

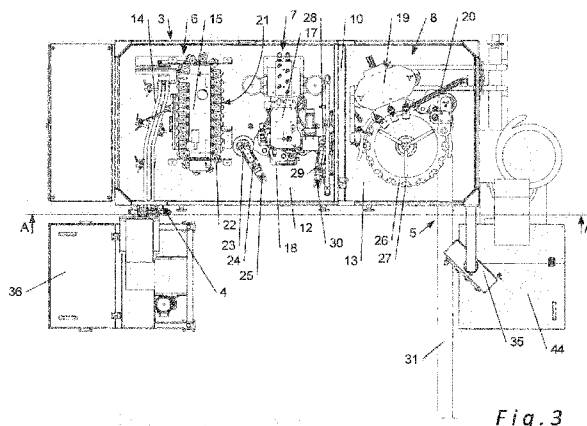


- (51) International Patent Classification:
B67C 3/00 (2006.01) *B65B 3/04* (2006.01)
B65B 3/02 (2006.01)
- (21) International Application Number:
PCT/EP2016/056251
- (22) International Filing Date:
22 March 2016 (22.03.2016)
- (25) Filing Language: English
- (26) Publication Language: English
- (71) Applicant: **CONTENO** [BE/BE]; Industrieweg 4, 2630 Aartselaar (BE).
- (72) Inventors: **VAN STEEN, Christophe**; Rozenlaan 4, 2630 Aartselaar (BE). **DEVEL, Christophe**; Jef Van Hooftlaan 20, 2630 Aartselaar (BE). **WUYTS, Bram**; Vaderlandstraat 37, 2610 Wilrijk (BE). **VAN HOECK, Patrick**; Grote Molenweg 101, 2940 Stabroek (BE). **VAN ROEY-EN, Dave**; Neerbroek 18, 2070 Zwijndrecht (BE). **BRUYNS, Gerry**; Boutersemstraat 55, 2550 Kontich (BE).
- (74) Agent: **GEVERS PATENTS**; Holidaystraat 5, 1831 Diegem (BE).

- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— with international search report (Art. 21(3))

(54) Title: INTEGRATED UNIT FOR FORMING, FILLING AND CLOSING CONTAINERS



(57) Abstract: The invention provides an integrated container forming, filling and closing unit comprising a cabinet with an input opening for preforms and an exit opening for containers. A first compartment of the cabinet comprises modules for receiving and heating the preforms and a transport system for transporting the preforms. A second compartment of the cabinet comprises modules for forming the containers. A third compartment comprises modules for filling and closing the containers and a transport system for transporting the containers. Transfer modules transfer the preforms and the containers between the compartments and the modules. A container output module outputs the containers via the exit opening. A separation wall between two successive compartments has a transfer opening for passing preforms or containers between those compartments. The air pressure in one of those compartments is elevated with respect to the other of those compartments by means of an air pressure control system.



Integrated unit for forming, filling and closing containers**Technical field**

5 The present invention relates to an integrated unit for forming, filling and closing containers, which is built as a single machine. Furthermore, the invention also relates to a transportable bottling plant comprising a freight container in which the integrated unit is provided.

Background art

10 Bottling plants, in particular transportable bottling plants adapted for producing drinking water bottles, are for example known from WO 2011/095464 A1 and FR 2 859 200 A1.

15 WO 2011/095464 A1 discloses an automated single machine capable of blowing the bottle out of a preform and to fill and cap the bottle, which is presented as fitting into a transportable Norm ISO 668 ISO freight container. The bottling plant shown in Fig. 1 comprises one closed loop transport unit running from station to station, which stations in sequence insert a PET preform, heat the preform, verify the temperature of the heated preform, blow the PET bottle, irradiate the bottle with UV light, fill the bottle, close off the
20 bottle, eject the filled and sealed bottle, upon which the carriers are returned back to the preform insertion station. Alternatively as shown in Fig. 10, the plant comprises an additional return loop by which improperly heated preforms are not discarded but are returned back to the entry into the heating station. The freight container comprising the plant is accessible through a single double
25 door on one of the smaller sides of the freight container, and further contains an air conditioning unit in order to assure an optimal processing stability. The closed loop unit, even in its most simple form of Fig. 1, occupies a substantial amount of the space inside the freight container, and leaves little room for extra equipment.

30 WO 2011/095464 A1 has the disadvantage that it is difficult to maintain the high hygienic standards with which the space containing the bottling plant, also called the bottling room, and thus all equipment contained therein, is expected to comply. This, because the processes of heating preforms, forming bottles from the preforms, and filling and closing the bottles are performed in

the single bottling room and relatively close to each other such that contaminants may easily spread between the different stations of the bottling plant. Furthermore, the use of the single closed loop transport unit running from station to station, and optionally the use of the additional return loop, further contributes to the spreading of contaminants between the different stations. The bottling plant of WO 2011/095464 A1 also has the disadvantage that not all the stations are easily accessible for maintenance or for repair in case of malfunction.

FR 2 859 200 A1 discloses a bottling plant having different stations for heating preforms, forming bottles from the preforms, and filling and closing the bottles, which stations are arranged consecutively along a single linear transport system for transporting the preforms and the bottles.

The bottling plant of FR 2 859 200 A1 has the disadvantage that contaminants may easily spread between the different stations of the bottling plant via the single transport system, which poses a problem for the hygienic use of the bottling plant. The bottling plant also has an extensive size, certainly lengthwise along the direction of the linear transport system, and is therefore unsuitable for use as a transportable bottling plant.

Other types of bottling plants are the so-called synchroblock devices from manufacturers such as Krones[®], KHS[®] or Sidel[®], which comprise independent units for heating preforms, forming bottles from the preforms, and filling and closing the bottles. These independent units are each controlled by a different central processing unit, and the operation of the different independent units needs to be synchronised with each other. To handle an overflow of preforms or bottles from one of the independent units to the next independent unit, the independent units are often provided with a buffer zone, i.e. intermediate storage, where the preforms or bottles are stored until the independent unit is ready for processing them. The synchroblock devices have the disadvantage that they are extensive in size, first because they are aimed at producing large quantities of bottles and not designed for being scaled down, and second because of the requirement of the buffer zones for storing an overflow of bottles and preforms in order to synchronise the different independent units of the synchroblock devices. Another disadvantage of the synchroblock devices is that the different independent units of the

synchroblock devices are linked by transport systems for preforms and bottles, which may easily spread contaminants from one independent unit to the other.

Another common disadvantage of the bottling plants of the state of the art, described above, is that they are not energy efficient.

5

Disclosure of the invention

It is an aim of the present invention to provide an integrated and compact unit, built as a single machine, for forming, filling and closing containers wherein the hygienic separation between the modules of the container forming process and the modules of the container filling/closing process is guaranteed.

This aim is achieved according to the invention with an integrated unit for forming, filling and closing containers showing the technical characteristics of the characterising part of the first claim.

Therefore, the invention provides an integrated unit for forming, filling and closing containers, for example bottles. The integrated unit comprises a cabinet. The cabinet has an input opening sized for inputting thermoplastic container preforms. The cabinet has an exit opening sized for outputting filled and closed containers. The integrated unit comprises a first compartment, zone or area in the cabinet adjacent to the input opening. In the first compartment there is mounted a preform receiving module for receiving thermoplastic container preforms via the input opening. In the first compartment there is mounted a preform heating module for heating the preforms. In the first compartment there is provided a first transport system for transporting the preforms through the first compartment. The integrated unit comprises a second compartment, zone or area adjacent to the first compartment. In the second compartment there is mounted a container forming module for forming containers from the heated preforms in a mould. In the second compartment there is optionally provided a second transport system for transporting the preforms and the containers formed from the preforms through the second compartment. The integrated unit comprises a third compartment, zone or area in the cabinet adjacent to the second compartment and adjacent to the exit opening. In the third compartment there is mounted a container filling module for filling the containers, which are formed in the second compartment, with a

30

fluent product. In the third compartment there is mounted a container closing module for closing the filled containers with a container closure, such as a cap. In the third compartment there is provided a third transport system for transporting the containers through the third compartment. The integrated unit comprises a first transfer module for transferring preforms from the first compartment to the second compartment. The integrated unit comprises a second transfer module for transferring containers from the second compartment to the third compartment. The integrated unit comprises an air pressure control system. The integrated unit comprises a separation wall according to a first configuration or a separation wall according to a second configuration. In the first configuration the separation wall is arranged between the first compartment and the second compartment. In the first configuration the separation wall has a transfer opening which is sized for allowing passage of preforms from the first compartment to the second compartment. In the first configuration the first transfer module is mounted at the transfer opening for transferring preforms from the first compartment to the second compartment via the transfer opening in the separation wall. In the first configuration the air pressure control system is provided for elevating the air pressure in the second compartment, and preferably the air pressure in the second compartment and the third compartment, with respect to the air pressure in the first compartment. In the second configuration the separation wall is arranged between the second compartment and the third compartment. In the second configuration the separation wall has a transfer opening which is sized for allowing passage of containers from the second compartment to the third compartment. In the second configuration the second transfer module is mounted at the transfer opening for transferring containers from the second compartment to the third compartment via the transfer opening in the separation wall. In the second configuration the air pressure control system is provided for elevating the air pressure in the third compartment with respect to the air pressure in the second compartment, and preferably with respect to the air pressure in the first compartment and the second compartment. The integrated unit comprises a container output module mounted at the exit opening. The container output module is provided for outputting containers filled and closed in the third compartment out of the cabinet via the exit opening. The integrated unit

comprises a single central processing unit. The central processing unit is operatively connected to the different components to be operated of the integrated unit, such as the modules and systems of the integrated unit. The central processing unit is provided for controlling the operation of the components to be operated of the integrated unit. The integrated unit comprises a human machine interface. The human machine interface is operatively connected to the central processing unit. The human machine interface is provided for enabling a user to control the operation of the components to be operated of the integrated unit by means of the central processing unit.

The inventors have found that the separation of the compartment by means of the separation wall is beneficial for preventing contaminants from spreading between the compartments, which contaminants may for example deteriorate the quality of the fluent product with which the containers are filled. Most beneficial is the prevention of contaminants being spread from the preform receiving module in the first compartment to the process of filling the containers in the third compartment, since the process of filling the containers is the most critical with regards to hygiene because then the fluent product is in contact with the ambient air in the third compartment, since contaminants may enter the first compartment together via the input opening together with the preforms and the heating of the preforms may stimulate bacterial growth and thus increase contaminants. This separation is achieved by both the separation wall in the first configuration and the separation wall in the second configuration. The separation wall in the second configuration has the further advantage that also the process of forming the containers is separated from the process of filling the containers.

Therefore, the division of the integrated unit in the different compartments allows for a close and compact arrangement of the different modules contributing to the process of forming, filling and closing the containers, without being concerned with contaminants spreading between the different modules. Thereby, a compact integrated unit for forming, filling and closing containers is provided.

One or more of the compartments having an elevated air pressure with respect to the air pressure in other compartments and thus also with respect to

the air pressure at the exterior of the cabinet offers the advantage that airborne contaminants in the compartments with lower pressure and at the exterior of the cabinet are prevented from entering the one or more compartments with elevated pressure, for example via the transfer opening in the separation wall and/or via the exit opening of the cabinet, and it also offers the advantage that possible airborne contaminants in the one or more compartments with elevated pressure are removed from the one or more compartments with elevated pressure, for example via the transfer opening in the separation wall and/or via the exit opening of the cabinet. Thereby, contributing to the hygiene of the process of filling the containers in the third compartment, and allowing for an even more compact design of the integrated unit according to the present invention.

It should be clear that in an embodiment of the integrated unit according to the present invention the air pressure control system may also be provided for elevating the air pressure in the first compartment with respect to the air pressure at the exterior of the cabinet. This offers the advantage that airborne contaminants at the exterior of the cabinet are prevented from entering the first compartment through for example the input opening. Thereby, contributing to the hygiene in the first compartment, and allowing for an even more compact design of the integrated unit according to the present invention.

Preferably, the first transfer module and the second transfer module form a non-continuous transport element between their respective compartments, i.e. the transfer modules are provided in such a way that they form no direct link between the modules and transport systems in their respective compartments via which contaminants may spread, for example by means of contact contamination.

The single central control unit is beneficial for synchronising the operation of the different independent modules of the integrated unit, and thereby provide a continuous production process. The human machine interface offers the advantage that a user may operate and monitor the integrated unit from a single location.

In an embodiment of the integrated unit according to the present invention the first transport system comprises a chain-linked carrier system

provided for transporting preforms from the preform receiving module through the preform heating module.

5 The inventors have found the chain-linked carrier system a beneficial means for continuously feeding a plurality of preforms through the preform heating module. This allows for a compact design of the preform heating module.

10 The chain-linked carrier system also offers the advantage that it may easily be driven by a drive motor via a single drive shaft which takes up little space in the first compartment, and thus allows for a compact design of the integrated unit.

15 In an embodiment of the integrated unit according to the present invention the third transport system comprises a rotatable container carrying wheel for transporting containers along the container filling module and the container closing module and for releasing closed and filled containers to the container output module.

20 The inventors have found the rotatable container carrying wheel to be a beneficial means to provide in a compact arrangement of the container filling module and the container closing module, by arranging them close to each other at the circumference of the rotatable container carrying wheel. Hereby, the rotatable container carrying wheel combines the function of transporting containers through the container filling module, transporting containers from the container filling module to the container closing module, transporting containers through the container closing module and transporting containers further towards the container output module, thereby eliminating the need for providing separate transport elements for each of these functions. As such, the rotatable container carrying wheel further contributes to the compact design of the integrated unit according to an embodiment of the present invention.

25 The rotatable carrying wheel also offers the advantage that it may easily be driven by a drive motor via a drive shaft which takes up little space in the third compartment, and thus allows for a compact design of the integrated unit.

30 In an embodiment of the integrated unit according to the present invention the third transport system comprises delay means for delaying transport of the containers to the container filling module a for predetermined

time period. Preferably, the delay means comprise a further rotatable container carrying wheel driven by the rotation of the rotatable container carrying wheel.

5 The delay means offer the advantage that the containers transferred from the second compartment to the third compartment by means of the first transfer module have, by selecting the predetermined time period, sufficient time to cool down before being provided to the container filling module. This prevents the containers from being deformed during the process of filling the containers.

10 Using the further rotatable container carrying wheel driven by the rotation of the rotatable container carrying wheel offers the advantage that no additional driving means have to be provided for driving the further container carrying wheel, which improves the energy efficiency and reduces the cost of the integrated unit.

15 In an embodiment of the integrated unit according to the present invention at least one of the first transfer module and the second transfer module comprises a rotatable gripping device.

20 The inventors have found the rotatable gripping device to be a beneficial means for preventing direct contact between the modules and transport systems of the different compartments via which contaminants may spread between the different compartments, for example by means of contact contamination. As such the rotatable gripping device forms a non-continuous transport element between the compartments. The use of the rotatable gripping device thus contributes to the hygiene of the processes in the different compartments, and as such also allows a compact design of the integrated unit.

25 The inventors have also found the rotatable gripping device to be a compact means for providing in the transportation of preforms or containers between the different compartments, which only takes up little space. Thereby further contributing to the compact design of the integrated unit according to an embodiment of the present invention.

30 The rotatable gripping device also offers the advantage that it may easily be driven by a drive motor via a drive shaft which takes up little space in the compartment or any other space in which the rotatable gripping device is arranged, and thus allows for a compact design of the integrated unit.

In an embodiment of the integrated unit according to the present invention the cabinet further comprises a fourth compartment above or below the first compartment, the second compartment and the third compartment. Preferably, the fourth compartment is below the first compartment, the second compartment and the third compartment. The fourth compartment is separated from the first compartment, from the second compartment and from the third compartment. At least one of the first transport system, if present, the second transport system, the third transport system, the first transfer module and the second transfer module is driven by at least one drive motor mounted in the fourth compartment.

The fourth compartment comprising the at least one drive motor and being separated from the first compartment, from the second compartment and from the third compartment, offers the advantage that contaminants, such as for example exhaust gases or engine oil from the at least one drive motor, are prevented from spreading from the at least one drive motor into the first compartment, into the second compartment and/or into the third compartment. The fourth compartment is thus beneficial for separating necessary but possibly contaminant spreading components from the processes in the first compartment, the second compartment and the third compartment. Thereby, the use of the fourth compartment further contributes to the hygiene of the integrated unit according to an embodiment of the present invention.

Providing the at least one drive motor, or any other components which do not necessarily have to be arranged in the first compartment, the second compartment or the third compartment, in the fourth compartment offers the advantage that the at least one drive motor may be accessed without thereby introducing any contaminants in the first compartment, the second compartment and/or the third compartment.

Positioning the fourth compartment above or below the first compartment, the second compartment and the third compartment offers the advantage that the modules and/or the transport systems in the first compartment, the second compartment and the third compartment which are driven by the at least one drive motor in the fourth compartment are easily accessible, for example via a drive shaft extending in the first compartment, the second compartment or in the third compartment.

Positioning the fourth compartment below the first compartment, the second compartment and the third compartment offers the advantage that the at least one drive motor in the fourth compartment is very easily accessible for maintenance, and that the centre of mass of the integrated unit is lowered which makes the integrated unit more stable.

In an embodiment of the integrated unit according to the present invention the at least one drive motor in the fourth compartment drives the at least one of the first transport system, if present, the second transport system, the third transport system, the first transfer module and the second transfer module via a drive shaft extending into the compartment, selected from the first compartment, the second compartment and the third compartment, housing the at least one of the first transport system, if present, the second transport system, the third transport system, the first transfer module and the second transfer module being driven by the at least one drive motor.

The inventors have found the drive shaft to be a simple and efficient means for driving the modules and/or the transport systems in the first compartment, the second compartment and/or in the third compartment by means of the at least one drive motor, which only takes up a limited amount of space in the first compartment, the second compartment and/or the third compartment. Thereby, thus further contributing to the compact design of the integrated unit according to an embodiment of the present invention.

Furthermore, the inventors have found the drive shaft to be a hygienic means for driving the modules and/or the transport systems in the first compartment, the second compartment and the third compartment by means of the at least one drive motor, which limits the amount of contaminants that may be spread from the fourth compartment on the one hand towards the first compartment, the second compartment and/or the third compartment on the other hand, for example because the drive shaft only requires a small entry opening from the fourth compartment into the first compartment, the second compartment and/or the third compartment. Thereby, thus further contributing to the hygiene of the integrated unit according to an embodiment of the present invention.

In an embodiment of the integrated unit according to the present invention the drive shaft is surrounded by a sleeve in the compartment,

selected from the first compartment, the second compartment and the third compartment, housing the at least one of the first transport system, if present, the second transport system, the third transport system, the first transfer module and the second transfer module being driven by the at least one drive motor.

5 The sleeve surrounding the drive shaft is beneficial for preventing contaminants on the drive shaft from spreading into the first compartment, the second compartment and/or into the third compartment, and thus contributes to the hygiene of the integrated unit according to an embodiment of the present invention.

10 In an embodiment of the integrated unit according to the present invention the preform receiving module, the preform heating module, the container forming module, the container filling module, the container closing module, the first transport system, if present, the second transport system, the third transport system, the first transfer module and the second transfer module are mounted on a support plate. The first transport system, if present, the second transport system, the third transport system, the first transfer module and the second transfer module are provided for transporting the preforms and the containers through the first compartment, through the second compartment and through the third compartment at a predetermined height above the support plate.

20 Providing the transport systems and the transfer modules such that preforms and the containers are transported through the first compartment, through the second compartment and through the third compartment at a predetermined height above the support plate, is beneficial for keeping the transport systems and the container transfer modules compact in size, since they do not have to be provided for transporting the preforms and the containers in a vertical direction, but only in a plane determined by the predetermined height above the support plate.

30 Transporting the preforms and the containers through the first compartment and the second compartment at a predetermined height above the support plate also offers the advantage that the integrated unit may readily be adapted for processing containers of different sizes, and more specifically different heights.

The predetermined height is preferably chosen that containers up to a certain maximum size may be transported through the first compartment, through the second compartment and through the third compartment without contacting the support plate.

5 In an embodiment of the integrated unit according to the present invention the support plate separates the fourth compartment from the first compartment, from the second compartment and from the third compartment.

10 Using the support plate as the separation between the fourth compartment on the one hand and the first compartment, the second compartment and the third compartment on the other hand offers the advantage that no additional means have to be provided to provide in the separation between the fourth compartment on the one hand and the first compartment, the second compartment and the third compartment on the other hand, such that a more compact design of the integrated unit according to an
15 embodiment of the present invention may be achieved.

 In an embodiment of the integrated unit according to the present invention the third compartment is provided with a sump at the bottom. The sump is provided for collecting spilt fluent product and for draining the spilt fluent product out of the third compartment.

20 Providing the third compartment with a sump at the bottom for draining any fluent product spilt during the process of filling the containers out of the third compartment, is beneficial for preventing the spilt fluent product from introducing any contaminants into the third compartment over time. As such, the sump contributes to the hygiene of the integrated unit according to an
25 embodiment of the present invention.

 In an embodiment of the integrated unit according to the present invention the integrated unit further comprises a disinfection module. The disinfection module is provided for disinfecting at least a neck part of the preforms and/or containers. Preferably, the disinfection module is provided for
30 disinfecting by means of ultraviolet radiation. Preferably, the disinfection module is arranged at the preform receiving module provided for disinfecting at least a neck part of the preforms.

 The disinfection module is beneficial for removing possible contaminants on at least a neck part of the preforms and/or containers.

Thereby preventing contaminants from spreading throughout the cabinet. The disinfection module thus further contributes to the hygiene of the integrated unit according to an embodiment of the present invention.

5 In an embodiment of the integrated unit according to the present invention the integrated unit is provided with an air cooling system. The air cooling system comprises a heat exchanger. The air cooling system is provided for extracting heated air from the preform heating module. The air cooling system is provided for cooling the extracted heated air by passing the extracted heated air through the heat exchanger. The air cooling system is provided for providing the cooled air to the integrated unit for further use.

10 The air cooling system offers the advantage that heated air from the preform heating module may be cooled and reused in the integrated unit, thereby reducing the need for fresh air from the exterior of the integrated unit to be supplied to the integrated unit, which fresh air might introduce contaminants into the integrated unit. The air cooling system is thus beneficial for the hygiene of the integrated unit according to an embodiment of the present invention. The use of the heat exchanger, specifically, is beneficial for the energy efficiency of the integrated unit.

15 In an embodiment of the integrated unit according to the present invention the air cooling system is provided such that the fluent product for filling the containers is used as the cooling liquid in the heat exchanger, to which cooling liquid the extracted air emits its heat in the heat exchanger when being cooled.

20 This offers the advantage that no separate cooling liquid has to be provided, which is beneficial for the compact design of the integrated unit according to an embodiment of the present invention.

25 In an embodiment of the integrated unit according to the present invention the cabinet is substantially beam shaped. Preferably, the cabinet is beam shaped. The cabinet has a width in the range from 1,0 m to 1,4 m. Preferably, the cabinet has a width in the range from 1,1 m to 1,3 m. More preferably, the cabinet has a width of approximately 1,2 m. Even more preferably, the cabinet has a width of 1,2 m. The cabinet has a length in the range from 2,4 m to 2,8 m. Preferably, the cabinet has a length in the range from 2,5 m to 2,7 m. More preferably, the cabinet has a length of approximately

2,6 m. Even more preferably, the cabinet has a length of 2,6 m. The cabinet has a height in the range from 1,7 m to 2,1 m. Preferably, the cabinet has a height in the range from 1,8 m to 2,0 m. More preferably, the cabinet has a height of approximately 1,9 m. Even more preferably, the cabinet has a height of 1,9 m.

The cabinet of the integrated unit according to an embodiment of the present invention being substantially beam shaped with the dimensions as described above offers the advantage that the integrated unit may easily be integrated in a freight container, for example for forming a transportable bottling plant. These dimensions of the cabinet allow sufficient space to be left around the integrated unit in the freight container, such that a person operating the integrated unit may easily move around the integrated unit.

Furthermore, these dimensions of the cabinet allow the integrated unit to be positioned in such a way in a freight container that a minimum distance of 60 cm is available between the side wall of the freight container and the integrated unit, at least in the area from the position from where a person would operate the integrated unit towards the exit of the integrated unit, such that, in case of a medical emergency with a person inside the freight container, still sufficient space is available for at least one further person to enter the freight container and to evacuate the person with the medical emergency.

In an embodiment of the integrated unit according to the present invention the preform receiving module, the preform heating module, the container forming module, the container filling module, the container closing module, the container output module, the first transport system, if present, the second transport system, the third transport system, the first transfer module and the second transfer module are arranged such that they are readily accessible by a user from one side of the cabinet.

Arranging the modules and transport systems of the integrated unit in such a way offers the advantage that may quickly access the different modules and transport systems of the integrated unit, without thereby being hindered. This is beneficial for maintenance and repair of the modules and transport systems of the integrated unit or in case of problems in the processes performed by the integrated unit, such as forming, filling and closing the containers.

In an embodiment of the integrated unit according to the present invention the operation of the first transport system, if present, the second transport system, the third transport system, the first transfer module, the second transfer module, and optionally the container output module are synchronised with respect to each other. Preferably, the operation of the first transport system, if present, the second transport system, the third transport system, the first transfer module, the second transfer module, and optionally the container output module are synchronised with respect to each other by means of the central processing unit.

The synchronised operation of the transport systems, the transfer modules, and optionally the container output module is beneficial for enabling a continuous supply of preforms, container closures, fluent product, etc. and a continuous output of filled and closed containers without interruptions. As, such the lead time of the preforms and the containers through the integrated unit is limited as much as possible, thereby further preventing the possibility of contamination of the preforms and containers while being processed in the integrated unit.

This embodiment also allows the integrated unit to be arranged for being operated without any intermediate storage for storing an overflow of preforms or containers between the processing thereof in the different modules of the integrated unit. The absence of such intermediate storage offers the advantage that the integrated unit may be made more compact. The absence of the intermediate storage is also beneficial for the hygienic operation of the integrated unit, since as such any contamination between preforms or containers which might occur in an intermediate storage is prevented.

In an embodiment of the integrated unit according to the present invention the integrated unit further comprises a quality monitoring module. The quality monitoring module is provided for monitoring the quality of preforms and/or containers. The quality monitoring module is provided for instructing, either directly or via the central processing unit, at least one of the first transport system, if present, the second transport system, the third transport system, the first transfer module and the second transfer module to eject preforms or containers if their quality is insufficient. Preferably, the quality monitoring module is provided for instructing, either directly or via the central

processing unit, at least one of the first transfer module and the second transfer module to eject preforms or containers if their quality is insufficient.

5 Providing the integrated unit with the quality monitoring module offers the advantage that defective preforms and containers are removed, such that they may not cause problems in the processes performed by the different modules of the integrated unit. Such problems might for example be the spillage of fluent product during the process of filling the containers, which might cause contamination in the third compartment, or preforms not being formed correctly or getting stuck in the mould during the process of forming the
10 containers. This embodiment is thus beneficial for a continuous and efficient operation of the integrated unit.

The transfer modules being provided for ejecting the preforms and/or the containers, is beneficial in case of problems in one or more of the modules, since as such an overflow of preforms and/or containers may be ejected as
15 long as the problem in the one or more of the modules is not solved, without thereby having to interrupt any of the processes still going on in any of the other modules of the integrated unit. This also prevents that for such cases some kind of intermediate storage for the overflow of preforms and/or containers needs to be provided.

20 For preforms the quality monitoring module may for example be any kind of suitable temperature sensor known by the skilled person, which monitors if the temperature of the preform is sufficient for forming a container from the preform in the mould, for example by blow moulding.

25 For containers the quality monitoring module may for example be any kind of suitable pressurising device known by the skilled person in combination with any kind of suitable pressure sensor known by the skilled person, which pressure sensor monitors if there are no leaks in the container when it is pressurised by the pressurising device.

30 For containers the quality monitoring device may for example also be any kind of suitable imaging device known by the skilled person, which monitors if the shape of the container has the desired shape.

In an embodiment of the integrated unit according to the present invention the container output module comprises a transport belt system through the exit opening.

The transport belt system may be a single transport belt extending from the third transport system through the exit opening towards the exterior of the cabinet. The transport belt system may also be a plurality of transport belts arranged for passing the containers between the different transport belts, wherein a first set of transport belts is arranged from the second transport system up till the exit opening and a second set of transport belts continues at the exterior of the cabinet from the exit opening. This offers the advantage that there is no direct contact between the first set of transport belts arranged in the third compartment and the second set of transport belts arranged at the exterior of the cabinet, such that contaminants are prevented from spreading from the exterior of the cabinet to the third compartment and vice versa via the transport belts.

The use of the transport belt system through the exit opening as the container output module offers the advantage that no direct contact between the third transport system transporting the containers out of the container closing module and the container output module is necessary, which is beneficial for preventing contaminants from spreading from the container output module to the third transport system, the container closing module and the container filling module in the third compartment. The filled and closed containers, when leaving the container closing module, only need to be positioned above the transport belt system by the third transport system and subsequently dropped onto the transport belt system. The use of the transport belt system as the container output module also has the additional advantage that the transport belt system may easily be cleaned and/or disinfected if required. As such, the transport belt system further contributes to the hygiene of the integrated unit according to an embodiment of the present invention.

The transport belt system also offers the advantage that it may easily be driven by a drive motor arranged at the exterior of the cabinet, thereby eliminating the spreading of any contaminants by the drive motor into the third compartment, which contributes to the hygiene of the integrated unit according to an embodiment of the present invention.

In an embodiment of the integrated unit according to the present invention the transport belt system of the container output module is adjustable in height for adapting the integrated unit to different container sizes.

Providing the transport belt system of the container output module such that the height of the transport belt system is adjustable, offers the advantage that independent of the size of the containers, the transport belt system may always positioned in such a way that containers are dropped off stably on the transport belt system. The transport belt system may thus be adapted to minimise the drop height of the containers on the transport band, and thereby preventing the containers from falling off the transport band on the floor of the third compartment, from where the containers are difficult to recover without contaminating the third compartment.

10 In an embodiment of the integrated unit according to the present invention the mould of the container forming module is exchangeable for adapting the integrated unit to different container sizes.

Providing the container forming module in such a way that the mould for forming the containers is exchangeable, offers the advantage that the integrated unit may be converted quickly and easily for forming containers of different sizes and/or shapes. This offers the advantage that there need not to be provided different designs of the integrated unit for forming containers of different sizes and/or shapes, but that only a single design of the integrated unit needs to be provided which may readily be adapted to different container sizes and/or shapes by merely exchanging the mould of the container forming module.

20 In an embodiment of the integrated unit according to the present invention the air pressure control system is provided for maintaining a pressure difference between compartments in the range from 0.1 atm to 0.2 atm.

25 The inventors have found the pressure difference between the compartments being in the range from 0.1 atm to 0.2 atm to be an optimal balance between on the one hand being sufficient for achieving the effect of preventing any airborne contaminants from entering the compartment with the elevated air pressure and the effect of removing any possible airborne contaminants in the compartment with the elevated air pressure out of said compartment, and on the other hand reducing the energy usage of the air pressure control system.

30 If, in an embodiment of the integrated unit according to the present invention the air pressure control system would also be provided for elevating

the air pressure in the first compartment with respect to the air pressure at the exterior of the cabinet, the air pressure control system would preferably also be provided for maintaining a pressure difference between the exterior of the cabinet and the first compartment in the range from 0.1 atm to 0.2 atm with the same advantages as described above.

In an embodiment of the integrated unit according to the present invention the integrated unit further comprises a container labelling module adjacent to the exit opening. Preferably, the container labelling module is arranged at the outside of the cabinet. The container labelling unit is provided for putting labels on filled and closed containers being outputted out of the cabinet via the exit opening.

Arranging the container labelling module at the outside of the cabinet offers the advantage that in such a way the container labelling module is prevented from spreading contaminants into the cabinet, and especially into the third compartment of the cabinet.

In an embodiment of the integrated unit according to the present invention the integrated unit comprises a further separation wall according to a configuration different from the configuration of the separation wall.

The use of the further separation wall in addition to the separation wall offers a separation between the first compartment, the second compartment and the third compartment for preventing contaminants from spreading between said compartments, as already discussed above, which is beneficial for the hygiene of the integrated unit according to an embodiment of the present invention.

In an embodiment of the integrated unit according to the present invention the integrated unit comprises the separation wall according to the first configuration. The container forming module is integrated with the container filling module such that the fluent product for filling the containers is also used for forming the containers from the heated preforms in the mould of the container forming module.

The integration of the container forming module and the container filling module offers the advantage that the integrated unit can be made more compact, and also offers the advantage that no additional fluid (i.e. liquid or

gas) has to be provided for forming the containers from the heated preforms in the mould, for example by means of blow moulding.

5 The use of the fluent product instead of a gas for blow moulding the containers in the mould, also offers the advantage that no compressor is required for compressing the gas, which increases the energy efficiency and cost of the integrated unit.

10 It should be clear to the skilled person that with the integration of the container forming module and the container filling module also the second compartment and the third compartment can be integrated in a single compartment.

15 The integrated unit according to any one of the preceding claims, wherein the integrated unit comprises a ventilation system for the preform heating module, the ventilation system being provided for passing air from the exterior of the cabinet via the preform heating module and for extracting the air after heating in the preform heating module back to the exterior of the cabinet, the ventilation system comprising an air filter for filtering contaminants out of the air before entering the cabinet.

20 The ventilation system comprising the air filter are a beneficial means for preventing heat from being built up inside the cabinet without introducing contaminants inside the cabinet.

In this way the preform heating module can beneficially be cooled by using fresh air from the exterior of the cabinet, without requiring more energy consuming devices for cooling the preform heating module.

25 The ventilation system of the integrated unit also offers the advantage that it also may be used for cooling a neck part of the preforms in the preform heating module, thereby aiding in preventing possible deformations of the neck part of the preforms by overheating of said neck part.

30 The invention further provides a transportable bottling plant comprising a freight container in which the integrated unit according to an embodiment of the present invention is provided.

Brief description of the drawings

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

5 Figure 1 shows a perspective view of an integrated unit according to an embodiment of the present invention.

Figure 2 shows a perspective view on a stripped down version of the integrated unit of Figure 1.

Figure 3 shows a top view of the integrated unit of Figure 1.

Figure 4 shows a front view of the integrated unit of Figure 1.

10 Figure 5 shows a cross section of the integrated unit of Figure 1 along line A-A shown in Figure 3.

Figure 6 shows a cross section of the integrated unit of Figure 1 along line B-B shown in Figure 5.

15 Figure 7 shows a preform providing unit for use with the integrated unit according to an embodiment of the present invention.

Modes for carrying out the invention

20 The present invention will be described 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 necessarily correspond to actual reductions to practice of the invention.

25 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 circumstances and the embodiments of the invention can operate in other sequences than described or illustrated herein.

30 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 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 not exclude other
5 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,
10 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.

As used herein, with a “freight container” is meant an intermodal container compliant with the dimensional requirements for an ISO 668 standard 20-foot freight container. The height of such a freight container is
15 typically 8 or 8.6 feet.

As used herein, with “container” 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
20 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 “container” 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
25 hardly narrower than the body part.

As used herein, with “bottling plant” is meant to include any plant in which a container, 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
30 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.

Figures 1-6 show an integrated unit for forming, filling and closing containers 1 according to an embodiment of the present invention, which is shown from different viewpoints. Figures 1 and 2 show the integrated unit in a perspective view. In Figure 1 some side panels of the integrated unit are removed to show the interior of the integrated unit. In Figure 2 some exterior components of the integrated unit are removed to provide a better view on the interior of the integrated unit. Figures 3 and 4 respectively show a top view and a front view of the integrated unit. Figures 5 and 6 each show a cross section through the integrated unit. The cross section of Figure 5 is taken along line A-A shown in Figure 3, and the cross section of Figure 6 is taken along line B-B shown in Figure 5.

The integrated unit comprises a cabinet 3 in which the main modules for forming, filling and closing the containers 1 are integrated. The cabinet 3 is provided with an input opening 4 which is sized for inputting thermoplastic container preforms 2 into the cabinet 3, and with an exit opening 5 which is sized for outputting filled and closed containers 1 out of the cabinet 3.

The cabinet 3 of the integrated unit comprises a first compartment 6 containing the modules for heating preforms 2, a second compartment 7 containing the modules for forming containers 1 and a third compartment 8 comprising the modules for filling and closing the containers 1. In this embodiment, the second compartment 7 and the third compartment 8 are separated from each other by means of a separation wall 10 according to a second configuration of the separation wall 10, but the separation wall may also be located between the first compartment 6 and the second compartment 7 according to a first configuration (not shown). The separation wall 10 has a transfer opening 11 which is sized for allowing containers 1 formed in the second compartment 7 to be passed to the third compartment 9. This division offers the advantage that the processes for heating the preforms 2 and for forming the containers 1, which have less strict hygienic requirements, are separated from the processes for filling and closing the containers 1, which have more strict hygienic requirements, such that the risk of contaminants spreading between the different modules is strongly reduced. This is certainly advantageous when constructing a compact integrated unit where the different modules have to be positioned as close as possible with respect to each other.

The hygienic separation between the different modules and thus processes is even further enhanced by elevating the air pressure in the third compartment 8 with respect to the air pressure in the second compartment 7 and the first compartment 6 by means of an air pressure control system, such that airborne contaminants entering the third compartment 8 are blown back out of the third compartment 8.

The first compartment 6 is located in the cabinet 3 adjacent to the input opening 4. In the first compartment 6 there is mounted a preform receiving module 14 and a preform heating module 15. The first compartment 6 is also provided with a first transport system 21 for transporting the preforms 2 through the first compartment 6.

The preform receiving module 14 is provided for receiving the preforms 2 which are inserted into the cabinet 3 via the input opening 4. Here, the preforms 2 are inserted into the cabinet 3 from a separate preform providing unit 36 arranged at the exterior of the cabinet 3 near the input opening 4. An example of such a preform providing unit 36 is shown in Figure 7. The preform receiving module 14 is further provided for delivering these preforms 2 to the first transport system 21 for further transportation through the first compartment 6. In this embodiment the preform receiving module 14 is provided by means of two parallel and downward inclined gliding rails, but may be provided by any other suitable means known by the skilled person.

The preform heating module 15 is provided for heating the preforms 2 by means of an heating oven. In this embodiment, the heating oven is provided with infrared lamps 16 for heating the preforms 2. Furthermore, the heating oven is provided with a heat shield of a ceramic material which is arranged for protecting the neck part of the preforms 2 from getting heated, which could cause undesired deformations of the neck part of the preforms 2 and the containers 1 formed from the preforms 2.

The preforms 2 are transported through the heating oven by means of a chain-linked carrier system 21, which forms part of the first transport system 21. The chain-linked carrier system 21 is driven by a drive motor 32 via a drive shaft 33. The chain-linked carrier system 21 comprises a plurality of carrier elements 22 which are each provided for carrying a preform 2, thereby supporting it at the neck part. The chain-linked carrier system 21 is arranged

such that preforms 2 carried by adjacent carrier elements 22 are located at a distance of approximately 63 mm from each other when passing through the heating oven. In this way five to six preforms 2 may be heated simultaneously in the heating oven at any time, without requiring a large number of infrared lamps 16, which improves the energy efficiency of the preform heating module 5 15 and thus of the integrated unit.

The heated preforms 2 exiting the heating oven are taken off the chain-linked carrier system 21 and transported to the container forming module 17 in the second compartment 7 of the integrated unit by means of a first rotatable gripping device 23 which forms part of a first transfer module 23 of the 10 integrated unit for transferring preforms 2 from the first compartment 6 to the second compartment 7. The first rotatable gripping device 23 comprises a rotatable arm 24 which is at one end attached to a drive shaft 33 connected to a drive motor 32 for driving the rotatable arm 24. At the opposite end the 15 rotatable arm 24 is provided with a clamp part 25 provided for gripping the preforms 2 at the neck part. The benefit of using such a rotatable arm 24 is that there is no direct connection between the preform heating module 15 and the container forming module 17 via which contaminants may spread between those modules.

20 Optionally, the integrated unit may be provided with a preform quality monitoring module (not shown) arranged between the preform heating module 15 and the container forming module 17 and provided for monitoring the quality of a preform 2 which is passed from the preform heating module 15 to the container forming module 17 with the first rotatable gripping device 23. The 25 preform quality monitoring module may for example comprise a temperature sensor for monitoring the temperature of the preform 2 or an imaging system or optical scanning system for optically inspecting the shape or physical properties of the preform 2. Preferably, the preform quality monitoring module is provided for instructing the first rotatable gripping device 23 to release the 30 preform 2 and drop it on the floor of the first compartment 6, such that the defect preform 2 is not used in the further processes for forming, filling and closing containers 1 where it might cause problems.

The container forming module 17 in the second compartment 7 comprises a mould 18 for forming containers 1 from the heated preforms 2 by

means of blow moulding. Preferably, the mould 18 is a replaceable mould 18 such that the integrated unit may readily be adapted for forming containers 1 of different sizes and/or shapes.

At the transfer opening 11 there is mounted a second transfer module
5 28, which is provided for taking the container 1 formed in the mould 18 of the container forming module 17 out of the mould 18 and transporting said container 1 through the transfer opening 11 to the third compartment 8. In this embodiment, the second transfer module 28 comprises a second rotatable gripping device 28. The second rotatable gripping device 28 is arranged
10 similarly to the first rotatable gripping device 23, thus having a rotatable arm 29 which is at one end attached to a drive shaft 33 connected to a drive motor 32 for driving the rotatable arm 29. At the opposite end the rotatable arm 29 is provided with a clamp part 30 for gripping the containers 1 at the neck part. This has the advantage that there is no direct connection between the second
15 compartment 7 and the third compartment 8 via which contaminants may spread between those compartments.

The third compartment 8 is located in the cabinet 3 adjacent to the second compartment 7 and adjacent to the exit opening 5. In the third compartment 8 there is mounted a container filling module 19 and a container
20 closing module 20. The third compartment 8 is also provided with a third transport system 26 for transporting the containers 1 through the third compartment 8.

The container filling module 19 is provided for filling the containers 1, which have been formed in the second compartment 7, with a fluent product.
25 At the bottom of the third compartment 8 there is arranged a sump 13 which is provided for collecting fluent product spilled by the container filling module 19 and for removing said spilt fluent product out of the third compartment 8 via a drain. The container closing module 20 is provided for closing the filled containers 1 with a container closure, such as for example caps and more
30 specifically screw caps provided for being screwed onto the neck part of the containers 1.

In this embodiment, the container filling module 19 and the container closing module 20 are arranged at the circumference of a rotatable container carrying wheel 26, which forms part of the third transport system 26. The

rotatable carrying wheel is driven by a drive motor 32 via a drive shaft 33. The rotatable carrying wheel 26 is provided at its circumference with equidistantly spaced recesses 27 in which containers 1 may be positioned with their neck part.

5 Containers 1, which have been filled with a fluent product by the container filling module 19 and which have been closed with a container closure by the container closing module 20, are released by the third transport system 26 onto the container output module 31 which is provided for transporting containers 1 out of the cabinet 3 via the exit opening 5. In this
10 embodiment, the container output module 31 comprises a transport belt system 31 with a single transport belt 31 extending from the third transport system 26 to the exterior of the cabinet 3 via the exit opening 5. Preferably, the transport belt system 31 is adjustable in height, such that the container output module 31 is readily adaptable for receiving containers 1 of different sizes from
15 the third transport system 26. At the exterior of the cabinet 3 there is arranged a separate container labelling unit 44 along the transport belt system 31. The container labelling unit 44 is provided for putting labels on the filled and closed containers 1 exiting the cabinet 3 of the integrated unit.

Optionally, the integrated unit may also be provided with a disinfection
20 module (not shown) arranged at the third transport system 26 before the container filling module 19. The disinfection module is provided for disinfecting at least a neck part of the containers 1 transferred to the third transport system 26 by the second transfer module 28. The disinfection module may for example comprise a source of ultraviolet radiation for disinfecting at least the neck part
25 of the containers 1.

Optionally, the integrated unit may be provided with a container quality monitoring module (not shown) arranged at the second transfer module 28
30 between the container forming module 17 and the third transport system 26 or the container filling module 19 and provided for monitoring the quality of a container 1 which is passed from the container forming module 17 to respectively the third transport system 26 or the container filling module 19 with the second transfer module 28. The container quality monitoring module may for example comprise the combination of a pressurising device and temperature sensor, which is provided for pressuring the container 1 and

simultaneously monitoring the pressure inside the container 1 to detect leakages in the container 1. The container quality monitoring module may for example also comprise an imaging system or optical scanning system for optically inspecting the shape or physical properties of the container 1.

5 Preferably the container quality monitoring module is provided for instructing the second transfer module 28 to release the container 1 and drop it on the floor of the second compartment 7 or the floor of the third compartment 8, such that the defect container 1 is not used in the further processes for filling and closing containers 1 where it might cause problems.

10 The integrated unit is provided with a single central processing unit which is operatively connected to the different modules and systems of the integrated unit, such as the preform receiving module 14, the preform heating module 15, the container forming module 17, the container filling module 19, the container closing module 20, the container output module 31, the first transport system 21, the third transport system 26, the first transfer module 23,

15 the second transfer module 28 and the air pressure control system, but not limited thereto. The central processing unit is provided for controlling the operation of the different modules and systems of the integrated unit. This is, for example, beneficial for synchronising the operation of the different modules and systems of the integrated unit with respect to each other, such that a smooth flow of preforms 2 and containers 1 through the integrated unit may be achieved. As such, the integrated unit may be operated without requiring any buffer zones for storing any abundant preforms 2 or containers 1 between the different modules. An example of such a synchronisation between systems and

20 modules of the integrated unit is synchronising the motion of the second rotatable gripping device 28 to the rotation of the rotatable carrying wheel 26 such that rotatable arm 29 of the second rotatable gripping device 28 always positions the preforms 2 in the recesses 27 of the rotatable carrying wheel 26.

25 Furthermore, the integrated unit is provided at the exterior of the cabinet with a human machine interface 35, which is operatively connected to the central processing unit. In this way, a user of the integrated unit may easily control the operation of the integrated unit from a single location which is beneficial for the ease of use of the integrated unit.

30

To further improve the ease of use, and more specifically the maintainability, of the integrated unit, the modules and the systems of the integrated unit are arranged in such a way that they are readily accessible from a single side of the cabinet 3 of the integrated unit, as for example can be seen in Figure 3.

In this embodiment, the cabinet 3 of the integrated unit also comprises a fourth compartment 9 besides the first compartment 6, the second compartment 7 and the third compartment 8. The fourth compartment 9 is arranged below the first compartment 6, the second compartment 7 and the third compartment 8. The fourth compartment 9 is separated from the first compartment 6, the second compartment 7 and the third compartment 8 by means of a support plate 12 on which the different modules and systems in the first compartment 6, the second compartment 7 and the third compartment 8 are mounted. The fourth compartment 9 is provided for housing components of the integrated unit which are less hygienic and may cause contamination inside the first compartment 6, the second compartment 7 and the third compartment 8. Such components may for example be the drive motors 32 which drive the different modules and systems mounted in the first compartment 6, the second compartment 7 and the third compartment 8 via drive shafts 33. To prevent contaminants spreading from the fourth compartment 9 into the first compartment 6, the second compartment 7 and the third compartment 8, the drive shafts 33 extending from the fourth compartment 9 into the first compartment 6, the second compartment 7, and the third compartment 8 are surrounded by sleeves 34.

In this embodiment, the first transport system 21, the third transport system 26 and the second transfer module 28 are provided in such a way that the preforms 2 and containers 1 are transported through the first compartment 6, the second compartment 7 and the third compartment 8 with their neck part substantially arranged in the same plane, indicated by line N in Figure 5, which plane is located at a predetermined height above the support plate 12. In this way, there is sufficient space available below said plane for transporting preforms 2 and, more importantly, containers 1 of different sizes through the first compartment 6, the second compartment 7 and the third compartment 8.

In this embodiment, the integrated unit comprises a further cabinet left of the cabinet 3 housing a power source for powering the different modules and systems of the integrated unit, but it should be clear to the skilled person that in alternative embodiments the integrated unit may also be provided for being connected to external power sources.

Figure 7 shows a preform providing unit 36 which may be used together with the integrated unit according to an embodiment of the present invention, but also with any other kind of container forming device which forms containers 1 from preforms 2. The preform providing unit 36 may be separate from the integrated unit, but can also be integrated with the integrated unit, for example by fixing it against the cabinet 3 at the input opening 4.

The preform providing unit 36 comprises a preform storage compartment 37 (preform buffer, preform hopper or preform bin), a preform elevator 38 and a preform orienter 39 (preform sorter or preform aligner).

Preforms 2 are provided in the preform storage compartment 37 from which the preforms 2 are lifted upwards in a vertical direction by means of the preform elevator 38. Therefore, the preform elevator 38 is provided with an elevator belt 42 having protruding elements or fingers 43 which grab the preforms 2, preferably at their neck part. At the top of the preform elevator 38, the preforms 2 are transferred from the elevator belt 42 towards the preform orienter 39 by means of a cam 40 which guides the preforms 2 from the elevator belt 42 towards the preform orienter 39. The cam 40 is provided with cut-outs 41 through which the fingers 43 of the preform elevator 38 can pass without contacting the cam 40. From, the preform orienter 39, the preforms 2 are then transported towards the input opening 4 of the cabinet 3 of the integrated unit.

The preform providing unit 36 is arranged such that the preform storage compartment 37 and the preform orienter 39 are arranged on the same side of the preform elevator 38. This arrangement offers the advantage allows a compact design of the preform providing unit 36 and of an integrated unit with the preform providing unit 36 integrated in it, and is thus beneficial for space saving.

The preform elevator 38 being mounted vertically also contributes to a compact design of the preform providing unit 36 and of an integrated unit with

the preform providing unit 36 integrated in it, and is thus beneficial for space saving.

References:

5	1	container		23	first rotatable gripping device
	2	preform		24	rotatable arm
	3	cabinet		25	clamp part
	4	input opening	30	26	rotatable container carrying wheel
	5	exit opening		27	recess
10	6	first compartment		28	2 nd rotatable gripping device
	7	second compartment		29	rotatable arm
	8	third compartment		30	clamp part
	9	fourth compartment	35	31	transport belt
	10	separation wall		32	drive motor
15	11	transfer opening		33	drive shaft
	12	support plate		34	sleeve
	13	sump		35	human machine interface
	14	preform receiving module	40	36	preform providing unit
	15	preform heating module		37	preform storage compartment
20	16	infrared lamp		38	preform elevator
	17	container forming module		39	preform orienter
	18	mould		40	cam
	19	container filling module	45	41	cut-out
	20	container closing module		42	elevator belt
25	21	chain-linked carrier system		43	finger
	22	carrier element		44	container labelling unit

Claims

1. An integrated unit for forming, filling and closing containers (1), the integrated unit comprising:

- 5 – a cabinet (3) with an input opening (4) sized for inputting thermoplastic container preforms (2) and an exit opening (5) sized for outputting filled and closed containers (1);
- 10 – a first compartment (6) in the cabinet (3) adjacent to the input opening (4), in which a preform receiving module (14) is mounted for receiving thermoplastic container preforms (2) via the input opening (4), in which a preform heating module (15) is mounted for heating the preforms (2), and in which a first transport system (21) is provided for transporting the preforms (2) through the first compartment (6);
- 15 – a second compartment (7) in the cabinet (3) adjacent to the first compartment (6), in which a container forming module (17) is mounted for forming containers (1) from the heated preforms (2) in a mould (18), and in which optionally a second transport system is provided for transporting the preforms (2) and the containers (1) formed from the preforms (2) through the second compartment (7);
- 20 – a third compartment (8) in the cabinet (3) adjacent to the second compartment (7) and adjacent to the exit opening (5), in which a container filling module (19) is mounted for filling the containers (1) which are formed in the second compartment (7) with a fluent product, in which a container closing module (20) is mounted for closing the filled containers (1) with a container closure, and in which a third transport system (26) is provided for transporting the
- 25 containers (1) through the third compartment (8);
- a first transfer module (23) for transferring preforms (2) from the first compartment (6) to the second compartment (7);
- a second transfer module (28) for transferring containers (1) from the second compartment (7) to the third compartment (8);
- 30 – an air pressure control system;
- a separation wall (10) according to a first configuration or a second configuration, wherein in the first configuration the separation wall (10) is arranged between the first compartment (6) and the second compartment (7), the

separation wall (10) has a transfer opening (11) which is sized for allowing passage of preforms (2) from the first compartment (6) to the second compartment (7), the first transfer module (23) is mounted at the transfer opening (11) for transferring preforms (2) from the first compartment (6) to the second compartment (7) via the transfer opening (11) in the separation wall (10) and the air pressure control system is provided for elevating the air pressure in the second compartment (7) with respect to the air pressure in the first compartment (6), and wherein in the second configuration the separation wall (10) is arranged between the second compartment (7) and the third compartment (8), the separation wall (10) has a transfer opening (11) which is sized for allowing passage of containers (1) from the second compartment (7) to the third compartment (8), the second transfer module (28) is mounted at the transfer opening (11) for transferring containers (1) from the second compartment (7) to the third compartment (8) via the transfer opening (11) in the separation wall (10) and the air pressure control system is provided for elevating the air pressure in the third compartment (8) with respect to the air pressure in the second compartment (7);

– a container output module (31) mounted at the exit opening (5) for outputting containers (1) filled and closed in the third compartment (8) out of the cabinet (3) via the exit opening (5);

– a single central processing unit, operatively connected to the modules and systems of the integrated unit, and provided for controlling the operation of the modules and systems of the integrated unit; and

– a human machine interface (35), operatively connected to the central processing unit, and provided for enabling a user to control the operation of the modules and systems of the integrated unit by means of the central processing unit.

2. The integrated unit according to claim 1, wherein the first transport system (21) comprises a chain-linked carrier system (21) provided for transporting preforms (2) from the preform receiving module (14) through the preform heating module (15).

3. The integrated unit according to claim 1 or 2, wherein the third transport system (26) comprises a rotatable container carrying wheel (26) for transporting containers (1) along the container filling module (19) and the

container closing module (20) and for releasing closed and filled containers (1) to the container output module (31).

4. The integrated unit according to any one of the preceding claims, wherein the third transport system comprises delay means for delaying transport of the containers (1) to the container filling module (19) for a predetermined time period, wherein, in combination with the preceding claim, the delay means preferably comprise a further rotatable container carrying wheel driven by the rotation of the rotatable container carrying wheel (26).

5. The integrated unit according to any one of the preceding claims, wherein at least one of the first transfer module (23) and the second transfer module (28) comprises a rotatable gripping device (23, 28).

6. The integrated unit according to any one of the preceding claims, wherein the cabinet (3) further comprises a fourth compartment (9) above or below, preferably below, the first compartment (6), the second compartment (7) and the third compartment (8) and separated from the first compartment (6), the second compartment (7) and the third compartment (8), and wherein at least one of the first transport system (21), if present, the second transport system, the third transport system (26), the first transfer module (23) and the second transfer module (28) is driven by at least one drive motor (32) mounted in the fourth compartment (9).

7. The integrated unit according to the preceding claim, wherein the at least one drive motor (32) in the fourth compartment (9) drives the at least one of the first transport system (21), if present the second transport system, the third transport system (26), the first transfer module (23) and the second transfer module (28) via a drive shaft (33) extending into the compartment, selected from the first compartment (6), the second compartment (7) and the third compartment (8), housing the at least one of the first transport system (21), if present the second transport system, the third transport system (26), the first transfer module (23) and the second transfer module (28) being driven by the at least one drive motor (32).

8. The integrated unit according to the preceding claim, wherein the drive shaft (33) is surrounded by a sleeve (34) in the compartment, selected from the first compartment (6), the second compartment (7) and the third compartment (8) housing the at least one of the first transport system (21), if present the second

transport system, the third transport system (26), the first transfer module (23) and the second transfer module (28) being driven by the at least one drive motor (32).

5 9. The integrated unit according to any one of the preceding claims, wherein the preform receiving module (14), the preform heating module (15), the container forming module (17), the container filling module (19), the container closing module (20), the first transport system (21), if present, the second transport system, the third transport system (26), the first transfer module (23) and the second transfer module (28) are mounted on a support plate (12), and
10 wherein the first transport system (21), if present, the second transport system, the third transport system (26), the first transfer module (23) and the second transfer module (28) are provided for transporting the preforms (2) and the containers (1) through the first compartment (6), through the second compartment (7) and through the third compartment (8) at a predetermined
15 height above the support plate (12).

10 10. The integrated unit according to the preceding claim at least in combination with claim 6, wherein the support plate (12) separates the fourth compartment (9) from the first compartment (6), from the second compartment (7) and from the third compartment (8).

20 11. The integrated unit according to any one of the preceding claims, wherein the third compartment (8) is provided with a sump (13) at the bottom, the sump (13) being provided for collecting spilt fluent product and for draining the spilt fluent product out of the third compartment (8).

25 12. The integrated unit according to any one of the preceding claims, wherein the integrated unit further comprises a disinfection module for disinfecting, preferably by means of ultraviolet radiation, at least a neck part of the preforms (2) and/or containers (1).

30 13. The integrated unit according to any one of the preceding claims, wherein the integrated unit is provided with an air cooling system comprising a heat exchanger, wherein the air cooling system is provided for extracting heated air from the preform heating module (15), for cooling the extracted heated air by passing the extracted heated air through the heat exchanger, and for providing the cooled air to the integrated unit for further use.

14. The integrated unit according to any one of the preceding claims, wherein the cabinet (3) is substantially beam shaped, preferably beam shaped, wherein the cabinet (3) has a width in the range from 1,0 m to 1,4 m, preferably a width in the range from 1,1 m to 1,3 m, more preferably a width of approximately 1,2 m and even more preferably a width of 1,2 m, wherein the cabinet (3) has a length in the range from 2,4 m to 2,8 m, preferably a length in the range from 2,5 m to 2,7 m, more preferably a length of approximately 2,6 m and even more preferably a length of 2,6 m, and wherein the cabinet (3) has a height in the range from 1,7 m to 2,1 m, preferably a height in the range from 1,8 m to 2,0 m, more preferably a height of approximately 1,9 m and even more preferably a height of 1,9 m.

15. The integrated unit according to any one of the preceding claims, wherein the preform receiving module (14), the preform heating module (15), the container forming module (17), the container filling module (19), the container closing module (20), the container output module (31), the first transport system (21), if present, the second transport system, the third transport system (26), the first transfer module (23) and the second transfer module (28) are arranged such that they are readily accessible by a user from one side of the cabinet (3).

16. The integrated unit according to any one of the preceding claims, wherein the operation of the first transport system (21), if present, the second transport system, the third transport system (26), the first transfer module (23), the second transfer module (28) and optionally the container output module (31) are synchronised with respect to each other, preferably by means of the central processing unit.

17. The integrated unit according to any one of the preceding claims, wherein the integrated unit further comprises a quality monitoring module for monitoring the quality of preforms (2) and/or containers (1), wherein the quality monitoring module is provided for instructing at least one of the first transport system (21), if present, the second transport system, the third transport system (26), the first transfer module (23) and the second transfer module (28) either directly or via the central processing unit, to eject preforms (2) or containers (1) if their quality is insufficient.

18. The integrated unit according to any one of the preceding claims, wherein the integrated unit comprises a further separation wall according to a configuration different from the configuration of the separation wall (10).

5 19. The integrated unit according to any one of the claims 1-17, wherein the integrated unit comprises the separation wall (10) according to the first configuration, and wherein the container forming (17) module is integrated with the container filling module (19) such that the fluent product for filling the containers (1) is also used for forming the containers (1) from the heated preforms (2) in the mould (18) of the container forming module (17).

10 20. The integrated unit according to any one of the preceding claims, wherein the integrated unit comprises a ventilation system for the preform heating module (15), the ventilation system being provided for passing air from the exterior of the cabinet (3) via the preform heating module (15) and for extracting the air after heating in the preform heating module (15) back to the exterior of the cabinet (3), the ventilation system comprising an air filter for filtering contaminants out of the air before entering the cabinet (3).

15 21. A transportable bottling plant comprising a freight container in which the integrated unit according to any one of the preceding claims is provided.

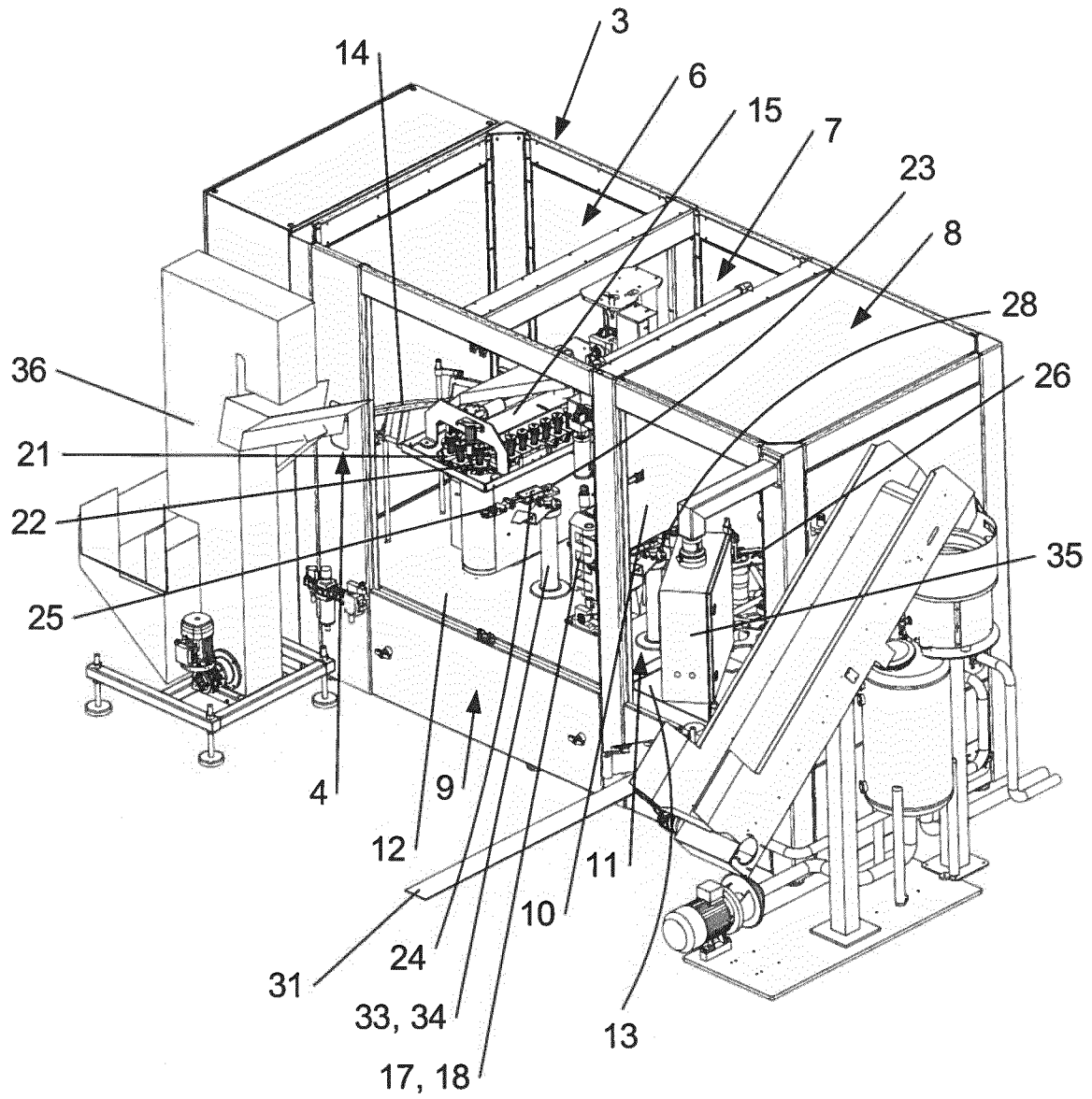


Fig. 1

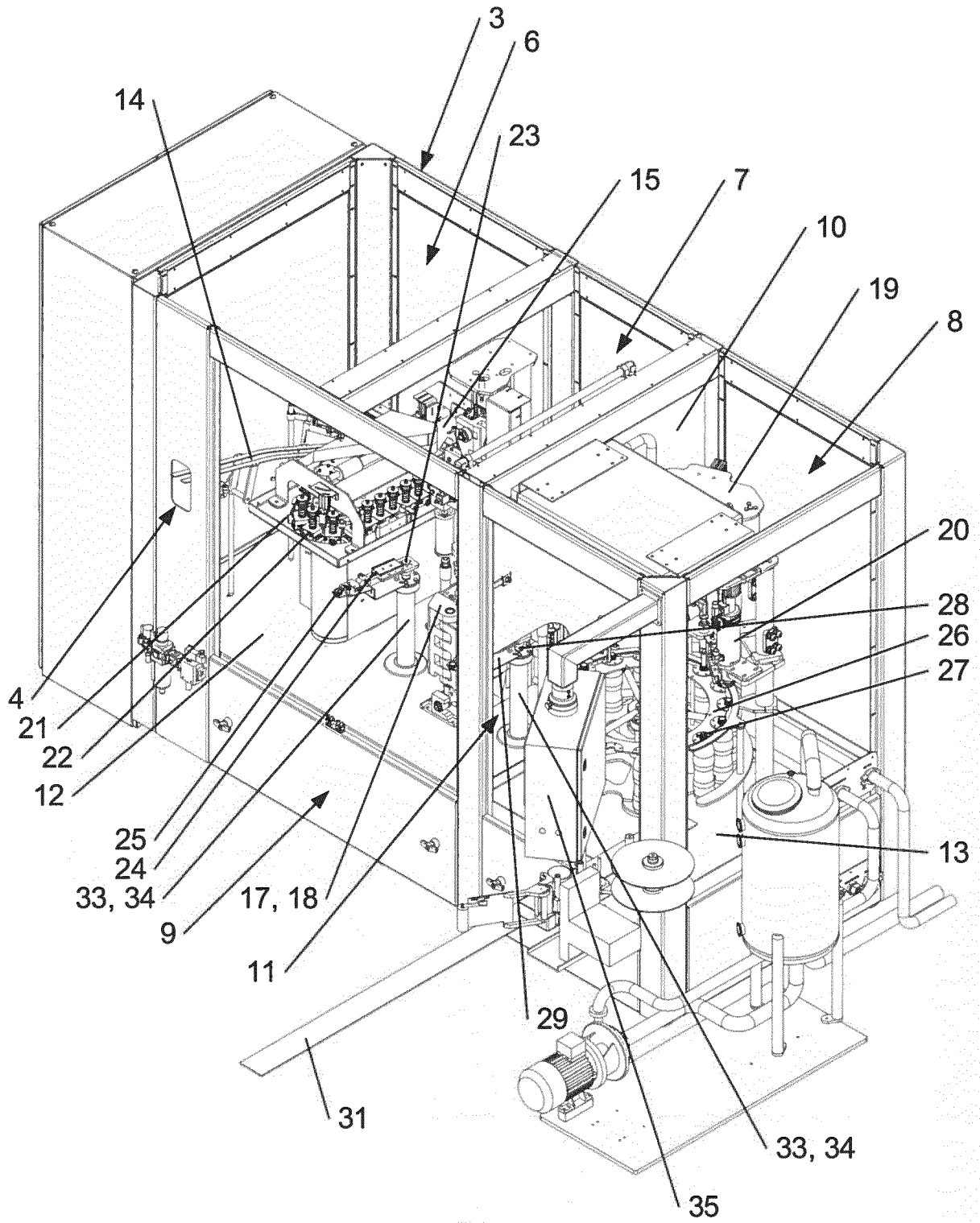
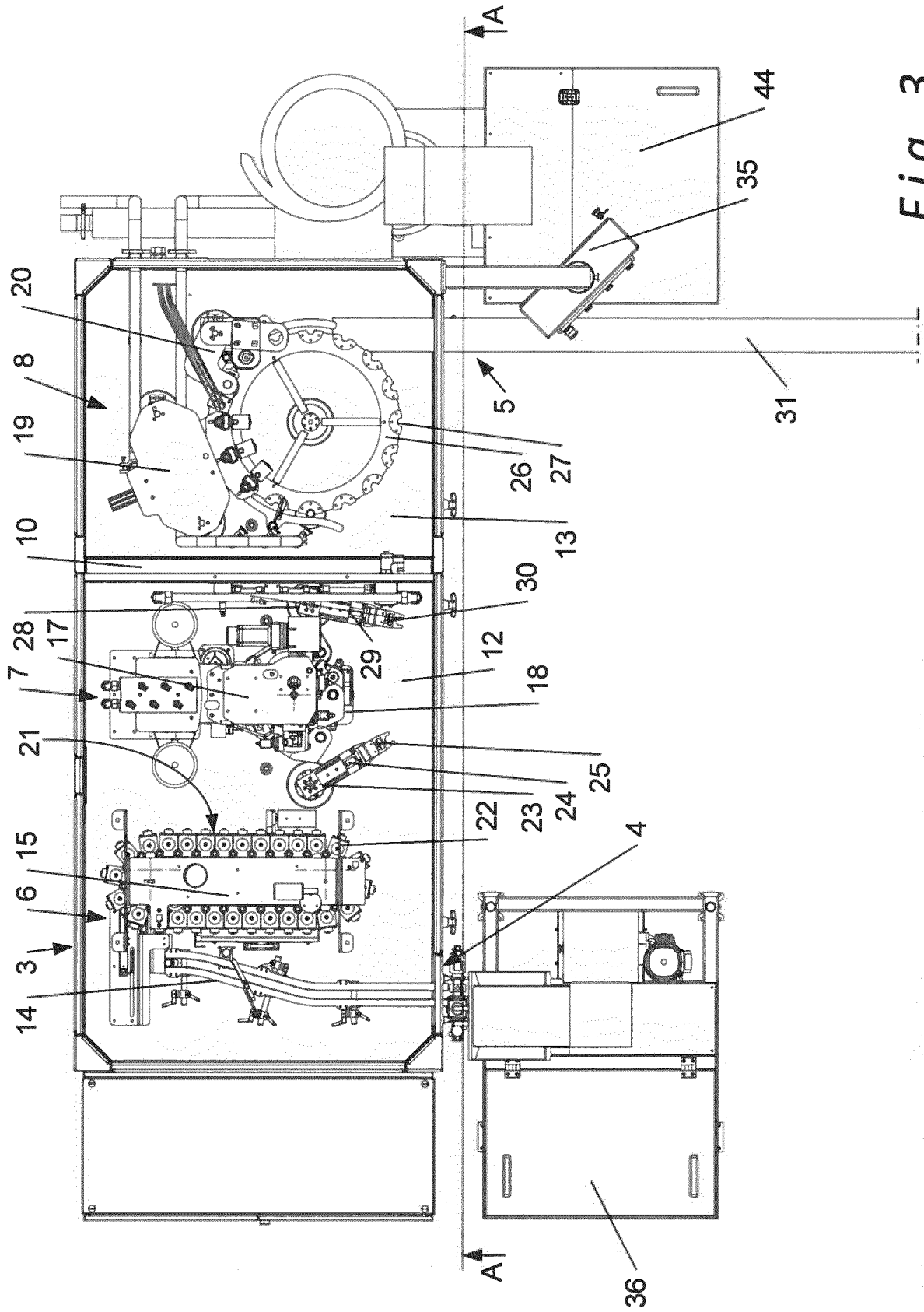


Fig. 2



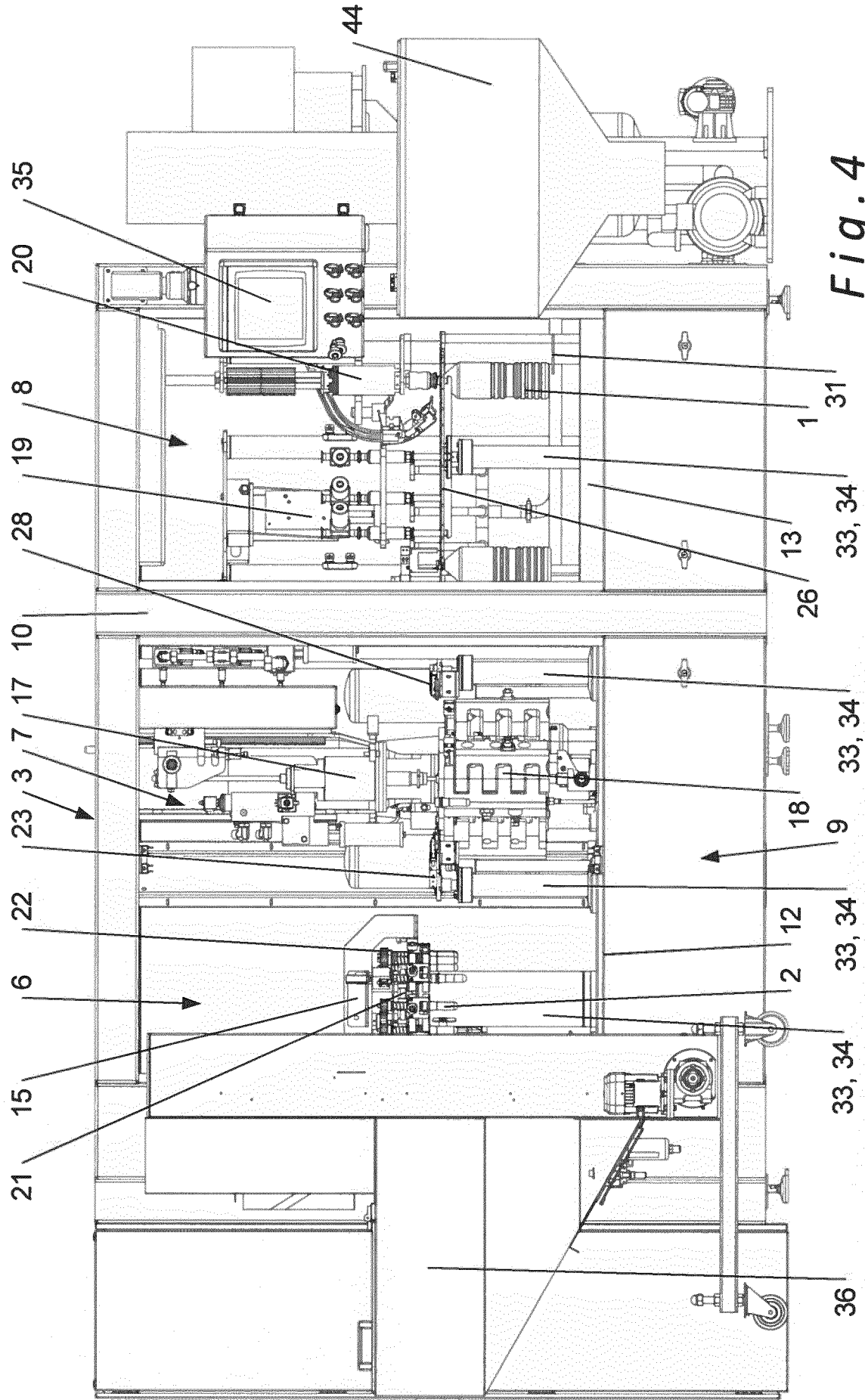
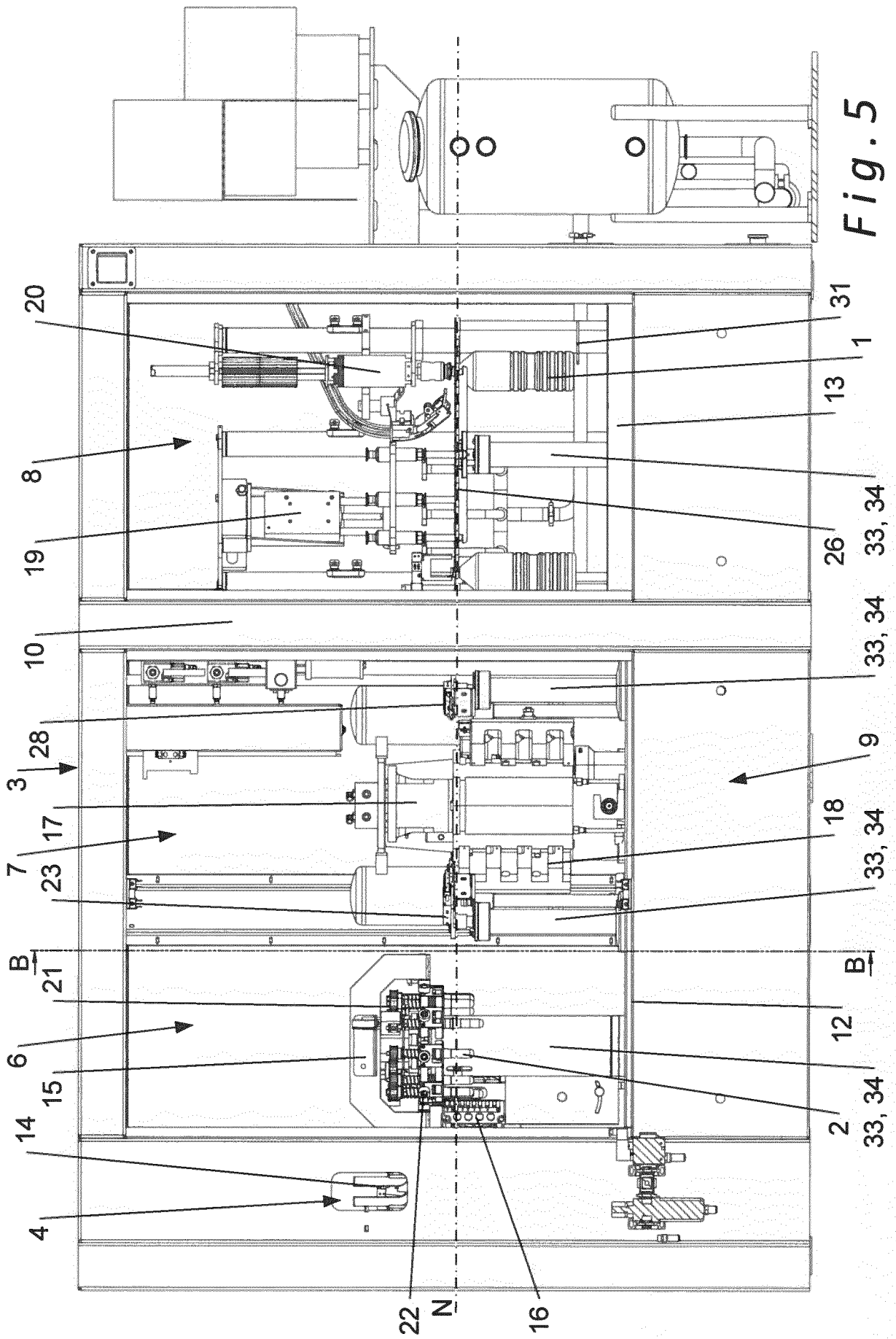


Fig. 4



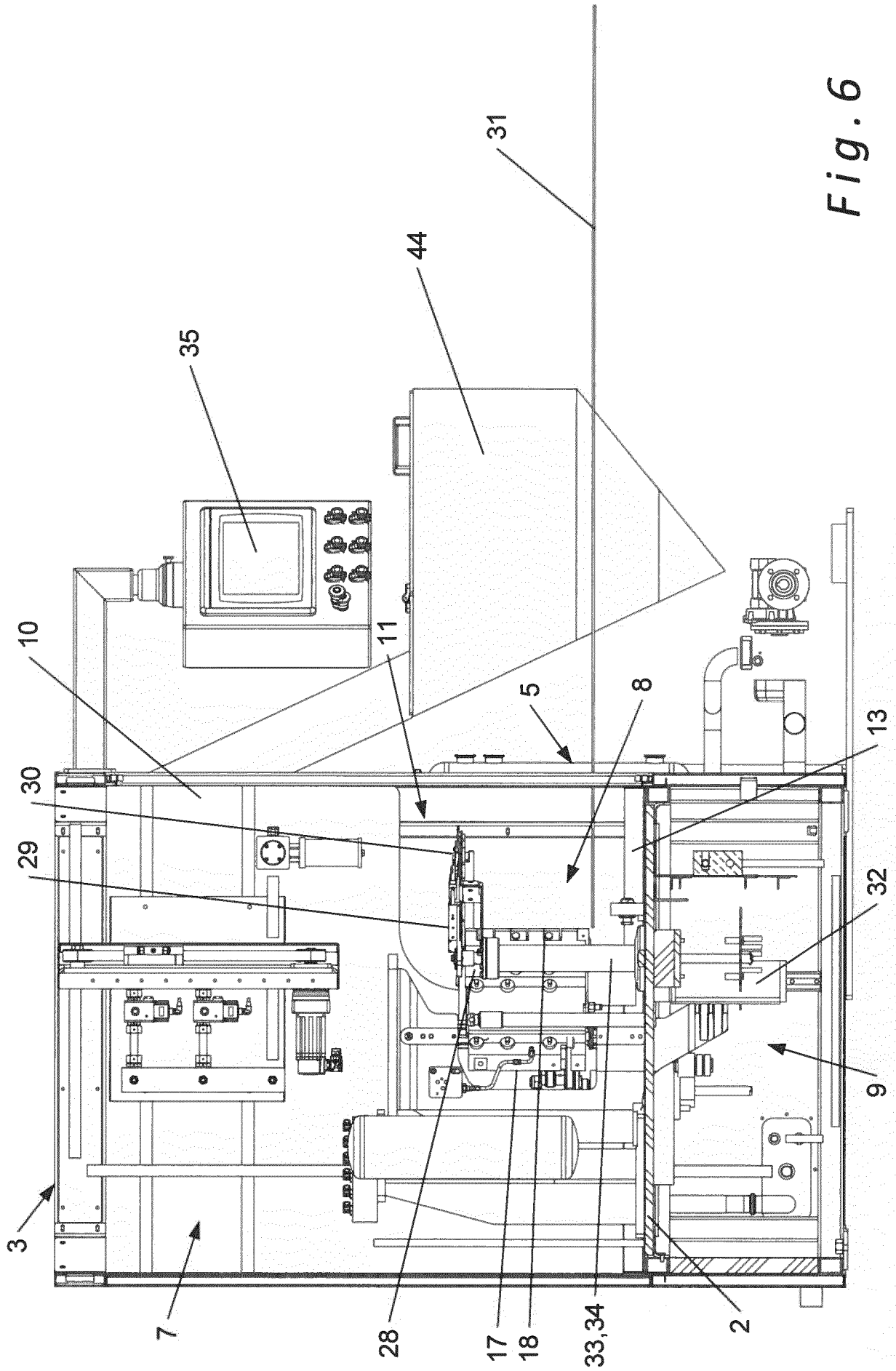


Fig. 6

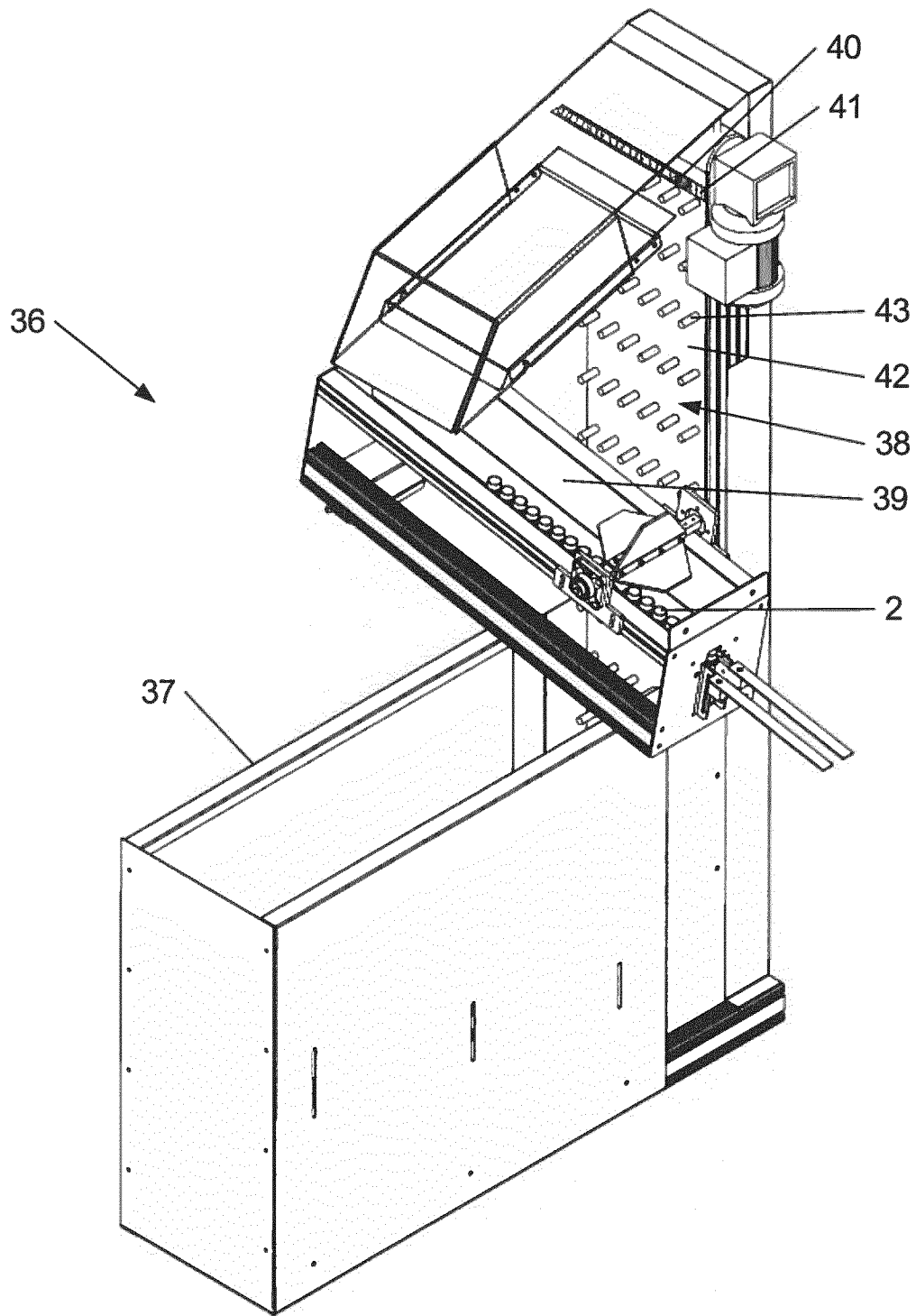


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/056251

A. CLASSIFICATION OF SUBJECT MATTER
INV. B67C3/00 B65B3/02 B65B3/04
ADD.
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)
B67C B65B

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.
A	US 8 479 475 B2 (VAN STEEN CHRISTOPHE ARMAND [BE]) 9 July 2013 (2013-07-09) column 5, line 16 - column 6, line 31; figure 1 -----	1-21
A	US 6 134 866 A (SCHOENEWOLFF MICHAEL J [US] ET AL) 24 October 2000 (2000-10-24) column 4, line 16 - column 5, line 60; figures 2-4 -----	1-21
A	US 2005/188651 A1 (CLUSSE RATH LUDWIG [DE]) 1 September 2005 (2005-09-01) paragraphs [0037] - [0044]; figures 1-3 -----	1-21
A	US 4 587 793 A (BRENNAN ERIC L [US] ET AL) 13 May 1986 (1986-05-13) column 5, line 1 - column 6, line 23; figures 1,2 -----	1-21

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 1 December 2016	Date of mailing of the international search report 15/12/2016
---	---

Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Kulhanek, Peter
--	--

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2016/056251

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 8479475	B2	09-07-2013	NONE

US 6134866	A	24-10-2000	NONE

US 2005188651	A1	01-09-2005	DE 102004005342 A1
			EP 1561722 A1
			JP 4955924 B2
			JP 2005219813 A
			RU 2354605 C2
			US 2005188651 A1

US 4587793	A	13-05-1986	NONE
