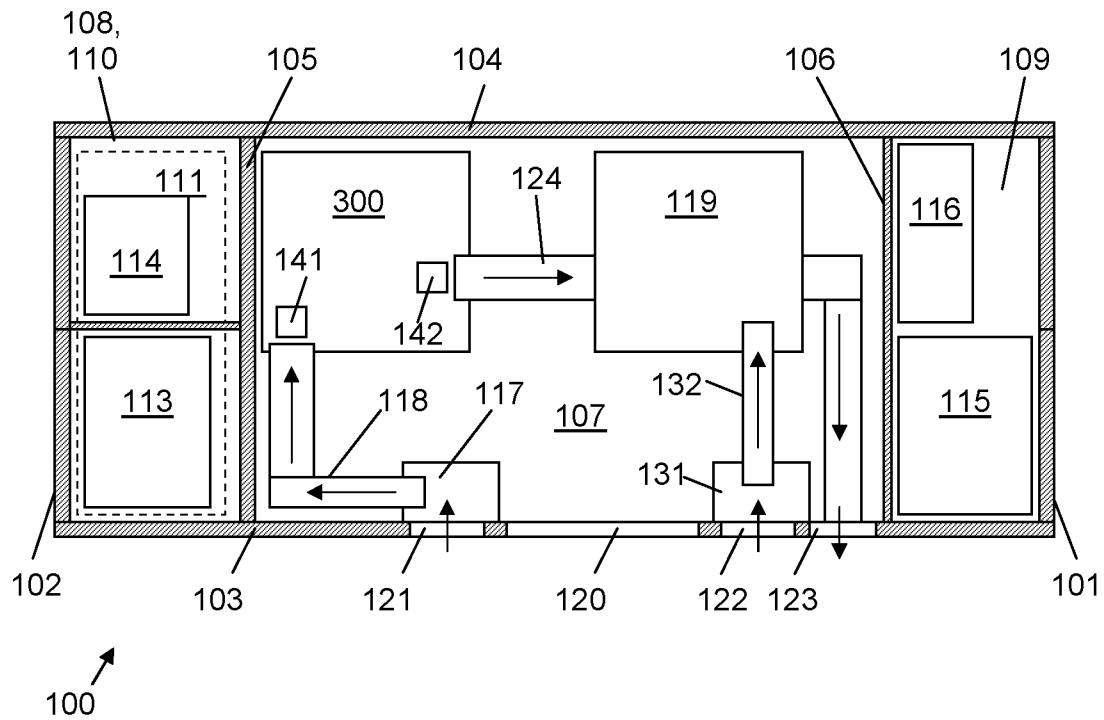
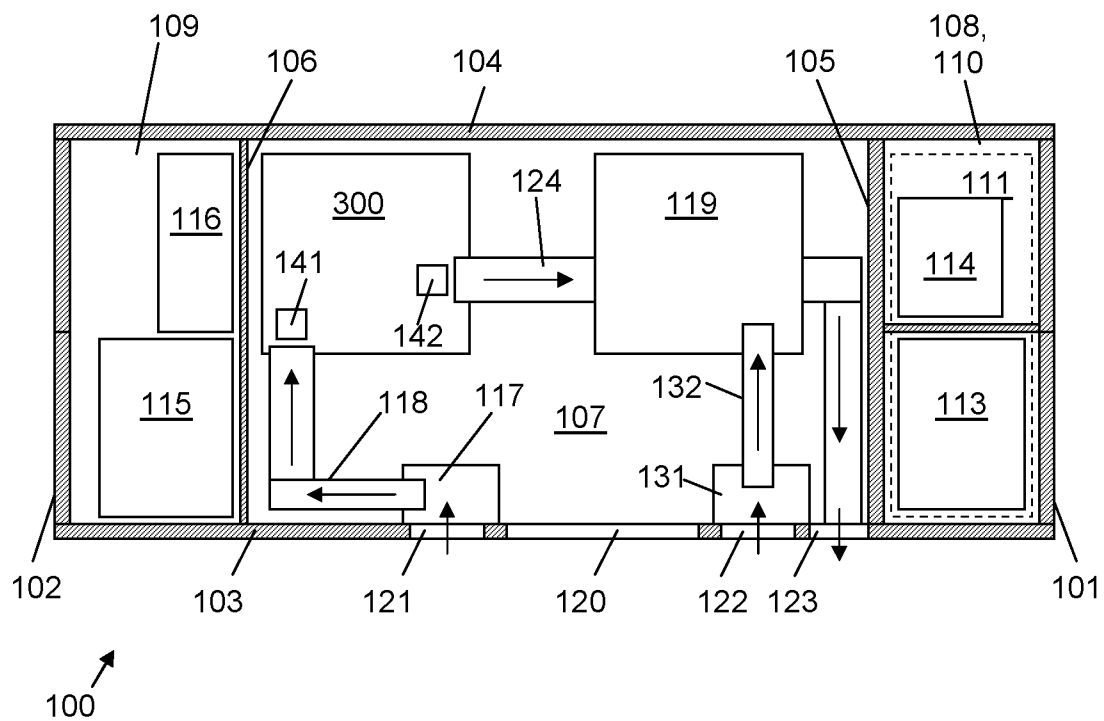


FIG. 2

**FIG. 3**

**FIG. 4****FIG. 5**

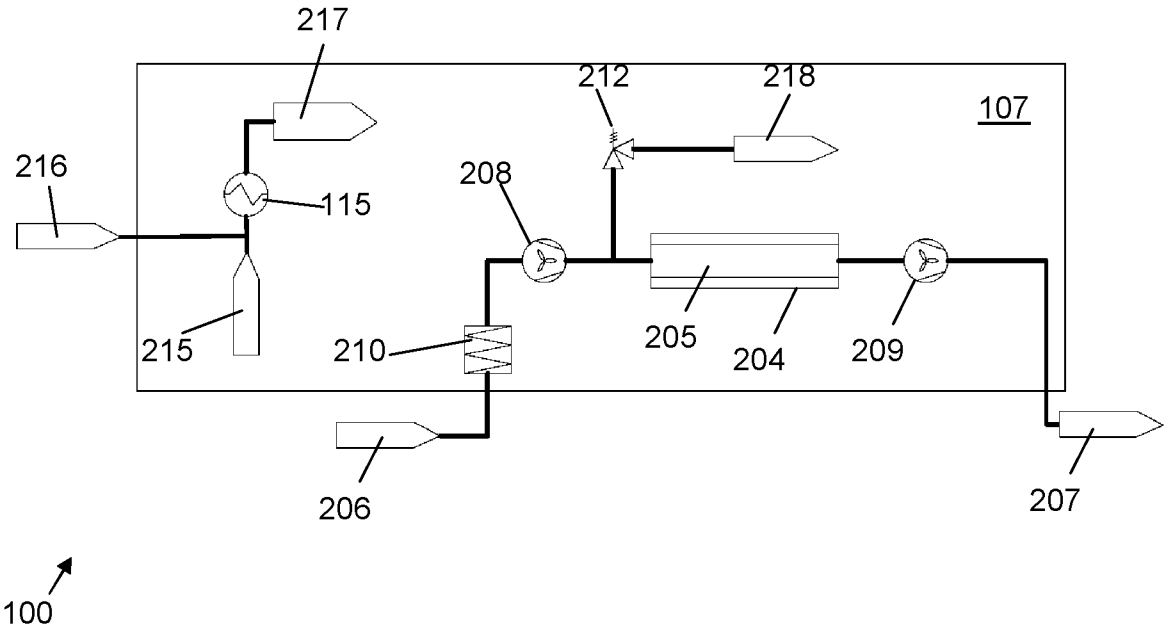


FIG. 6

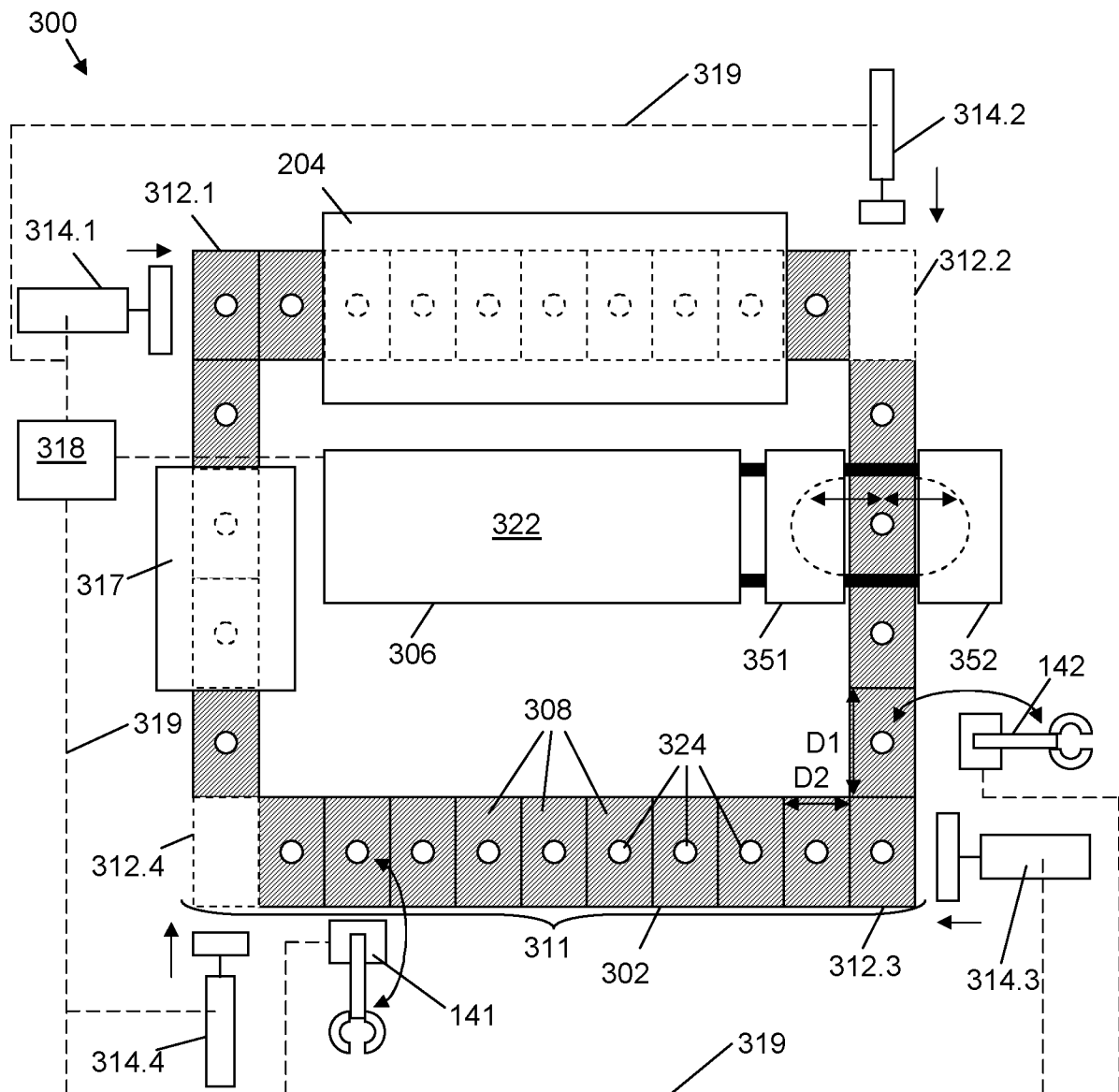


FIG. 7

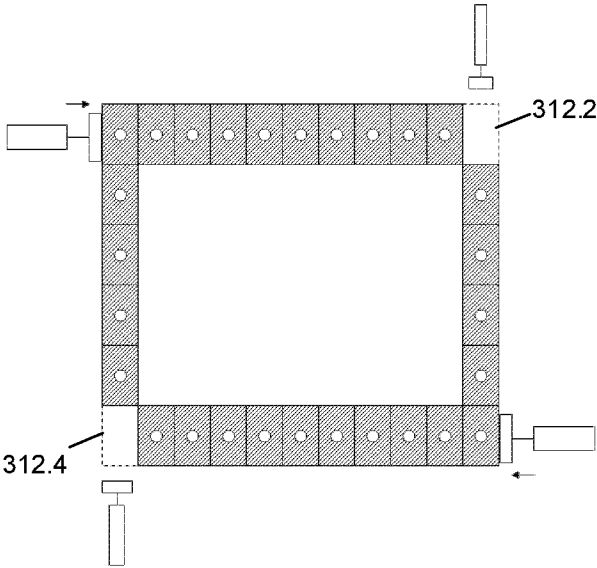


FIG. 8A

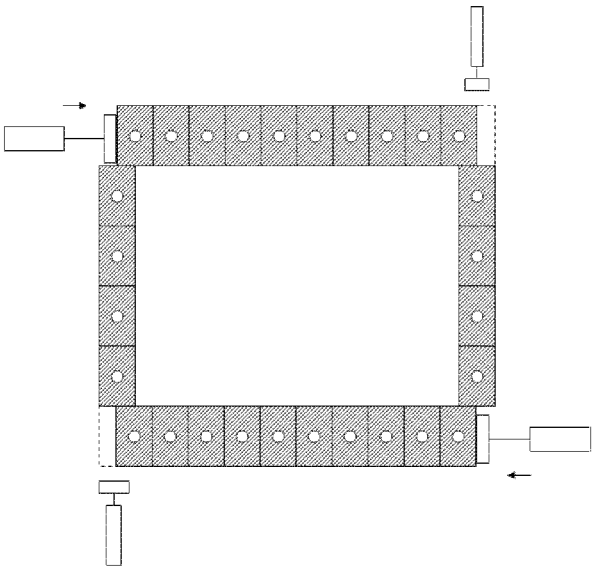


FIG. 8B

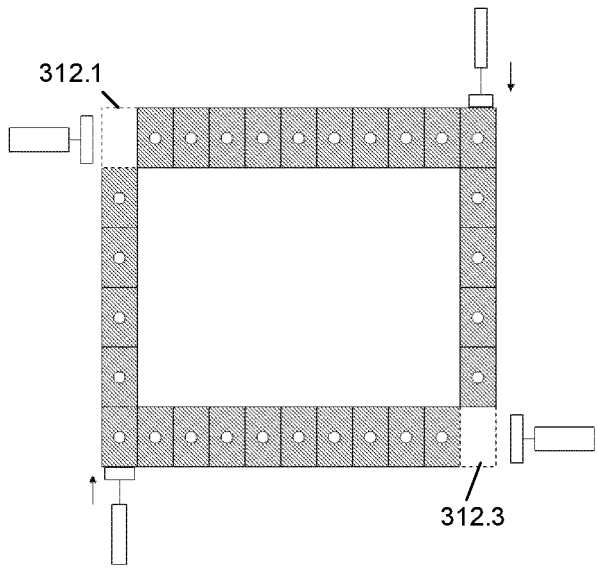


FIG. 8C

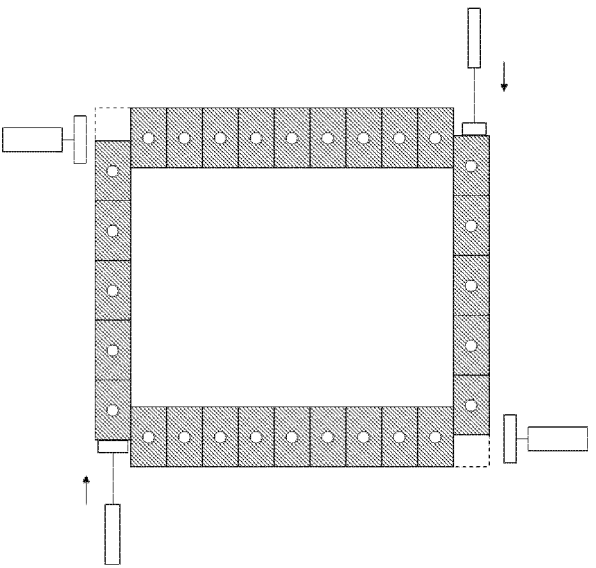
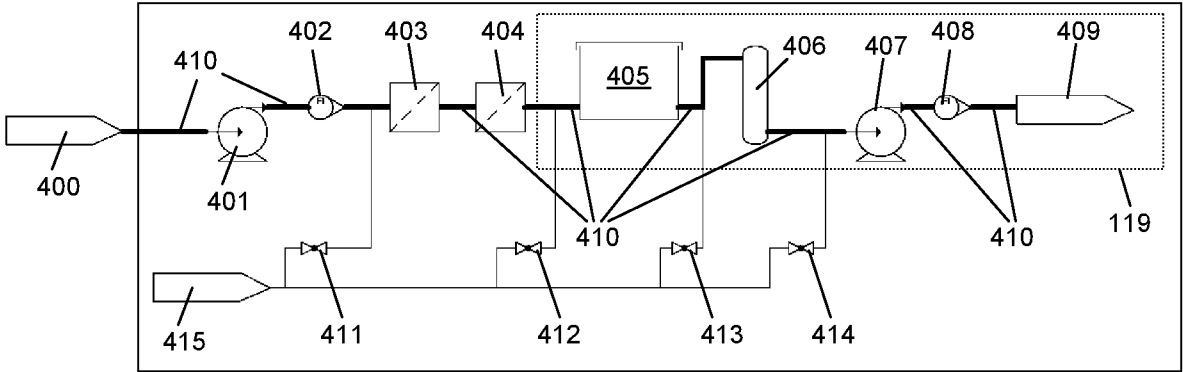
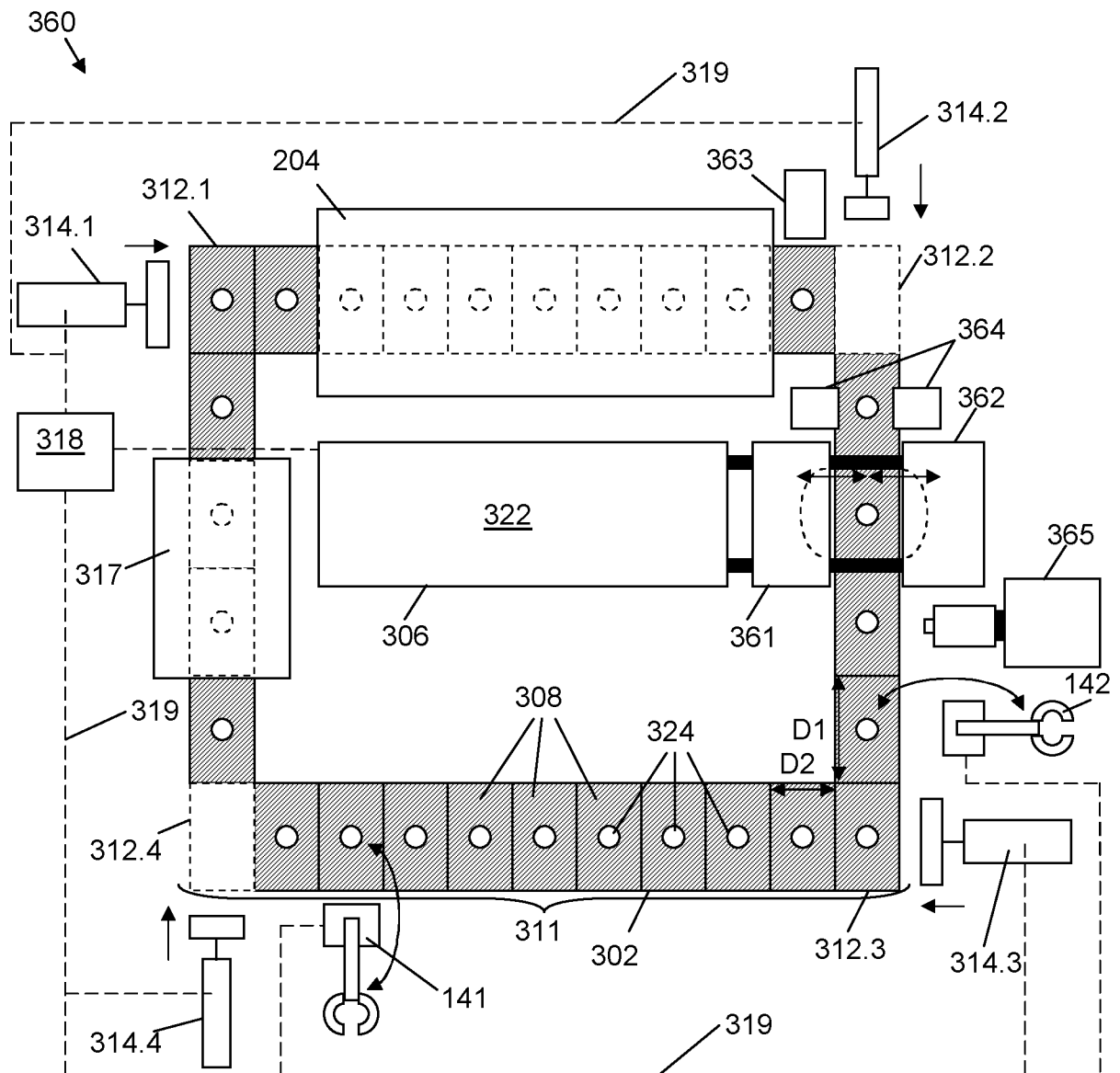


FIG. 8D



100

FIG. 9

**FIG. 10**

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/051701

A. CLASSIFICATION OF SUBJECT MATTER INV. B29C49/42 B67C3/00 ADD. B29K27/06 B29K67/00 B29C49/46 B29C49/06 B29C35/08 B29C49/12 B29C49/64		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) B29C B67C		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 522 581 A (SCHAD ROBERT D [CA] ET AL) 11 June 1985 (1985-06-11)	1-16
Y	column 3, line 60 - column 5, line 67; figure 1	17,18
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