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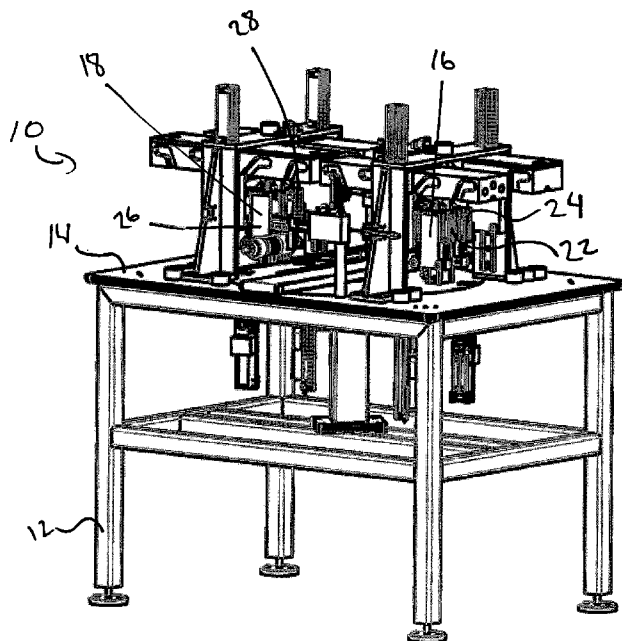


Fig. 1

(57) Abstract: The present invention relates to an apparatus for producing a container defining a container geometry, the apparatus comprising a frame comprising a base supporting at least one mold, the mold including an opening, a pulp material feeding device configured to reciprocally enter the mold via the opening, a pulp reservoir in communication with the pulp material feeding device, the pulp reservoir configured to hold a pulp material, a pulp pressure reservoir configured to provide pressure so as to deliver the pulp material from the pulp reservoir via the pulp material feeding device to the at least one mold, an expandable device configured to be inserted into the at least one mold via the opening, wherein the expandable device have a geometry corresponding to the container geometry. The present invention relates to method for producing a container using an apparatus comprising a frame comprising a base supporting at least one mold. The present invention relates to method of configuring a product by using an apparatus comprising a mold having a cavity defining a geometry. The present invention relates to container having a container body defining a longitudinal axis, the container body defining a maximum diameter at a point on the container body, the container body defining a first end and an opposite second end, the first end and the second end being disposed in the longitudinal axis orientation, the first end being closed, the second end including an opening being smaller than the maximum diameter, and the container body being formed from a pulp

material.

Container

FIELD OF THE INVENTION

The present invention relates to a container, a method for making a container and an apparatus for making a container. Specifically the present invention relates to a container made from a pulp material, a method for making a container from a pulp material, and an apparatus for making a container from a pulp material.

BACKGROUND OF THE INVENTION

The of containers for e.g. beverages, such as carbonated beverages, alcoholic beverages and non-carbonated beverages have a tendency to be discarded by the consumer shortly after consuming the beverage. If the container is made from a non-biodegradable material, such as PET, the container will be present in the environment for a long time. The amount of waste on the global scene is rising and landfill areas are filling up.

The various return systems for collecting and reusing specifically beverage containers, but also other plastic products; seek to reduce the amount of waste. However, there is always a part of the containers on the marked that do not return via the return system and thus end up in unwanted places polluting the environment. Therefore there is a need for a container that allow storage of a fluid and where the container is degradable so that the container is not unwantedly present for a prolonged period of time.

The use of pulp material for certain beverage containers have been described in some publications such as US 7,077,933, US 5,356,518, GB 501224 A or GB 461372 A.

Molding plastic is less complex than molding pulp material. The elasticity of plastic simplifies manufacturing and allow pouring heated plastic into a mold having a desired shape, allowing the plastic to harden, and removing the hardened plastic from the mold. Further, the elasticity of plastic allows it to bend in different directions and resiliently recover when drawn from a mold, thus as pulp material is inelastic and fragile molding techniques used for plastic is not transferrable to pulp material. Applying plastic molding techniques causes the pulp to tear. Additionally, pulp molding is less capable of attaining

complex shapes, e.g., reverse drafts on surfaces, since it cannot elastically recover when drawn from molds.

When moulding products such as a container where a relative small opening is the only channel in and out of the container, and the container is made from pulp material, there is a need for a device that is able to apply pressure to deposited pulp material in a mould from the inside of the product. This operation has several purposes including reducing surface at the interior of the container, so as to reduce the risk of bacteria growth in the container, and at the same time allow the pulp material to be compressed to establish a strong container wall. The inventor have appreciated that an improved inflatable device for this use is of benefit.

The inventor of the present invention has additionally appreciated that an improved container is of benefit, and has in consequence devised the present invention.

SUMMARY OF THE INVENTION

It would be advantageous to achieve an improved container, an apparatus for manufacturing a container and a method for making a container. In general, the invention preferably seeks to mitigate, alleviate or eliminate one or more of the above mentioned disadvantages singly or in any combination. In particular, it may be seen as an object of the present invention to provide a method that solves the above mentioned problems, or other problems, of the prior art.

To better address one or more of these concerns, in a first aspect of the invention an apparatus is presented that allow production of containers from pulp material. The apparatus for producing a container may comprise a frame comprising a base supporting at least one mold, the mold including an opening, a pulp material feeding device configured to reciprocally enter the mold via the opening, a pulp reservoir in communication with the pulp material feeding device, the pulp reservoir configured to hold a pulp material, and a pulp pressure reservoir configured to provide pressure so as to deliver the pulp material from the pulp reservoir via the pulp material feeding device to the at least one mold.

It should be noted that the apparatus' and methods described herein may be used to make or produce any suitable geometry of a container made of pulp material. The method is advantageous for producing a container having a relatively small opening, such as

seen on beer bottles, soft-drink bottles, juice bottles, oil cans etc.. The container body may advantageously be rotationally symmetrical around the longitudinal axis, as most of the containers for beverages are today, but the apparatus allow for more complex geometries if desired.

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The frame, base and mold are preferably made from a metallic material so as to allow long apparatus lifetime and high resistance to wear. Further, it is contemplated that providing the apparatus in a metallic material cleaning of the apparatus. The frame attached the apparatus to a surface, e.g. a floor.

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The at least one mold is provided for producing at least one product at a time. By providing two molds the apparatus may produce two products at one time etc. The mold includes an opening, and as will be apparent later, the opening may be used for inserting different devices into the mold for different purposes. The opening may correspond approximately in size to the opening in the finished product.

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The pulp material feeding device may be a conduit with a valve and/or dispersive element for allowing the pulp material to be sprayed into the mold, preferably in a layer having a somewhat even thickness.

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The mold may be a two-part mold having female parts defining the outline of the product to be produced. The mold may include grooves or ridged for providing the surface of the finished product with aesthetic features.

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The pulp reservoir may be any suitable container, such as a plastic container, container of a metallic material.

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The pulp pressure reservoir is configured to provide pressure so as to deliver the pulp material from the pulp reservoir via the pulp material feeding device to the at least one mold. The pulp pressure reservoir may include a pressure generator for generating during the operation of the apparatus. The pulp pressure reservoir may feed the pressure directly to the pulp reservoir for driving the pulp material to the mold. Other suitable configurations are also possible.

The material used for the container is preferably a recyclable material, a disposable material, a plant fiber material such as hemp fibers or flax, i.e. *Linum usitatissimum*, and/or a compostable cellulose fiber material. The material used for the container may be a mixture of then mentioned materials. Also additives of different kinds may be used for establishing different material properties. The pulp material does preferably not include recycled material as the material used for a beverage container should not release possibly toxic material to the beverage. However if an appropriate, i.e. food grade, coating is used it is contemplated that recycled material may be used for the container. The coating will then ensure that any contaminants will not be transferred from the container and into the liquid, e.g. beverage, inside the container.

Advantageously the apparatus further comprises an expandable device configured to be inserted into the at least one mold via the opening. The expandable device may be collapsible so that the expandable device may be retracted from the interior of the mold, and thus also from the interior of the product. The expandable device is configured to apply pressure to the pulp material disposed in the mold. The expandable device may be regulated so as to control the amount of pressure applied.

Advantageously the expandable device is a balloon-like device. The shape of the expandable device may match the female part of the mold, so that the expandable device may be regarded as a male part of the mold. The expandable device is also collapsible so that the expandable device may be retracted from the mold after the pressure has been applied.

Advantageously the container may be provided with a threaded part for engaging with a closure device for establishing a seal for closing the container when an appropriate liquid has been filled into the container. The closure device may advantageously be made from a material similar to that of the container.

A second aspect of the present invention relates to a method for producing a container using an apparatus comprising a frame comprising a base supporting at least one mold, the mold including an opening to the interior of the mold, a pulp material feeding device configured to reciprocally enter the mold via the opening, a pulp reservoir in communication with the pulp material feeding device, the pulp reservoir configured to hold a pulp material, and a pulp pressure reservoir configured to provide pressure so as to deliver

the pulp material from the pulp reservoir via the pulp material feeding device to the at least one mold, the method comprising the steps of operating the apparatus by supplying pressure from the pulp pressure reservoir so as to dispose the pulp material from the pulp reservoir via the pulp material feeding device to the interior of the at least one mold, and applying a vacuum pressure to the mold so that the pulp material is distributed in the mold. By supplying pressure from the pulp pressure reservoir the pulp material is disposed inside the mold. The vacuum ensures that the pulp material is distributed inside the mold and that a somewhat even layer is formed. When a layer of a certain thickness is formed the vacuum does no longer attract new pulp material.

Advantageously the apparatus further comprises a pressure application device configured to be inserted into the mold and the method includes applying pressure to pulp material within the mold. This helps the product to obtain a more stable form. This also allows the product to be moved from a mold station to a curing station where the product is to be cured.

Advantageously the pressure application device is a flexible device configured to expand so as to provide the mentioned pressure to the pulp material within the mold, the method comprising supplying a pressure application device pressure to the pressure application device. The flexible device may after application of pressure be collapsed and removed from the interior of the container. The application of pressure also establishes a smoother surface on the inner surface of the container than compared to containers where such a pressure is not established.

Advantageously the pressure application device is preshaped so as to correspond to the geometry of the container. This is contemplated to allow the pressure application device to hold or support the container when it is to be moved from one station in the apparatus for producing the container to another station in the apparatus. Also, the preshaped pressure application device is contemplated to provide a flexible inner core that may be inflated so that it does not apply pressure to the mold material constituting the container at this point, but only supports the material. The pressure application device then supports the fragile material when the container is removed from the mold, if the pressure application device was not preshaped, the pressure application device would then return to the original shape which would then cause the container to be damaged or destroyed.

A third aspect of the present invention relates to a method of configuring a product by using an apparatus comprising a mold having a cavity defining a geometry, a storage device for storing a molding material product for constituting part of the product, a molding material product delivery device configured for spraying the molding material product into the cavity, and a pressure transfer device configured to be inserted into the cavity for transferring pressure to a part of the inside surface of the product, the method including spraying the molding material product into the mold, applying pressure to the part of the inside surface of the product via the pressure transfer device.

Advantageously the apparatus further comprises a curing device, and the method further comprises curing the product in the curing device. This allows the container product to achieve an increased strength. Further the container is able to store and hold a liquid for a shorter or extended period of time. The curing may include heat, pressure, vacuum, radiation or a combination of these. The curing process hardens the container so that the container may be provided with e.g. a carbonated beverage or a non-carbonated beverage.

Advantageously the pressure transfer device is an inflatable device and the application of pressure includes supplying gas at a pressure being higher than the surrounding air pressure. Advantageously the gas is a gas that is non-toxic and does not leave any substantial amount of material in the container. Advantageously the pressure transfer device is further pre-shaped to match the geometry of the product.

Advantageously the molding material product is a pulp material and the method comprises drying the pulp material after spraying the molding material product into the mold. The main part of the drying may be performed in a curing station. The mold station may also at least partly dry the container.

Advantageously the method further comprises applying a coating to the interior of the container. The coating may ensure that the container is capable of storing a liquid. The coating may make the container impermeable to the liquid that the container is to store. The specific coating may be chosen based on the intended liquid. If the container is intended for use as a foodstuff container, e.g. beverages, any coating should be approved for use in connection with food, such as approved by FDA (Food and Drug Administration in USA).

Advantageously the method further comprises applying a coating to the exterior of the container. The coating may ensure that the container is not damaged due to exposure to e.g. rain, spills, or other effects of handling the container. The coating for the interior of the container and the exterior does not need to be the same kind, but may in some instances be of the same kind.

A fourth aspect of the present invention relates to a container having a container body defining a longitudinal axis, the container body defining a maximum diameter at a point on the container body, the container body defining a first end and an opposite second end, the first end and the second end being disposed in the longitudinal axis orientation, the first end being closed, the second end including an opening being smaller than the maximum diameter, and the container body being formed from a pulp material. The pulp material is contemplated to allow the container to be biodegradable or compostable, such that the container will be decomposed if it is dumped as litter. .

Advantageously the container may further comprise a liquid impermeable coating at an interior surface therefor allowing the container to store a liquid. The coating is contemplated to protect the pulp material after the pulp material has cured or hardened, as the liquid to be stored in the container may dissolve the pulp material. The container may advantageously have a relative small opening or orifice for dispensing the liquid, e.g. the opening may have a size suitable for a person to drink directly from the container. Advantageously the coating does not mix substantially with the liquid to be stored in the container. Advantageously the coating is degradable. The coating may be applied to the entire inner surface of the container or at least a part of the inner surface of the container. A mixture of different types of coating may be used on the interior surface, e.g. one type of coating may be used for a part of the inner surface and another type of coating may be used for a different part of the inner surface. The coating may advantageously be approved for use with foodstuffs, such as beverages.

Advantageously the container may further comprise a liquid impermeable coating at an exterior surface thereof providing protection of the pulp material in the container when exposed to liquids from external sources. The exterior coating may be applied to the entire outer surface. A mixture of different types of coating may be used. Advantageously the coating is degradable. The coating may be applied to the entire outer

surface of the container or at least a part of the outer surface of the container. A mixture of different types of coating may be used on the outer surface, e.g. one type of coating may be used for a part of the outer surface and another type of coating may be used for a different part of the outer surface.

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A fifth aspect of the present invention relates to a container comprising a first portion and a second portion, where the first portion have a first diameter and the second portion have a second diameter and the second diameter being larger than the first diameter, the first portion including an opening, a threaded portion being provided at the first portion.

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Advantageously the container has one opening. The threaded portion is advantageously located at the opening so that a closure device may be provided to establish a good closure for the container. The closure device will then ensure that the content in the container is kept inside the container until the closure device is removed.

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Advantageously the first portion of the container may be a neck portion. The container may be shaped as a conventional bottle having a larger diameter where the liquid is stored and a smaller diameter at the neck portion wherefrom the liquid may be dispensed.

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Advantageously the threaded portion is provided at the outside of the first portion and the closure device is to be fastened. Advantageously the threaded part is provided as a helical thread. The closure device is then to be provided with a matching thread so that the closure device may be screwed onto the first portion of the container.

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A sixth aspect of the present invention relates to an apparatus for producing a container defining a container geometry. The apparatus may comprise a supporting base supporting a mold having a mold cavity defining the exterior of the container geometry, the mold including an opening. The apparatus may further comprise a pulp material feeding device configured to enter the mold via the opening, a pulp material reservoir in

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communication with the pulp material feeding device, the pulp reservoir configured to temporarily store pulp material, a pulp pressure reservoir configured to provide pressure so as to deliver the pulp material from the pulp reservoir via the pulp material feeding device to the mold. The apparatus may further comprise a flexible device having an inlet part attached at the opening of the mould the flexible device being configured to be inserted into the mold via

the opening, a gas source in communication with the flexible device to selectively inflate and/or deflate the flexible device and the flexible device being semi-permeable or partly permeable to the gas so as to allow gas to pass or diffuse from the flexible device through the flexible device and further through pulp material present at the mold cavity so as to dry the pulp material.

The apparatus according to the sixth aspect is contemplated to be advantageous in that it allow gas to be transferred from the flexible device through the pulp material present in the mould. The pulp material is wet when applied. The amount of water in the pulp may vary between pulp batches. The gas then helps dry and/or cure the pulp material so as to establish a strong, at least partly rigid, product. By using a heated gas heat may be applied to the pulp material from the inside. Additionally heat may be applied to the pulp material via the mould it self. Alternatively the gas used may be at a temperature similar to that of the sourroundings. The flexible device then simply applies pressure to the pulp material thereby squeezing the pulp material.

Advantageously the flexible device may be made from a non-expandable material. This is contemplated to provide the most durable flexible device. The device may be compacted so as to be inserted into the mould via an opening and subsequently be inflated so as to press the wet pulp material.

Advantageously the flexible device is made from a wowed material. This is contemplated to allow use of heated gas at a relatively high pressure. The wowed material also yields a flexible device that is semipermeable so as to allow gas, i.e. at least air, to pass through at a given rate.

In an embodiment the mould have a gas inlet and a gas outlet, the apparatus may further comprise a first heating chamber having a first heating chamber inlet and a first heating chamber outlet, a second heating chamber having a second heating chamber inlet and a second heating chamber outlet, a gas path defined from an apparatus inlet to an apparatus outlet where gas is transported via the gas path, the gas path including from the apparatus inlet to the first heating chamber inlet further to the first heating chamber outlet, from the first heating chamber outlet to the second heating chamber inlet, from the the second heating chamber inlet to the second heating chamber outlet, from the mould inlet to the mould outlet,

from the mould outlet to the apparatus outlet. The system may advantageously use of pressureised atmospheric air at room temperature. Room temperature can vary but is usually considered as around 18-20 degrees C.

5 In an embodiment the flexible device is attached at the mould inlet, the flexible device being arranged to receive gas via the gas path so as to inflate the flexible device to a degree where it applies pressure to pulp material present in the mould chamber.

Advantageously the first heating chamber includes a part of the gas path from
10 the mould outlet to the apparatus outlet so as to allow gas in the part of the gas path to heat gas in the first heating chamber. The reuse of heat provides a reduced energy use.

An eighth aspect of the present invention relates to method of manufacturing a product comprising a pulp body using an apparatus comprising a mould having an interior
15 chamber and an opening in communication with the interior chamber and an inflatable device being permeable to gas, the method comprises applying and distributing wet pulp material to the interior chamber of the mould, inserting an inflatable device into the interior chamber, providing gas having a temperature in a first temperature interval at a first pressure for a first period of time so as to press the pulp material against the mould to dry the pulp material.

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The method allow production of product from wet pulp material. The product produced have high tensile strength, which is required for products for storing e.g. liquids.

Advantageously the first temperature interval may be 100 degrees C to 150
25 degrees C, such as 110 degrees C to 130 degrees C. Gas that has been heated to this temperature from a lower temperature without adding moisture have a relative low humidity and may thus be used for absorbing liquid, i.e. mainly water, from the wet pulp material.

Advantageously the first pressure may be in the interval 2-15 bar, such as 5 to
30 12 bar, such as 7 to 9 bar, such as around 8 bar. By applying a high pressure to the wet pulp material a faster drying may be achieved as moisture in the pulp is pressed out.

A ninth aspect of the present invention relates to a product obtained using the method according to the eighth aspect. Such a product will be produced with a relatively low

power consumption. The product will also have other advantages that are apparent from the description as a whole.

A tenth aspect of the present invention relates to an inflatable device adapted for applying pressure to a part of the interior of a container made from a pulp material. When moulding products from pulp material wet pulp material is used. The wet pulp material is applied to a mould. In order to produce products from having sufficient strength the pulp material must be dried. Also compressing the pulp material increases strength. The inflatable device is made from a material that allow a percentage of the gas used for inflating the inflatable device to pass through so as to dry the pulp material out while applying pressure to the pulp material.

In general the various features and advantages of the mentioned aspects of the invention may be combined and coupled in any way possible within the scope of the invention. These and other aspects, features and/or advantages of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be described, by way of example only, with reference to the drawings, in which

Fig. 1 is a schematic perspective view of an apparatus for producing a container,

Fig. 2 is a schematic top-view of an apparatus for producing a container,

Fig. 3 is a schematic side-view of an apparatus for producing a container,

Fig. 4 is a schematic view of a mold station,

Fig. 5 is a schematic view of a part of an apparatus for producing a container seen from below,

Fig. 6 is a schematic view of a mold station with a pulp delivery device,

Fig. 7 is a schematic view of a mold station with a pressure delivery device,

Fig. 8 is a schematic view of a curing station,

Figs. 9A-9G are schematic views of steps of a method for producing a container, and

Fig. 10 is a schematic illustration of a system for producing containers from pulp material while reusing heat.

DESCRIPTION OF EMBODIMENTS

An embodiment of the invention is illustrated in Fig. 1 which illustrates an apparatus 10 having a frame 12 and a base plate 14. The base plate is supported by the frame 12. The base plate 14 supports a molding station 16 and a curing station 18. In the
5 embodiment in Fig. 1 a second set of molding station and curing station is located opposite the stations 16 and 18.

The molding station 16 comprises first and second mold parts 22 and 24. The first mold part 22 and second mold part 24 each comprising a half of the product, i.e. the
10 female part of the mold or negative, as seen in e.g. Fig. 4.

The curing station 18 comprises first and second curing station parts 26 and 28. The first curing station part 26 and the second curing station part 28 each comprise a female half of the geometry of the finished product.
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The operation of the molding station 16 and the curing station 18 will be discussed in more detail below.

The apparatus 10 is configured for producing containers, specifically
20 containers made from pulp material. The pulp material is preferably paper pulp material that does not comprise recycled material. The recycled material usually comprises materials that are not well suited for containers for foodstuff, e.g. print ink and the like. However, for certain containers this may not be an issue, e.g. if the container is to be used for storing oil or other liquid not suited for human consumption.

Fig. 2 is a top-down view of the apparatus 10. The apparatus 10 comprises four stations, where two stations are molding stations 16, and two stations are curing stations 18. The curing stations may also be pressing stations as will be discussed.
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The base plate 14 includes a rotatable part 20. A product is first formed at the mold station and then rotated to the curing station via the base plate 14.
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Fig. 3 is a schematic side-view of the apparatus 10. The figure also illustrates a pulp delivery part 30 that is configured to be in communication with the mold station 16.

When the two mold parts, 22 and 24, are brought together a chamber is formed. The chamber defines a negative of the product to be formed. A pressure supply device 32 is also illustrated. The function of this will be discussed below.

5 Fig. 4 schematically illustrates a mold 34 comprising a negative or female image 36 of an object to be produced, here a part of a bottle-shaped product. The mold 34 is part of the mold station 16. An opening 38 is defined in one end of the image. At the opening 38 an external thread 40 is formed. The external thread 40 is to interface with a closure device, i.e. a cap or the like. The cap to be fitted at the thread 40 could be made from a
10 fibrous material similar to that of the container or a cap made from another material, such as plastic. The cap could be coated with a coating suitable for foodstuff.

Fig. 4 further illustrates the pulp delivery part 30. When the two parts of the molding station, namely the first and second mold parts 22 and 24, are assembled to form the
15 mold the pulp delivery part 30 is moved into the interior chamber formed in the mold.

Fig. 5 schematically illustrates the apparatus where the molding station 16 and the curing station 18 are opened. The apparatus 10 is viewed from below without the frame 12 or base plate 14. The mold part 22 constitutes one half of the mold. The mold part 22 may
20 pivot about the point at 42.

As illustrated in Fig. 6 a pulp delivery part 30 is introduced into the mold chamber 44 formed in the mold station 16 by the mold parts 22 and 24. The pulp delivery part 30 is in communication with a pulp material reservoir, not illustrated here, wherefrom
25 the pulp material is sprayed into the mold chamber 44. The pulp material is a wet pulp material. By disposing the pulp material by spraying the material into the chamber 44 the inside surface of the resulting product, here a container, will likely have a non-smooth surface as the fibers will be unorganized on the surface. It may be a disadvantage to have a relative large surface as this allows certain bacteria to grow, even though beverages to be
30 stored in the container is subject to requirements regarding bacteria content. Therefore establishing a surface having a relatively small area, i.e. a smooth surface, in the product, especially the inner surface of the container, is advantageous.

Fig. 7 schematically illustrates the molding station 16 where an expandable device 46 has been inserted into the chamber 44. In other embodiments a device such as the flexible device 56 discussed below may be used. The expandable device 46 is in the embodiment illustrated in Fig. 7 an inflatable balloon, made from silicone, but other materials may be used, e.g. latex. Preferably the material used for the expandable device 44 is chosen so that the device may be used several times. The expandable device 46 is also collapsible to that after use it may be removed from the inside of the product. The cost and durability may have an impact on the choice of material. The expandable device 46 is shaped so as to match the inner geometry of the end-product. The expandable device 46 could be viewed as a male part of a mold. In the molding station 16 the expandable device 46 is expanded just enough so that the product is supported by the expandable device 46. The mold station 16 is then opened, i.e. the two mold parts 22 and 24 are separated and the product is shifted or rotated to the curing station 18. At this stage the product have a thickness of around 3 mm and is soft and fragile.

By introducing a specific amount of gas into the expandable device 46 the expandable device reach a certain size. In an embodiment the expandable device 46 could be inflated to a volume of 3 dl and the end-product have a volume of approximately 5 dl. The expandable device will have a geometry corresponding to the end-product, i.e. container, but with a smaller volume. There will be a gap of around 0,5 mm from the inflated expandable device 46 and the pulp material. Pressure is then applied so that the pulp is blown onto the expandable device 46, thereby releasing it from the inside of the molding station 16. As the expandable device 46 is close to the product the product will not break despite being very fragile. The product is supported by the expandable device 46 during the shift to the curing station 18.

Further it is important that the pulp is not pressed into the mold by the expandable device 46. This is ensured not to happen as the expandable device will not apply any pressure to the inside of the pulp material while the pulp material is at the mold.

The curing station 18 comprises the two parts 26 and 28. When the parts are assembled a curing station chamber 48 is formed. When the product is placed in the curing station chamber 48 and the chamber is closed, the expandable device 46 is expanded so that the pulp material is pressed against the inner walls of the curing station parts 26 and 28. The

curing station parts 26 and 28 are configured with steam ducts 50. The steam ducts 48 lead steam or moisture from the product, which is generated when the product is under pressure from the expandable device 46. Further a vacuum pressure may be applied from the outside of the curing mold to speed up the process.

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The expandable device 46 is deflated and twisted by a supporting member so that it may be retracted from the now cured product via the opening of the container. As the expandable device 46 is twisted around the supporting member it will not damage the product. If the expandable device 46 was allowed to simply deflate inside the product there is a risk that it will damage the product while it is being retracted. If the expandable device 46 is deflated by applying a low pressure or suction, the shape of the deflated expandable device 46 cannot be controlled. The supporting member help control the shape of the expandable device 46 as it is being deflated.

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A heating device may be applied to provide heat to the product during the pressing process so as to dry the molding material, i.e. the wet pulp material. Advantageously the product is heated to around 180 degrees C. After this curing process the product have a substantial strength and may be passed on to further processing, such as coating, printing or the like. The expandable device 46 is deflated and retracted from the product and reused for the production of the next product.

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Fig. 9A schematically illustrates a step of a method for producing a container. In this step paper pulp material 52 has been applied to the inside of a mould 54. A flexible device 56 is attached at an inlet 58 of the mould. An insertion device 60 is connected to the flexible device 56. The insertion device 60 is configured to move into the interior of the mould 54 so as to deploy the flexible device 56 in the interior. Fig. 9B schematically illustrates a step where the insertion device 60 is in an extreme position and the flexible device 56 is loosely deployed in the mould 54 cavity.

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Fig. 9C schematically illustrates that a gas is introduced in the flexible device, illustrated by the arrows. The flexible device 56 is at least partly permeable to the gas, meaning that a part of the gas introduced into the flexible device 56 is allowed to pass through the flexible device 56 wall and further through the pulp material 52, as indicated by the arrows 62.

Fig. 9D schematically illustrate that when a certain pressure is established in the flexible device 56, the flexible device 56 is in contact with the entire surface of the pulp material 52 and/or the mould 54 so as to press the pulp material 52. The flexible device 56 is not expandable, which is contemplated to allow a relatively high gas pressure to be used, which in turn provides a faster drying of the wet pulp material 52 and provides a more compact pulp container wall. In other embodiments a device such as the expandable device 46 may be used.

Fig. 9E is a zoomed view illustrating that part of the gas passes through the flexible device 56 and through the pulp material 52. As the gas may be warm the heat may also contribute to a faster drying of the wet pulp material 52.

When the process has been completed, the flexible device 56 is deflated, either by evacuating some of the gas supplied, or simply by not adding any further gas to the flexible device 56. This is illustrated in Fig. 9F. The insertion device may then be retracted, as illustrated in Fig. 9G, leaving the resulting product ready to be removed from the mould 54.

Fig. 10 schematically illustrates a system 62 where a pressurised gas is supplied at a system inlet 64. The gas is provided at a temperature indicated by the thermometer 68. The gas is heated in a first heating chamber or heating station 66. As is seen a return pipe 70 is passed through the first heating chamber 66 so as to allow reuse of some of the residual heat from the process. The temperature is indicated by the thermometer 72.

The preheated gas is transferred to a second heating station or heating chamber 74 where the gas is heated to a desired target temperature, indicated by the thermometer 76. After the second heating chamber 74 the gas is supplied to a mould 78, as described above, where the heated gas is used for pressurizing a flexible device 80. The gas escaping the mould 78 is returned for preheating the inlet gas in the first heating chamber 66.

The gas follows a gas path through the system 62. The gas path is defined from the apparatus inlet 64 to an apparatus outlet 82 where gas is transported via the gas path. The gas is pressureized before being introduced into the gas path illustrated. The gas path is defined from the apparatus inlet to the first heating chamber inlet further to the first heating chamber outlet, from the first heating chamber outlet to the second heating chamber inlet,

from the the second heating chamber inlet to the second heating chamber outlet, from the mould inlet to the mould outlet, from the mould outlet to the apparatus outlet.

While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. A computer program may be stored/distributed on a suitable medium, such as an optical storage medium or a solid-state medium supplied together with or as part of other hardware, but may also be distributed in other forms, such as via the Internet or other wired or wireless telecommunication systems. Any reference signs in the claims should not be construed as limiting the scope.

With reference to the drawings the following reference numerals are used:

10	Apparatus
12	Frame
14	Base plate
16	Molding station
18	Curing station
20	Rotatable part
22	Mold part
24	Mold part
26	Curing station part
28	Curing station part
30	Pulp delivery part
32	Pressure supply device
34	Mold

	36	Negative image
	38	Opening
	40	External thread
	42	Point
5	44	Mold chamber
	46	Expandable device
	48	Curing station chamber
	50	Steam ducts
	52	Pulp material
10	54	Mould
	56	Flexible device
	58	Mould inlet
	60	Insertion device
	62	Arrow
15	64	Inlet
	66	First heating chamber
	68	Thermometer
	70	Return pipe
	72	Thermometer
20	74	Second Heating chamber
	76	Thermometer
	78	Mould
	80	Flexible device
	82	Outlet

The present invention may be characterised by the following points:

Point 1. An apparatus for producing a container defining a container geometry, the apparatus comprising:

- 5 a frame comprising a base supporting at least one mold, the mold including an opening,
- a pulp material feeding device configured to reciprocally enter the mold via the opening,
- a pulp reservoir in communication with the pulp material feeding device, the
- 10 pulp reservoir configured to hold a pulp material,
- a pulp pressure reservoir configured to provide pressure so as to deliver the pulp material from the pulp reservoir via the pulp material feeding device to the at least one mold, and
- an expandable device configured to be inserted into the at least one mold via
- 15 the opening, wherein the expandable device have a geometry corresponding to the container geometry.

Point 2. The apparatus according to point 1 further comprising a curing station for curing the container.

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Point 3. A method for producing a container using an apparatus comprising:

- a frame comprising a base supporting at least one mold, the mold including an opening to the interior of the mold,
- a pulp material feeding device configured to reciprocally enter the mold via
- 25 the opening,
- a pulp reservoir in communication with the pulp material feeding device, the pulp reservoir configured to hold a pulp material,
- a pulp pressure reservoir configured to provide pressure so as to deliver the pulp material from the pulp reservoir via the pulp material feeding device to the at least one
- 30 mold,
- the method comprising the steps of:
- operating the apparatus by supplying pressure from the pulp pressure reservoir so as to dispose the pulp material from the pulp reservoir via the pulp material feeding device to the interior of the at least one mold, and

applying a vacuum pressure to the mold so that the pulp material is distributed in the mold.

Point 4. The method according to point 3, wherein the apparatus further comprises a pressure application device configured to be inserted into the mold and apply pressure to pulp material within the mold.

Point 5. The method according to point 4, wherein the pressure application device is a flexible device configured to expand so as to provide the mentioned pressure to the pulp material within the mold, the method comprising supplying a pressure application device pressure to the pressure application device.

Point 6. A method of configuring a product by using an apparatus comprising:
a mold having a cavity defining a geometry,
a storage device for storing a molding material product for constituting part of the product,
a molding material product delivery device configured for spraying the molding material product into the cavity,
a pressure transfer device configured to be inserted into the cavity for transferring pressure to a part of the inside surface of the product,
the method including:
spraying the molding material product into the mold, and
applying pressure to the part of the inside surface of the product via the pressure transfer device.

Point 7. The method according to point 6, wherein the apparatus further comprises a curing device, the method further comprising: curing the product in the curing device.

Point 8. The method according to point 7, wherein the step of applying pressure to the part of the inside surface of the product via the pressure transfer device is performed at the curing station.

Point 9. The method according to any one of the points 6-8, wherein the pressure transfer device is an inflatable device and the application of pressure includes supplying gas at a pressure being higher than the surrounding air pressure.

- 5 Point 10. The method according to any one of the points 6-9, wherein the molding material product is a pulp material and the method comprises drying the pulp material after spraying the molding material product into the mold.

- Point 11. The method according to any one of the points 3-10, further comprising
10 applying a coating to the interior of the container.

Point 12. The method according to any one of the points 3-11, further comprising applying a coating to the exterior of the container.

- 15 Point 13. A container having a container body defining a longitudinal axis, the container body defining a maximum diameter at a point on the container body,
the container body defining a first end and an opposite second end, the first end and the second end being disposed in the longitudinal axis orientation, the first end being closed, the second end including an opening being smaller than the maximum diameter, and
20 the container body being formed from a pulp material.

Point 14. The container according to point 13, further comprising a liquid impermeable coating at an interior surface therefor allowing the container to store a liquid.

- 25 Point 15. The container according to point 13 or 14, further comprising a liquid impermeable coating at an exterior surface thereof providing protection of the pulp material in the container when exposed to liquids from external sources.

- Point 16. An apparatus for manufacturing a product comprising a pulp body, the
30 apparatus comprising:
a mould having an interior chamber including a gas inlet and a gas outlet,
a first heating chamber having a first heating chamber inlet and a first heating chamber outlet,

a second heating chamber having a second heating chamber inlet and a second heating chamber outlet,

a gas path defined from an apparatus inlet to an apparatus outlet where gas is transported via the gas path, the gas path including from the apparatus inlet to the first heating chamber inlet further to the first heating chamber outlet, from the first heating chamber outlet to the second heating chamber inlet, from the the second heating chamber inlet to the second heating chamber outlet, from the mould inlet to the mould outlet, from the mould outlet to the apparatus outlet,

a flexible device insertable into the mould and being attached at the mould inlet, the flexible device being arranged to receive gas via the gas path so as to inflate the flexible device to a degree where it applies pressure to pulp material present in the mould chamber.

Claims

1 An apparatus for producing a container defining a container geometry, the apparatus comprising:

5 a supporting base supporting a mold having a mold cavity defining the exterior of the container geometry, the mold including an opening,

a pulp material feeding device configured to enter the mold via the opening,

a pulp material reservoir in communication with the pulp material feeding device, the pulp reservoir configured to temporarily store pulp material,

10 a pulp pressure reservoir configured to provide pressure so as to deliver the pulp material from the pulp reservoir via the pulp material feeding device to the mold, and

an flexible device having an inlet part attached at the opening of the mould the flexible device being configured to be inserted into the mold via the opening,

15 a gas source in communication with the flexible device to selectively inflate and/or deflate the flexible device and the flexible device being semi-permeable or partly permeable to the gas from the so as to allow gas to pass from the flexible device through the flexible device and further through pulp material present at the mold cavity so as to dry the pulp material.

20 2. The apparatus according to claim 1, wherein the flexible device is made from a non-expandable material.

3. The apparatus according to claim 1 or 2, wherein the flexible device is made from a woven material.

25 4. The apparatus according to any one of the claims 1-3, wherein the mould having a gas inlet and a gas outlet, the apparatus further comprising:

a first heating chamber having a first heating chamber inlet and a first heating chamber outlet,

30 a second heating chamber having a second heating chamber inlet and a second heating chamber outlet,

a gas path defined from an apparatus inlet to an apparatus outlet where gas is transported via the gas path, the gas path including from the apparatus inlet to the first heating chamber inlet further to the first heating chamber outlet, from the first heating

chamber outlet to the second heating chamber inlet, from the the second heating chamber inlet to the second heating chamber outlet, from the mould inlet to the mould outlet, from the mould outlet to the apparatus outlet.

- 5 5. The apparatus according to claim 4, wherein the flexible device is attached at the mould inlet, the flexible device being arranged to receive gas via the gas path so as to inflate the flexible device to a degree where it applies pressure to pulp material present in the mould chamber.
- 10 6. The apparatus according to claim 4 or 5, wherein the first heating chamber includes a part of the gas path from the mould outlet to the apparatur outlet so as to allow gas in the part of the gas path to heat gas in the first heating chamber.
- 15 7. A method of manufacturing a product comprising a pulp body using an apparatus comprising a mould having an interior chamber and an opening in communication with the interior chamber and an inflatable device being permeable to gas, the method comprises:
- 20 applying and distributing wet pulp material to the interior chamber of the mould,
- inserting an inflatable device into the interior chamber,
- providing gas having a temperature in a first temperature interval at a first pressure for a first period of time so as to press the pulp material against the mould to dry the pulp material.
- 25 8. The method according to claim 7, wherein the first temperature interval is 100 to 150 degrees C, such as 110 to 130 degrees C.
- 30 9 The method according to claim 7 or 8, wherein the first pressure is in the interval 2-15 bar, such as 5 to 12 bar, such as 7 to 9 bar, such as around 8 bar.
10. A product obtained using the method according to any of the claims 7-9.
11. A container having a container body defining a longitudinal axis, the container body defining a maximum diameter at a point on the container body,

the container body defining a first end and an opposite second end, the first end and the second end being disposed in the longitudinal axis orientation, the first end being closed, the second end including an opening being smaller than the maximum diameter, and

the container body being formed from a pulp material, and further comprising
5 a liquid impermeable coating at an interior surface therefor allowing the container to store a liquid.

12. The container according to claim 11, further comprising a liquid impermeable coating at an exterior surface thereof providing protection of the pulp material in the
10 container when exposed to liquids from external sources.

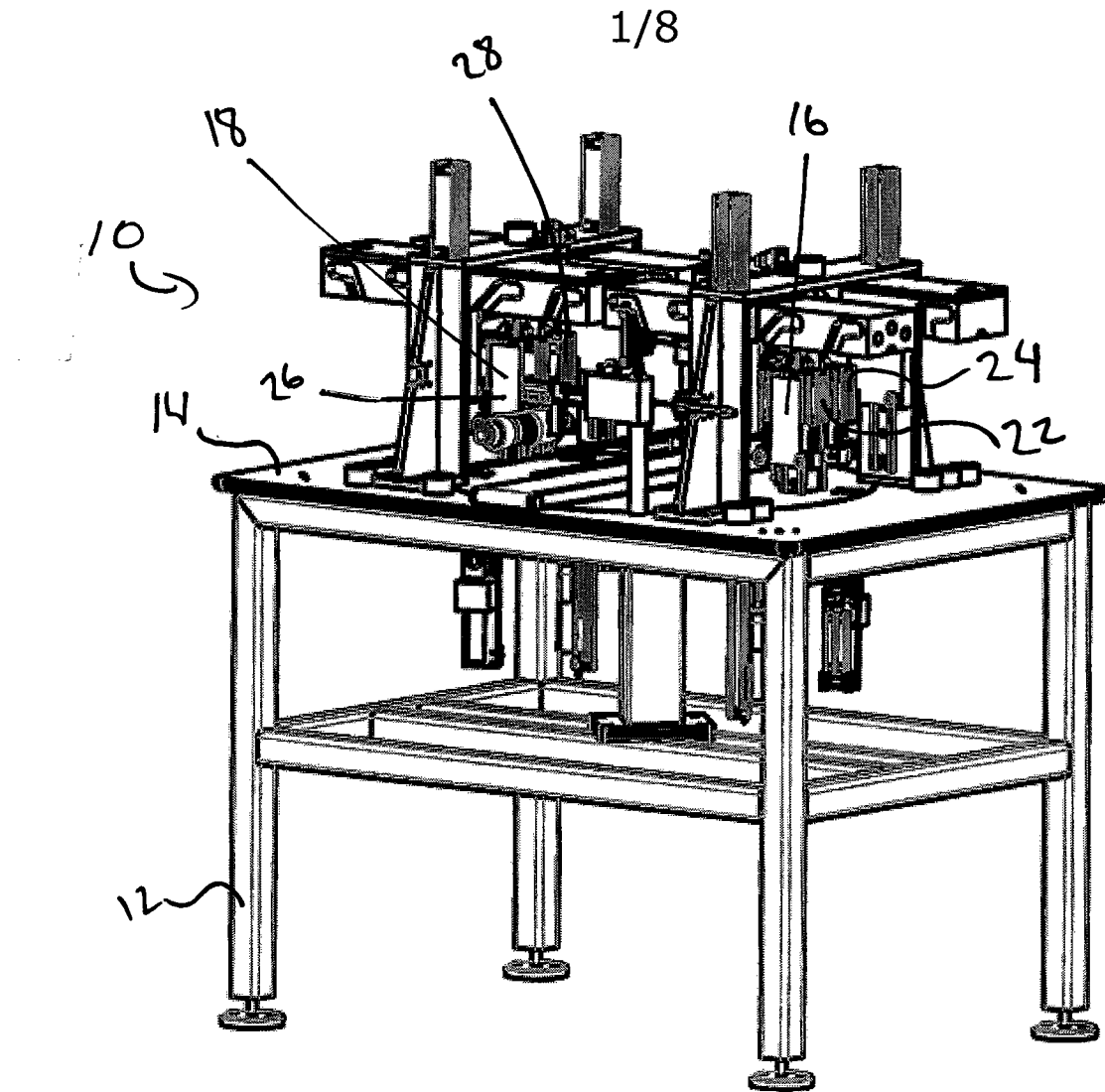


Fig. 1

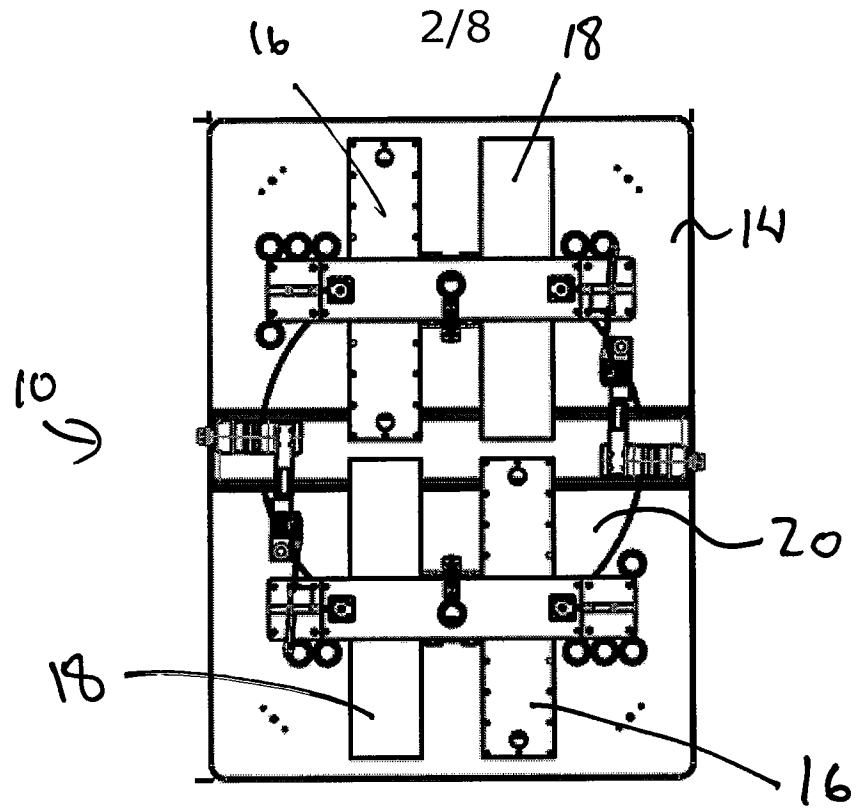


Fig. 2

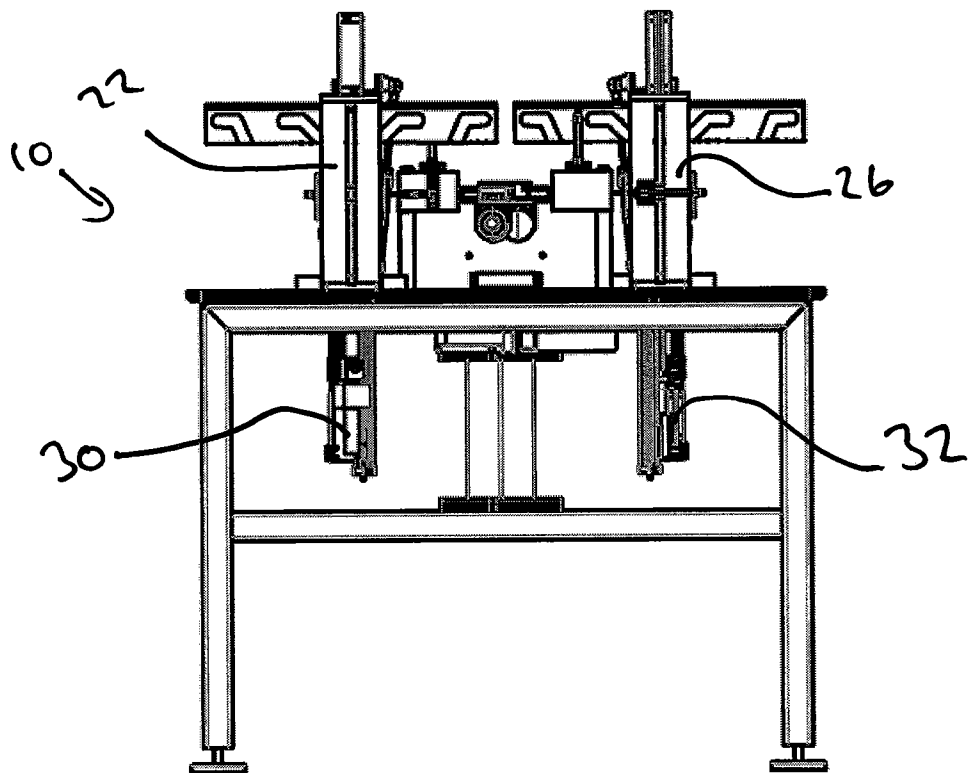


Fig. 3

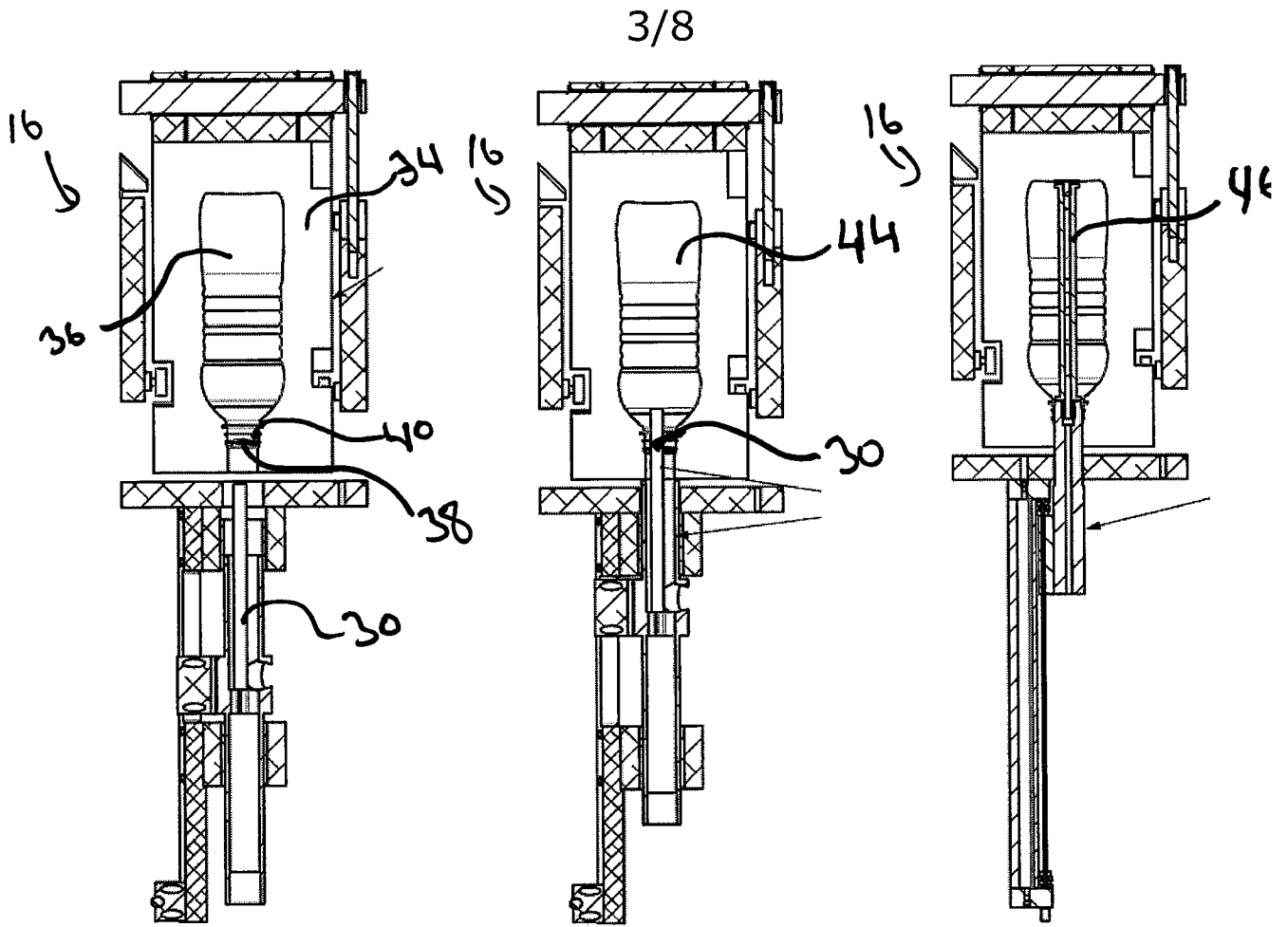


Fig. 4

Fig. 6

Fig. 7

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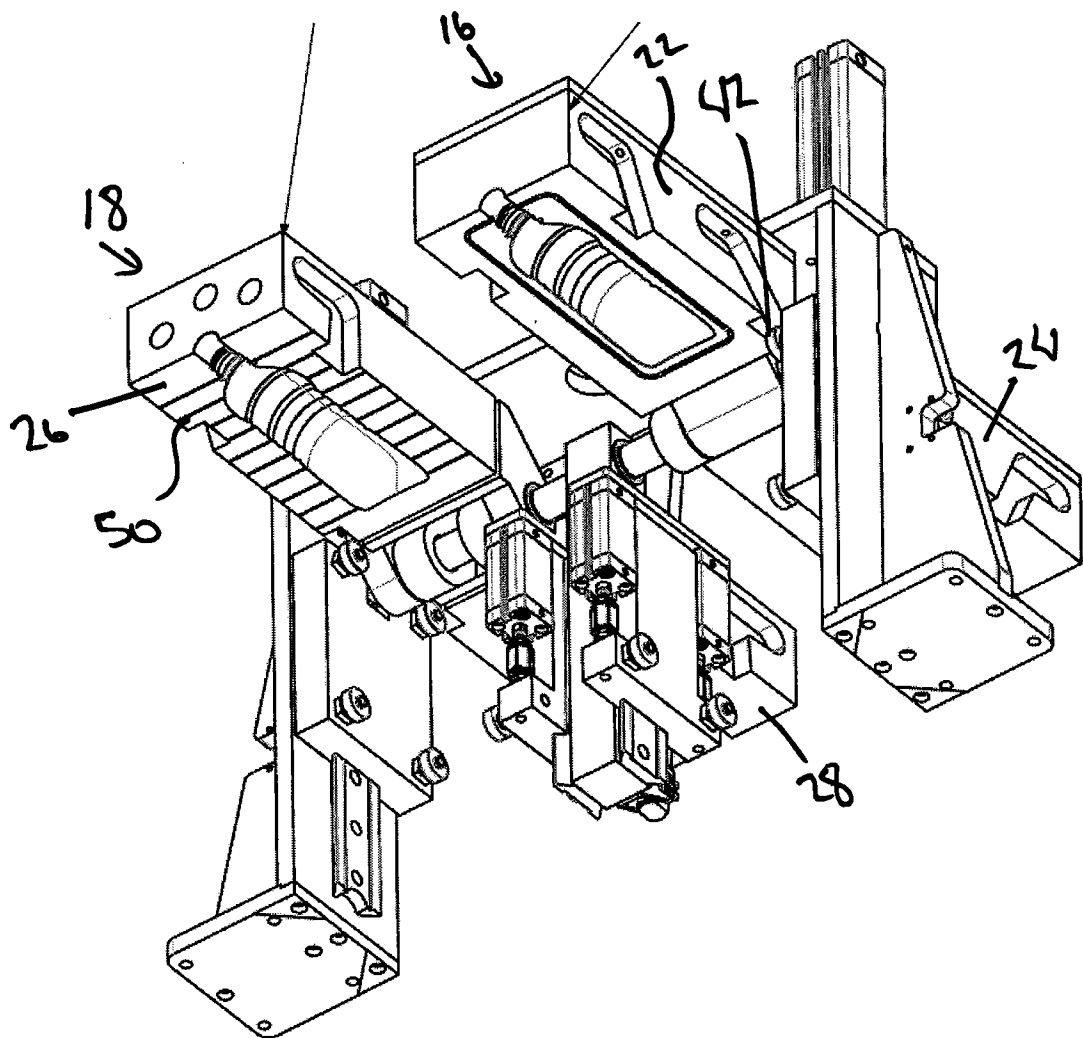


Fig. 5

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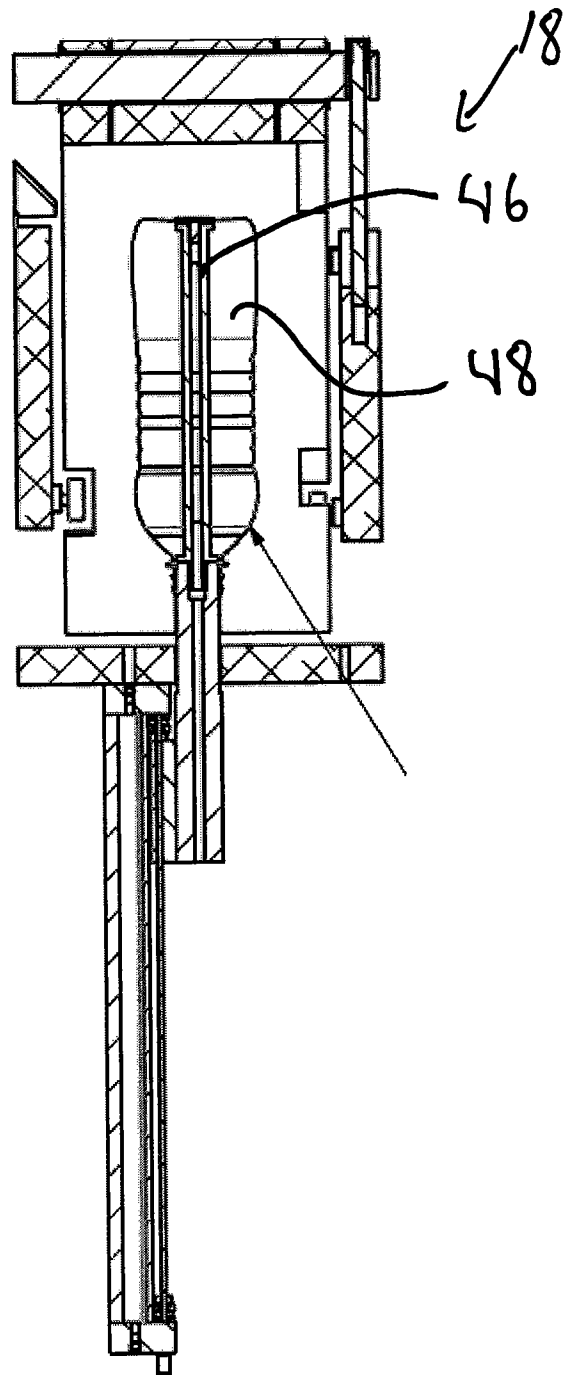


Fig. 8

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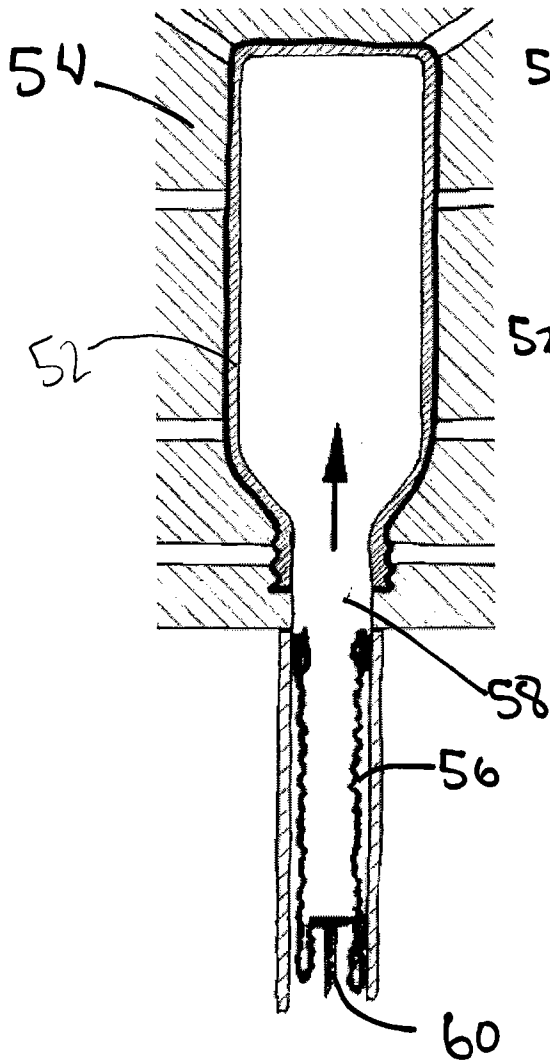


Fig. 9A

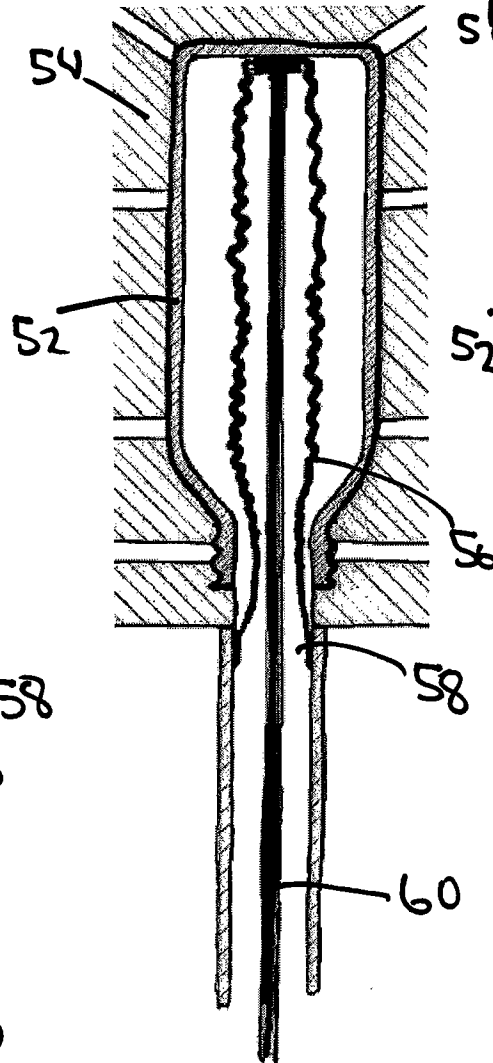


Fig. 9B

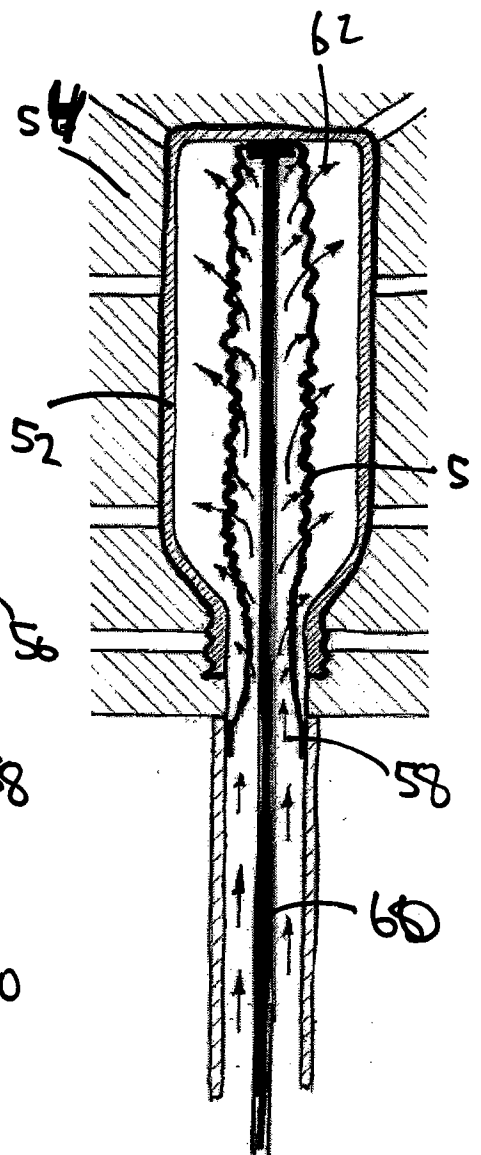


Fig. 9C

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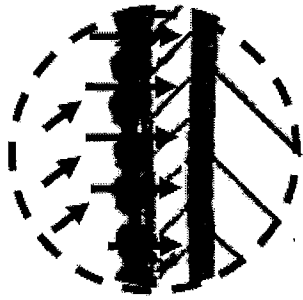


Fig. 9E

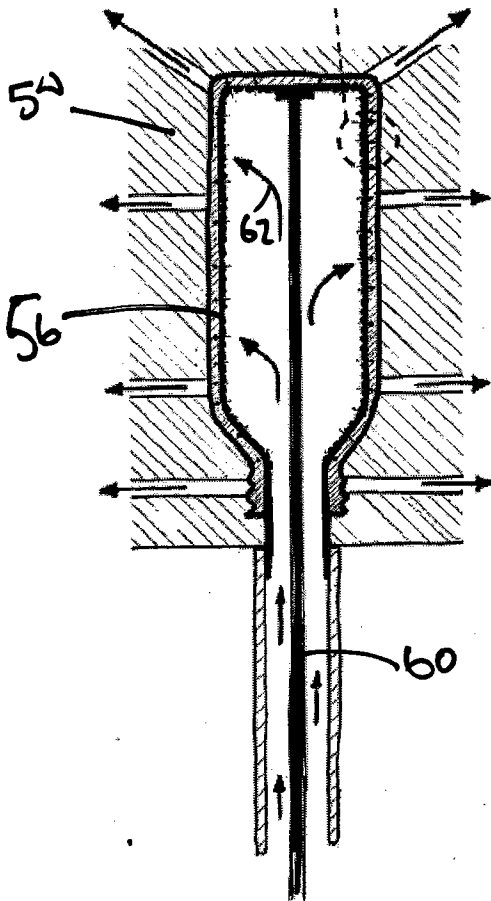


Fig. 9D

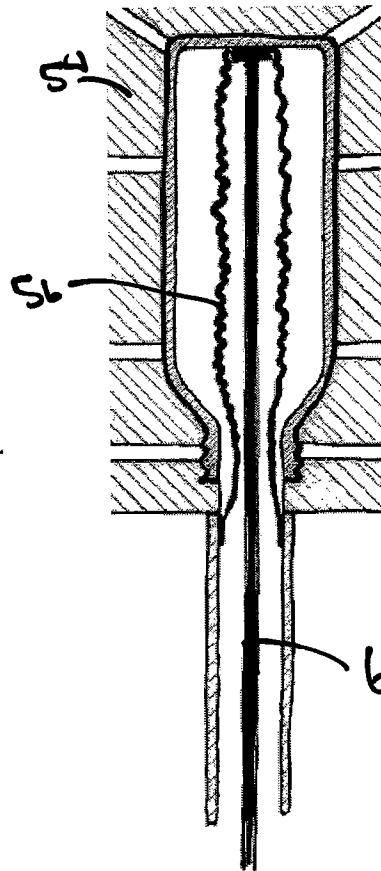


Fig. 9F

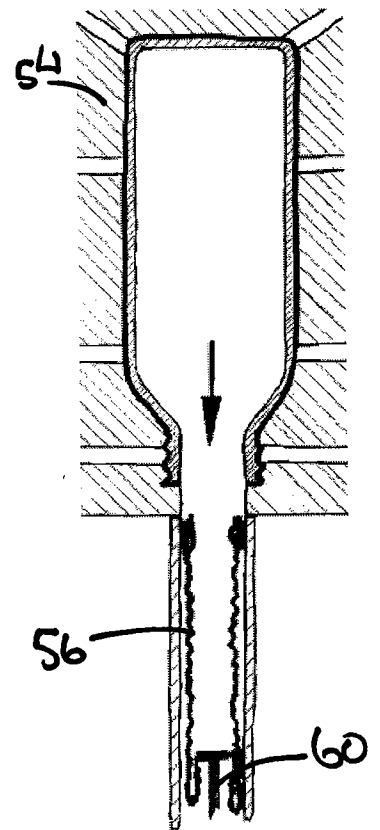


Fig. 9G

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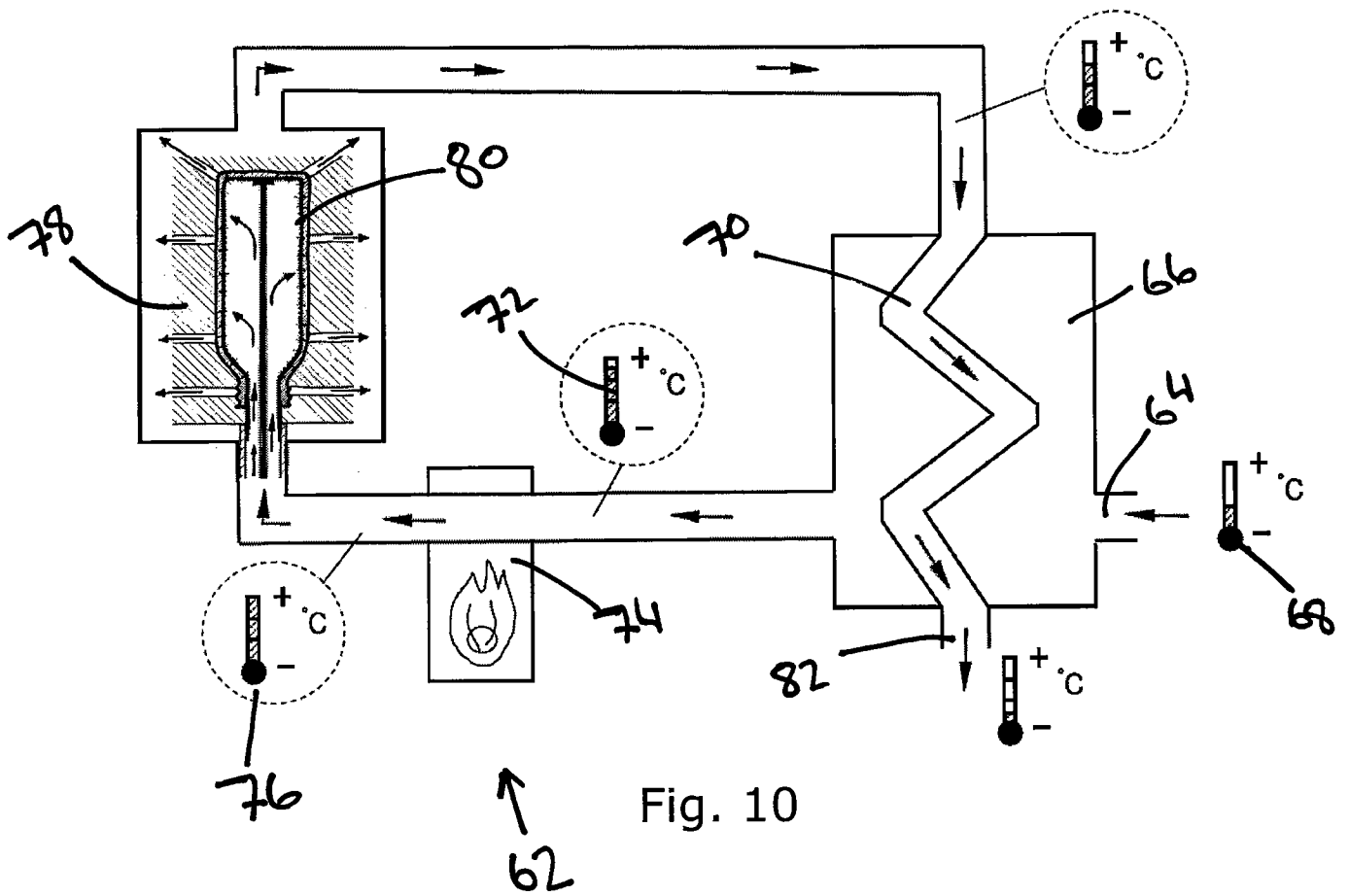


Fig. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2012/050126

A. CLASSIFICATION OF SUBJECT MATTER

INV. D21J3/10 D21J7/00 B65D1/02
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)

D21J B65D

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 029 978 A2 (KAO CORP [JP]) 23 August 2000 (2000-08-23) paragraphs [0021], [0022], [0030], [0033], [0070], [0084] - [0086] figures	1-3,7-12
X	----- US 2003/029591 A1 (OTANI KENICHI [JP] ET AL) 13 February 2003 (2003-02-13) cited in the application paragraphs [0019], [0020] -----	11



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

"E" earlier application or patent but published on or after the international filing date

"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)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search

4 June 2012

Date of mailing of the international search report

20/06/2012

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Authorized officer

Pregetter, Mario

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/DK2012/050126

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
EP 1029978	A2	23-08-2000	CN 1263968 A	23-08-2000
			DE 60024901 T2	29-06-2006
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