



(11)

EP 4 223 400 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
09.08.2023 Bulletin 2023/32

(51) International Patent Classification (IPC):
B01F 23/2361 ^(2022.01) **B01F 35/71** ^(2022.01)

(21) Application number: **22155359.7**

(52) Cooperative Patent Classification (CPC):
B01F 23/2361; B01F 35/718

(22) Date of filing: **07.02.2022**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

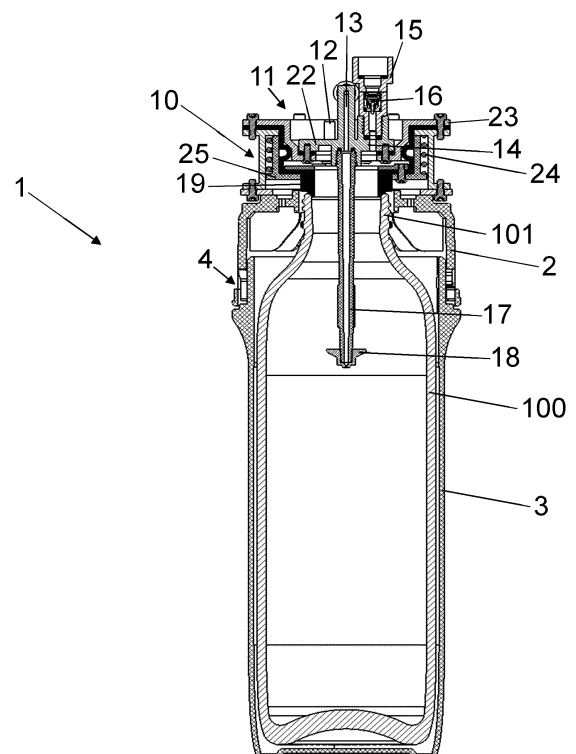
(71) Applicant: **BRITA SE**
65232 Taunusstein (DE)

(72) Inventor: **IMÖHL, Dominik**
65193 Wiesbaden (DE)

(54) **APPARATUS AND METHOD FOR FILLING LIQUID IN A CONTAINER AND FOR ENRICHING WITH A GAS**

(57) The present invention refers to an apparatus (1) for filling a liquid into a removable container (100) and for enriching said liquid inside said removable container (100) with gas, e.g. by carbonating. The invention further refers to a method for filling liquid into a container (100) and/or enriching the liquid with a gas. The apparatus comprises a filling head (10) with a cover plate (11) for closing an opening (101) of the container (100), having a liquid inlet port (14), a gas outlet port (12) and a gas inlet port (13), and a seal (19) for sealing the cover plate (11) with respect to the opening (101) of the container (100). The seal comprises a first surface (21) fixed to the cover plate (11) and a second surface (20) elastically movable relative to the cover plate (11). The apparatus (1) further comprises a suction pump connected to the gas outlet port (12), a pressure supply unit connectable to the gas inlet port (13), a tank to be filled with liquid and connectable to the liquid inlet port (14), and a control unit configured to operate the suction pump to lower a gas pressure inside said removable container (100) below a gas pressure acting on the liquid inside the tank.

Figure 1



Description

[0001] The present invention refers to a filling head for an apparatus, such as a home soda machine, for filling a liquid into a removable container and for enriching the liquid inside said container with a gas, e.g. by carbonating. More precisely, the present invention refers to a filling head which can be used both for filling a container at negative pressure and for enriching the liquid with a gas, for example CO₂, at positive pressure. The invention further refers to such an apparatus and to a method for filling liquid into a container and/or enriching the liquid with a gas.

[0002] Beverage dispensers, soda machines and other devices for enriching liquids for drinking inside a container with a gas, e.g. by carbonating, or for filling the container with liquid, which container is typically a bottle, are known for a long time and are preferably used at home for conditioning and preparing liquids such as water. Using such machines has the advantage of saving the need to carry water bottles home, while at the same time protecting the environment by, for example, using fewer disposable bottles. Further, using machines for preparing liquids at home also has the advantage that the enrichment of the liquid with gas such as CO₂, i.e., carbonation, can be determined by the user and thus adapted to the needs of different users.

[0003] Typically, the bottle is prefilled by use of a water tap before the liquid inside the bottle is carbonated. This still water is then carbonated inside a respective apparatus afterwards wherein the pressure inside the bottle is increased. However, there also exists apparatus that are able to fill liquid into the bottle without having to use the water tap to prefill the bottle. Nevertheless, if liquid is to be dispensed inside the bottle directly by means of an apparatus instead of using the water tap beforehand, typically pumps are required.

[0004] Here, a differentiation can be made between pumps with direct liquid contact and those without liquid contact, when pumping a liquid. Pumps in contact with liquid, such as mini gear pumps, create a potentially critical hygienic problem, as liquid contact, in combination with stagnation and room temperature, as well as pump internals (seals, dead spots, etc.), favors microbiological growth. Consequently, in order to prevent contact between the pump and the liquid, air pumps may be used, which create an overpressure/positive pressure in the tank and thus convey the liquid into the bottle.

[0005] For example, US 10,752,483 B1 discloses an apparatus for dispensing a liquid such as water from a liquid storage container into cups. In this regard, water inside a bottle, which represents a water tank, is pressurized using an air pump and flows into a reservoir. From here, the liquid can be filled into a respective cup due to the applied pressure. For pressurizing the water in the water tank, instead of the air pump, a CO₂ cylinder for carbonating the liquid may be used for pressurizing the water tank. Hence, both for filling and carbonation, the

use of an overpressure is applied.

[0006] Generally speaking, when applying an air pump for pressurizing water in a container, typically, air is sucked in from the environment to generate the positive pressure, which air is then blown into the apparatus whereby it gets into contact with the water. Therefore, if an apparatus pressurizing water of its water tank by an air pump is used in a kitchen, this may have the disadvantage that, for example, aerosols and particles from cooking, such as onion steam, oil vapor or the like, are sucked into the system, which in turn may also allow for microbial growth. Further, to provide a cost-effective product, compressed air pumps, i.e., the components used for such air pumps, are usually not certified food safe, since they do not come into direct contact with water. Nevertheless, the air pumped by the air pump comes into contact with both pump and water, which is why contamination of the water cannot be ruled out.

[0007] The above described risk of contaminating the water of the water tank by pressurizing it with an air pump may be avoided by carrying out the this pressurizing by means of CO₂ from the CO₂ cylinder. However, applying CO₂ for applying an overpressure in the water tank in order to convey the water to a container such as a cup has the disadvantage that CO₂ is consumed, which results in an earlier emptying of the CO₂ cylinder. However, in particular in the field of home soda machines, the consumers are very sensitive regarding efficiency regarding CO₂ consumption, i.e. how many containers of carbonized sparkling water can be obtained with one CO₂ cylinder.

[0008] A further disadvantage of pressurized air to convey liquid such as water is that the tank for storage must be completely sealed pressure-proof, which leads to higher manufacturing costs. Furthermore, when the user wants to refill such a tank of an apparatus using pressurized air, for example using tap water, in order to refill the tank, the removal process takes an additional effort. This is due to the fact that those tanks, since they have to hold the pressure for conveying the liquid, require a pressure proof connection with the apparatus. For example, the user must unscrew the tank instead, as otherwise the system would not be sufficiently sealed.

[0009] An alternative system for conveying water from a tank to a tap is disclosed in US 5,992,684 A. Here, a vacuum pump is provided to suck water from a first storage tank into a second storage tank located above the first storage tank. Water may be dispensed from the second storage tank via three different taps. The conduit between the second storage tank and one of these taps comprises a mixer for carbonation of the water flowing through the mixer using a compressor to flow the water from the second water storage tank towards the tap. In addition to the disadvantage that the water is conveyed, at least in part, by a compressor that sucks in air from the environment to compress said air as described above, such a system requires two storage tanks.

[0010] Consequently, the object of the present inven-

tion is to provide a filling head for an apparatus which allows for both, filling a liquid into a removable container and enriching the liquid inside the container with a gas, e.g. by carbonating, as well as a method for efficient filling and enriching liquids with a gas, e.g. by carbonating.

[0011] This object is solved by an apparatus as defined in claim 1, and by a method according to claim 12.

[0012] According to an aspect of the present invention, a filling head for an apparatus for filling a liquid into a removable container and for enriching the liquid inside said container with a gas, e.g. by carbonating, is provided. Preferably, the filling head is for an apparatus according to present claim 1. The filling head comprises a cover plate for closing an opening of a container, a liquid inlet port and a gas outlet port provided in the cover plate, and a seal for sealing said cover plate with respect to the opening of said container. Further, the seal comprises a first surface fixed to the cover plate and a second surface elastically movable relative to the cover plate. Furthermore, the filling head comprises a gas inlet port provided in said cover plate.

[0013] The filling head and apparatus according to the present invention is suitable for use with any kind of removable container having an opening. Preferably, said removable container will have an upper portion having a smaller diameter than its lower portion, which upper portion may be termed as "neck" of the container. Said opening is typically located on top of said upper portion, i.e. the opening has a smaller diameter than the largest diameter of the container of the lower portion.

[0014] Preferably, the container is a bottle or carafe, more preferably a bottle. Besides of said opening, the container may have additional openings.

[0015] When a removable container is used with the filling head, the second surface of the elastically movable seal is configured to be in contact with and rest against the opening of the container. Consequently, when the respective removable container is used with said filling head, the elastic material of the seal is at least partially compressed or deformed while being moved towards the cover plate. This in turn results in a force caused by the compression and deformation of the elastic seal acting on the seal to force the second surface towards to the first surface, i.e., towards to the cover plate. The second surface is the most distal surface of the seal, which, when a container with an inner and outer surface is used with the filling head, the second surface is defined by facing the opening of the container. Therefore, as long as the container is in contact with the filling head, the force compressing and deforming the seal allows for the seal to abut against the opening and allows for a pressure proof sealing in order to allow a suction pump to suck air outside the container through the gas outlet port. A respective suction pump, thus, may provide a negative pressure inside the container, i.e., a gas pressure below a gas pressure inside a tank comprising liquid to be filled into the container, by sucking out gas, preferably air, via the gas outlet port. Typically, the tank is at atmospheric pressure.

Further, the container is filled with liquid from the tank through the liquid inlet port via an optional connection nozzle arranged between in the liquid flow path between tank and liquid inlet port, which connection nozzle preferably is attached to the cover plate of the filling head. Furthermore, once the container is filled with liquid, pressurized gas can be supplied into the container via a gas inlet port, therefore allowing to enrich the liquid with said gas. Therefore, all fluids, i.e., liquid and/or gas, pass through the filling head in order to enter or leave the container, wherein during gas extraction by means of a suction pump, the gas pressure inside the container is a negative pressure (underpressure). It is preferred that the seal and/or liquid inlet and outlet ports are arranged within the filling head such that liquid fluids, e.g. water, do not contact the seal of the filling head, in order to avoid contamination such as microbiological growth initiated by a wet seal. Preferably, the gas pressure inside the container is lower than the atmospheric pressure present in the above water surface of the water tank of the apparatus, which atmospheric pressure is typically around 1 bar. Therefore, the gas pressure inside the container is preferably less than 1 bar, preferably 0.1 bar to 0.9 bar, more preferably 0.6 to 0.8 bar. And wherein when the liquid is pressurized by supplying gas via a gas inlet port, the gas pressure inside the container rises typically to pressures between 2 bar and 8 bar.

[0016] Consequently, the filling head allows for a pressure proof sealing both in the event of negative pressure in the container during a filling process and in the event of positive pressure during a gassing process.

[0017] A container which may be used with the filling head may be any container with a opening configured to hold a respective liquid. Typically, a water container is used having a maximum fill volume of about 1 liter. The container is preferably made of glass, plastic or stainless steel. The gas used to enrich the liquid is typically carbon dioxide (CO₂), oxygen (O₂) or the like. Independent of the gas used to enrich liquid, here, this process is called carbonation. Further, the liquid which is filled into the removable container is typically water or any other water-based beverage.

[0018] In principle, the seal used for sealing the filling head when used with a container may comprise an elastomeric polymer which is both certified food safe and has suitable elastomeric properties for providing a kind of (spring) tension, such as shore hardness. Preferably, suitable elastomeric polymers certified food safe are selected from ethylene propylene diene monomer (EPDM) rubber, silicone rubber, nitrile butadiene rubber (NBR) and chloroprene rubber (known under the tradename Neoprene®). As regards the elastomeric properties of the seal comprising said polymer preferably has a shore hardness scale of A40 to A90, more preferably A50 to A80, and most preferably A60 to A70. The cover plate may be made from metal or plastic material, wherein the first surface of the seal may be fixed to the cover plate by the use of any kind fixing means, such as screws,

glue, welding or the like.

[0019] Alternatively, the cover plate and the first surface of the seal, or preferably the whole seal including first and second surface, are fixed together in that they are formed as one integral part. Said integral part may either be formed by molding or welding the first surface of the seal to the cover plate, or by forming cover plate and first surface of the seal as one single part, e.g. by molding.

[0020] Furthermore, the seal may be provided either as one part comprising both first and second surface or as two parts in which a first part comprises the first surface and a second part comprises the second surface. Preferably, the seal is provided as one part comprising both first and second surface.

[0021] The ports of the cover plate are generally provided by respective openings for attaching tubes and pipes of the suction pump, the tank and the pressure supply unit. However, said openings may also comprise connection nozzles to allow for a better connection. Those connection nozzles may be an integral part of the cover plate or may be screwed or otherwise connected to the respective ports.

[0022] Further, the cover plate may be provided by a flat disc, but may also have a different shape, for example the shape of a cylinder. Further, the cover plate may be provided by multiple components coupled to one another by tight fit, force fit, or material fit. If the cover plate comprises multiple components, there may be extra sealing elements provided to seal interfaces between the components. Independent of the shape of the cover plate, the ports are preferably arranged on a component of the cover plate comprising a surface directly facing a spout of a container, when a container is attached to the filling head. Preferably the seal is also fixed with its first surface to this same surface of the cover plate, i.e., the surface facing the spout.

[0023] In addition, the shape of the cover plate and the seal fixed to the cover plate may be chosen such that apart from the ports, the cover plate and the seal form a sealed volume together with a container when used with the filling head. The seal, which for example has essentially a tube-like shape, is preferably fixed to the cover plate at one end, i.e., the first surface. The lateral surface of this tube-like shaped seal is in turn preferably also arranged on the filling head in such a way, for example clamped, that, in the event of a negative pressure in the container, e.g., a pressure lower than the atmospheric pressure, the seal, e.g., the tube-like shape seal, does not contract radially, i.e., the lateral surface does not narrow significantly. The first surface of the seal may also be provided by a portion of the lateral surface of the seal.

[0024] In order to attach a container to the filling head, it may either be possible to hold the container and press the container against the seal. However, it is preferred when the container is directly attached to the filling head by respective connection means, for example a thread provided at the opening of the container and a respective

counterpart on the filling head, or indirectly by a receptacle which holds the container. Such a receptacle may be coupled to the filling head by respective coupling means.

[0025] In a further embodiment, the seal may have, at least partially, an annular or tubular shape with a wall thickness being smaller than a distance between the first surface and the second surface of the seal. Preferably the section of the seal with the greatest wall thickness defines the second surface and therefore provides contact with the spout of the container, in the event of a container being used with the filling head. In general, the wall thickness contributes to the material strength of the seal. The wall thickness of the seal at the second surface may be at least three times smaller than the distance between the first surface and the second surface of the seal. Due to the respective dimensions of the seal, sufficient deformation or compression of the seal can be ensured in particular in order to be able to seal tightly even at greater overpressures (positive pressures) and underpressures (negative pressures). Respective overpressures may be, for example between 5 bar and 8 bar during enrichment of a liquid inside the removable container with gas. Underpressures may be in between 0.1 bar and 1 bar during the use of a suction pump, i.e., during filling of the container.

[0026] The distance between the first surface of the seal and the second surface of the seal may be determined from the most distal point of the seal of the second surface to the first surface, which is the surface being fixed to the cover plate by screws or the like.

[0027] In addition or as an alternative, the seal may comprise a bellows portion which may be compressed when the second surface of the seal is moved towards the cover plate, e.g., by the opening of the container. A respective bellows may be provided in between the first surface and the second surface of the seal, wherein the bellows is compressed, when the second surface of the seal is moved towards the first surface of the seal. Compressing the bellows provides a force that pushes the second surface away from the first surface. This means, the compressed bellows applies a force onto the seal in order to force the second surface of the seal away from the first surface being fixed to the cover plate, i.e., away from the cover plate. Providing a bellows may further increase the force with which the second surface pushes against a opening of a removable container when that container is used with the filling head.

[0028] In order to achieve better sealing during a gas enrichment process, i.e., during a pressure supply process, it is advantageous if the force with which the second surface of the seal presses against the opening of the container is increased. For this purpose, the seal may comprise a flange-like pressure surface connecting two portions of the seal having different diameters, wherein a space is formed between the flange-like pressure surface, an upper part of the second surface of the seal representing one of said portions of different diameter,

and the cover plate, which space is in fluid communication with the gas inlet port, and wherein the area of the flange-like pressure surface is larger than the area of the opening of the container.

[0029] For example, the seal may be stepped so that the seal has a larger diameter in a contact area with the cover plate, i.e., in the area of the first surface, than in the area of the second surface. This stepped shape may be selected so that the step that forms a pressure surface is larger than the second surface. A void annular space may be formed between the pressure surface and the cover plate which space is in fluid communication with the interior of the container, if the container is attached to the filling head. Thus, when the pressure inside the container increases, the force pressing against the pressure surface is significantly greater than the force pressing against areas of the second surface. Depending on the selected dimensions, the force with which the seal presses against the opening during an enrichment process can be significantly increased and rises as the pressure in the container rises. The stepped shape of the seal may be supported by additional components, e.g. a washer, which may be fixed to the seal.

[0030] In an exemplary embodiment, the seal comprises a flange-like portion defining the first surface protruding radially outwards from a first tubular portion, e.g. comprising the bellows, and a flange-like pressure portion connecting the tubular portion with a second tubular portion which comprises the second surface. The second tubular portion has an inner diameter significantly smaller than the inner diameter of the first tubular portion, specifically, the outer diameter of the second tubular portion may be smaller than the inner diameter of the first tubular portion.

[0031] Alternatively or in addition, the filling head may comprise a separate spring element which may be tensed when the second surface of the seal is moved towards the cover plate, e.g., by the opening of the container. In other words, the spring element may bias the second surface of the seal towards the spout of the container. Thus, the spring element may be supported by the cover plate and the seal and thus be tensed when the second surface of the seal is moved in the direction of the cover plate.

[0032] For support on the seal, an extra element is preferably provided, for example a spring guiding element attached to the seal and/or the cover plate. The spring guiding element is movable in axial direction, i.e. in direction between container and filling head, and it guides the spring in that it prevents it to move in at least one lateral direction. The spring guiding element may be formed of one or two parts.

[0033] The one part spring guiding element is preferably adjacent to or directly fixed to the flange-like pressure surface of the filling head's seal, wherein the spring element is arranged around one surface side of the spring guiding element by being in direct contact with the outer surface of the spring guiding element, such that it sup-

ports the spring element, i.e. prevents the spring element from movements in one lateral direction, namely in direction to the one-part spring-guiding element. Furthermore, it is preferred that the one part spring guiding element is concentrically arranged around the outside of the flange-like pressure surface, and the spring element in turn is concentrically arranged around the outside of the one part spring guiding element. Preferably, both flange-like pressure surface, one part spring guiding element and spring element have the same cross sectional shape such that there's a snugly fit at least between spring guiding element and spring element in order to effectively guide the spring, i.e. avoid movements of the spring in lateral direction. In principle, said cross sectional shape could be any shape, but for pragmatical reasons, since commercial spring elements typically have a circular cross sectional shape, a circular shape is preferred for the flange-like pressure surface, the one part spring guiding element and the spring element.

[0034] The two part spring guiding element comprises the above described one part spring guiding element which will be termed "first element" in the context of the two part spring guiding element. In addition to the first element, the two part spring guiding element comprises a second element for avoiding lateral movement of the spring element in a second lateral direction. For this purpose, the spring element is interposed between first and second element, such that a spring movement is possible in axial direction of the spring, but not in its lateral direction, since lateral movement of the spring is avoided by the first and second elements between which (the windings of) the spring element are interposed. For the two part spring guiding element, it is preferred that flange-like pressure surface, first element, spring element and second element have the same cross sectional shape, preferably a circular cross sectional shape.

[0035] The spring guiding element and the spring element may be arranged around the outer side or the inner side of the flange-like pressure surface, wherein an arrangement at the outer side is preferred, since this not only provides for more space in the inside of the filling head for other components, but also provides for a more effective and reliable axial spring force applied on the opening of the container, because in this case, the spring will have a larger diameter than the opening of the container.

[0036] In the present specific embodiments depicted in the Figures, the spring element is a compression spring. However, by means of an alternative fastening of the spring element, also a tension spring may be used. This means, that independent of the type of spring element, the spring element is used to provide an additional force, forcing the second surface of the seal away from the cover plate when a removable container is used with the respective filling head, so that the second surface is moved towards the cover plate.

[0037] According to a further aspect of the present disclosure, the seal may comprise an inner sealing lip con-

figured to protrude into the opening of the removable container. This sealing lip may extend from the second surface of the seal away from the cover plate. During enrichment of a liquid inside a removable container, the pressure rises inside the container, so that the inner lip is pressed against an inner surface of the container, thereby additionally improving the sealing.

[0038] In addition or as an alternative, the seal may comprise an outer sealing lip configured to encase, i.e. to extend past, the opening from outside of the removable container. This sealing lip may also extend from the second surface of the seal away from the cover plate. Consequently, when the pressure during filling of a removable container with liquid is lowered inside the container, the outer sealing lip is sucked onto an outer surface of the container, thereby additionally improving the sealing.

[0039] Thus, when a seal comprises both an inner sealing lip as well as an outer sealing lip, the contact surface of the spout of the removable container, i.e., the contact surface of the container, is located between the two lips, when the container is used with the filling head. In such an exemplary embodiment, a groove may be formed between the sealing lips into which the contact surface of the spout may enter.

[0040] The above described sealing lips, alone or in combination, provide for an improved sealing between filling head and removable container.

[0041] According to an alternative embodiment, the lowermost part of the second surface of the seal has a flat or planar surface for contacting the opening of the container, i.e. the seal has none of the above described lips. Such flat or planar surface has the advantage that it is compatible with any kind of container, hence the user is free in using almost any container as removable container for the present apparatus.

[0042] In one embodiment, the gas inlet port may be positioned centered with respect to the cover plate and the first surface of the seal being fixed to the cover plate and to the second surface of the seal. Therefore, the gas inlet port is centered with respect to the seal. The centered arrangement of the gas inlet port allows for a centered introducing of the gas into a removable container, which increases a uniform distribution of the gas within the container and the liquid, particularly in the case of a rotationally symmetrical container shape. In addition, this may facilitate introducing a tube connected to the gas inlet port into the container.

[0043] As mentioned before, the object of the invention is also solved by an apparatus for filling a liquid into a removable container and for enriching said liquid inside said removable container with a gas, e.g. by carbonating, using the above mentioned filling head. The apparatus may comprise a suction pump connectable or connected to the gas outlet port, a pressure supply unit connectable or connected to the gas inlet port, a tank to be filled with liquid connectable or connected to the liquid inlet port, and a control unit. The control unit is configured to operate the suction pump to lower a gas pressure, preferably

an air pressure, inside said removable container below a gas pressure, preferably an air pressure, acting on the liquid inside said tank. Hence, the suction pump is configured to suck gas, preferably air, out of the removable container, in order to lower the gas pressure inside said removable container below a gas pressure acting on the liquid inside the tank. In other words, within the removable container, an underpressure is created compared to the gas pressure in the tank to be filled with liquid. This underpressure in turn allows to convey liquid from the tank into the removable container. Optionally, said suction pump or an additional suction pump may be configured to control flow of gas from the pressure supply unit into the container in order to enrich said liquid filled into said removable container with said gas. It is preferred that the suction pump for lowering the gas pressure inside the removable container can also be used for controlling the flow of gas for enriching the liquid inside said removable container, e.g. of CO₂ gas, since this allows for saving an additional pump. In an exemplary arrangement of the components of the apparatus, the tank may be located next to the container, i.e. substantially at the same level of height which reduces the energy consumption required to suck e.g. water from the tank into the container.

[0044] The apparatus for filling a liquid into a removable container and for enriching said liquid inside said removable container with a gas may further comprise the removable container having the opening.

[0045] The suction pump is preferably connected via a valve to the gas outlet port of the filling head of the apparatus. As soon as the container is inserted into the apparatus to be filled and/or following actuation of an input device, e.g. a button, the pump may start to suck the air out of the container. If there is a valve arranged between the pump and the container, the valve is open in this state. The tank is connected to the filling head via the liquid inlet port and may also have a backflow preventer between the inlet port and the tank, which backflow preventer is preferably arranged within the connecting nozzle. A backflow preventer is a means

[0046] The backflow preventer may be a non-return damper e.g. having a simple mechanical flaps mechanism preventing backflow, or a passive or active backflow valve, wherein an active backflow valve may be solenoid backflow valve. A non-return damper is preferred, because it is cost efficient and sufficient for the intended purpose. The selection of the type of backflow preventer depends on the type of mode of how the gas is flown into the replaceable container in order to enrich the liquid therein with gas. For example, for a so-called "batch-type" carbonation", where CO₂ gas directly flows into the liquid within the replaceable container without reducing the pressure of the gas, a non-return damper e.g. having a simple mechanical flaps mechanism preventing backflow may be sufficient. However, in other carbonation types, e.g. when the gas is applied in multiple pulses and/or the gas is circulated within the apparatus, one or more active backflow valves, preferably solenoid back-

flow valves, may be required. If a backflow preventer is arranged between the tank and the filling head, i.e. within the liquid flow path comprising the liquid inlet port of the cover plate of the filling head, this backflow preventer is also open at this point. Consequently, as soon as sufficient vacuum has been generated in the container by the suction pump, the liquid from the tank begins to flow into the container. The suction pump thus sucks continuously, with the liquid flowing from the tank into the container. After the container is filled with liquid, the pressure supply unit provides pressurized gas through the gas inlet port in order to enrich the liquid with gas. Here, the suction pump is not running, and the aforementioned valves are closed to avoid that the suction pump and the tank are exposed to the pressure present in the removable bottle, which is typically around 8 bar. This is because the suction pump will typically not be designed for such a high pressure, and back-pressure within the tank would result in an undesired bubbling within the tank. During the entire operation, the control unit takes over the control of all devices (suction pump, pressure supply unit, valves etc.).

a

[0047] However, the apparatus may also comprise a control interface to allow the user to select the amount of gas which is enriched inside the liquid. Therefore, the user may select a medium sparkling liquid. Consequently, the control unit will start to operate the respective devices accordingly. The user may also be able to select an amount of liquid to be filled into the container or the like by use of said interface. Thus, after the user's selection, the apparatus may fill the container with liquid and enrich the liquid with gas fully automated.

[0048] Accordingly, the control unit comprises a processor, a memory etc. However, the apparatus may also be manually controlled, wherein each unit is started by an individual operation of the user. To supply the control unit with power, the device preferably has a power supply unit. In an example, the control unit may comprise a PCBA, e.g. with a micro-controller, and may be connected to the power supply. One or more operation modes may be stored on the PCBA, e.g. for different degrees of carbonation and/or different fill levels or amounts of liquid to be carbonated. The control unit may be connected with one or more sensors, e.g. for detecting gas pressure, fill level of the container or the like. In addition, a display unit, actuation means (user operation interface) and the like may be connected to or part of the control unit.

[0049] Further, according to one embodiment the apparatus may comprise a measuring unit configured to determine an amount of liquid filled inside the removable container. Typically, if for example a container with a maximum volume of 1 liter is used, only 0.8 liters are supposed to be filled into the container, before the liquid is enriched with gas. The measuring unit may determine the amount of liquid continuously or may only be detected whether a predetermined amount of liquid is reached. Such a predetermined amount of liquid may be selected

by the interface or may be preset by the size of the container. The measuring of the amount of liquid may be done by using a sensor in order to determine the amount of liquid running from the tank into the container. Alternatively, there may be a respective sensor for detecting the liquid level inside the tank. Thus, detecting a liquid level inside the tank when a filling process is started and continuously measuring the liquid level inside said tank may allow for calculation of the amount of liquid inside the container by means of the control unit. Other alternatives for measuring the amount of liquid filled into the container may be used.

[0050] In a further embodiment, the apparatus may comprise a pressure compensation valve configured to be operated by the control unit before the liquid inside the container is enriched with the gas. After the suction pump has been operated, there is a negative pressure (underpressure) in the container, which may be compensated by the gas flowing in, which is the preferred operating mode, since the typical operation mode will be that after conveying the liquid by means of said negative pressure, the user wants to enrich the conveyed liquid in the container with the gas flowing into said liquid. However, alternatively, a pressure compensation valve may be used as described here, wherein upon opening the pressure compensation valve, the pressure inside the container is adjusted to the atmospheric pressure. This also allows for an easy removal of the container, when the user does not want the apparatus to supply the liquid with pressurized gas, e.g. since the user assumes that the water stored in the apparatus too long and may not be fresh any more, for cleaning reasons or other purposes, e.g. in case the user wants to have a non-sparkling liquid dispensed by the apparatus according to the invention.

[0051] In addition, the tank filled with liquid may be removably connectable to the liquid inlet port, i.e., to said apparatus. Thus, the tank may for example have a maximum filling level of 8 liters, and thus allows for ten fillings of an aforementioned container when only 0.8 liters are filled into said container. When the tank is empty, the user may therefore use tap water to refill the tank. An advantage of the one aspect of the present inventive concept of applying vacuum is that the lid of the tank does not need a special sealing for making the tank pressure proof or air tight. Rather, a simple lid that protects against dust can be used, which can easily be removed as well as closed by the user. Only the lower part of the tank, that is the flow path below the tank's water column needs to be seal for safeguarding the vacuum within the removable container generated by the suction pump. Hence, a sealing has to be provided between the liquid outlet port of the tank and the remaining apparatus and/or between filling head and the liquid flow path starting from the tank's liquid outlet. In addition, from time to time, the user may clean the tank, wherein a removably connectable tank is especially helpful, wherein for cleaning purposes, it is preferable that a vacuum safeguarding sealing between tank and remaining apparatus is detachable from tank

and/or remaining apparatus. Further, it is particularly preferred that a filter is arranged in between the outlet of the tank and the liquid inlet port of the cover plate. This filter may be arranged inside a filter cartridge, wherein it may be easier to exchange the filter when the tank is removably connectable to the apparatus. The filter may be any kind of water filter suitable for pressurized filtering, such as activated carbon filter, ceramic filter for removing viruses and/or bacteria, ion exchange resins, or a combination thereof. Owing to present inventive concept of conveying liquid by providing a pressure in the removable container which is below the atmospheric pressure present in the above water surface of the water tank of the apparatus, the water of the water tank can be filtered without burden for the user such as a preceding, separate filtration of the water to be filled into the water tank of the apparatus, e.g. by means of a percolation type table water filter. A further, additional advantage of the present concept of conveying the liquid by pressure difference is that contamination of the liquid by means of contaminants in the surrounding air, such as e.g. garlic or onion smells, as well as contaminations deriving from part of the pump, can be effectively ruled out.

[0052] Further, the apparatus may comprise a receptacle for receiving the container and configured to be coupled to the apparatus. Therefore, the container itself is not directly coupled to the apparatus and is rather held to the apparatus by the receptacle. Thus, when the apparatus is used with a removable container, the user may first place the container inside said receptacle and may then couple said receptacle to the apparatus. Due to said coupling, the container is forced against the seal of the filling head, thereby pushing the second surface of the seal towards the cover plate.

[0053] In this regard, in one embodiment the receptacle may be coupled to the apparatus, e.g. to the filling head, by means of a coupling. This, type of coupling may allow for an easy coupling and decoupling of the receptacle and the apparatus. In addition, the coupling may urge the receptacle and thus the container towards the seal. Preferably, the coupling is a bayonet coupling.

[0054] Further, the object of the invention may be solved by a method for filling a liquid into an attached removable container and for enriching said liquid inside said removable container with a gas, e.g. by carbonating, using the apparatus according to the description above. The method comprises the following steps: a.i) signaling to the control unit to operate the suction pump to lower a gas pressure, preferably an air pressure, inside the removable container below a gas pressure, preferably an air pressure, acting on the liquid inside the tank connected to the liquid inlet port thereby filling said container with liquid from said tank; and b) thereafter signaling to said control unit to operate the pressure supply unit to supply pressurized gas to the liquid of said removable container when the liquid is fully filled into the container thereby enriching said liquid filled into the container with said gas.

[0055] Consequently, once a user has a container attached to the apparatus, and has, for example, used the interface in order to select the preferred liquid, a signal is sent to the control unit in order to operate the suction pump, thereby filling the container. Further, when the container is filled to with the desired amount of liquid, for example, when a user manually stops pushing a button or a measuring unit detects a predetermined amount of liquid inside the container, a signal is sent to the control unit in order to operate the pressure supply unit, thereby enriching the liquid inside the container with gas.

[0056] In one embodiment, the method may additionally comprise between steps a.i) and b) the steps of a.ii) determining when an amount of liquid filled inside said removable container reaches a predetermined liquid level; and a.iii) signaling to the control unit that the predetermined liquid level is reached, thereby operating the pressure compensation valve and stopping the suction pump.

[0057] As already mentioned before, in order to determine when a predetermined amount of liquid inside the container is reached, the apparatus may be provided with sensor means. Thus, as soon as the predetermined amount of liquid is reached, the control unit receives a signal in order to open the pressure compensation valve and/or to stop the suction pump. Alternatively, the suction pump may be operated only for a relatively short time in order to provide a relatively small pressure difference between removable container and tank, which relatively small pressure difference is predetermined such that is sufficient for initiating a suction of the liquid from the tank, wherein once the liquid flows, no vacuum is necessary any more, because after flow of the liquid is initiated by the relatively small pressure difference, all further liquid is conveyed by gravity. This alternative operating mode of the suction pump has the advantage that the lifetime of the suction pump is substantially extended, the pump consumes less electrical energy and there's substantially less noise emission. Hence, stopping of the suction pump depends on the aforementioned two different operating modes: Either, the suction pump is running until sensor means transmit a signal to the control unit that the predetermined amount of liquid inside the container is reached, or the pump is operated for a relatively short time and then stopped, in order to provide for a liquid conveyance basically provided by gravity. The amount of liquid inside the container may also be less than the desired amount of liquid inside the container so that the remaining pressure difference is then compensated by gas flowing into the container in a subsequent step flowing gas into the container for enriching the liquid with gas.

[0058] Preferably, process steps a.i) and b) are automatically processed by the control unit after the user presses a single button of the apparatus, and more preferably, steps a.i), a.ii), a.iii) and b) are automatically processed by the control unit after the user presses a single button of the apparatus.

[0059] Consequently, the invention provides the filling

head, the apparatus with said filling head as well as the method for use of said apparatus with an attached removable container according to the description above, wherein the filling head, the apparatus and the method allow for both, filling a liquid into a removable container and enriching the liquid inside said container with a gas, e.g. by carbonating, using underpressure and overpressure respectively.

[0060] Non-limiting, exemplary embodiments of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 shows a cross-sectional view of an apparatus comprising a filling head according to the invention and a removable container;

Figure 2 shows a part of the apparatus of Figure 1 in a cross-sectional view;

Figure 3 shows the part of the apparatus according to Figure 2 without a spring element;

Figure 4 shows a part of an apparatus of an embodiment according to the invention in a perspective cross-sectional view with a spring element and a seal comprising an inner and an outer sealing lip;

Figure 5 shows a close-up of a cross-sectional view of a seal with an inner sealing lip;

Figure 6 shows the close-up of a cross-sectional view of the seal according to Figure 5 with an additional outer sealing lip; and

Figure 7 shows a close-up of a cut away view of a seal according to a further embodiment.

[0061] In Figure 1 an apparatus 1 for filling liquid into a removable container 100 and enriching the liquid inside said container 100 with a gas, e.g. by carbonating, is depicted. The apparatus 1 comprises a housing formed by an upper housing portion 2 and a lower housing portion, i.e., the receptacle 3, in which the container 100 is inserted. Here, the upper housing portion 2 and the lower housing portion 3 are coupled to one another by means of a bayonet coupling 4.

[0062] Further, a filling head 10 is provided together with the apparatus 1 comprising a cover plate 11 with respective gas outlet port 12, configured to be connected to a suction pump (not shown), a gas inlet port 13, configured to be connected to a pressure supply unit (not shown) and a liquid inlet port 14 with a connection nozzle 15 screwed into the liquid inlet port 14. Preferably, within a gas path comprising gas outlet port 12 and gas inlet port 13, one or more overpressure valves are arranged in order to safeguard that the gas pressure within container 100 does not exceed a predetermined value, of

e.g. at most 8 bar, by closing the overpressure valve(s) in order to avoid unnecessary stress of (parts of) the suction pump. The liquid inlet port 14, and more specifically the connection nozzle 15 is configured to be connected to a tank (not shown). The tank is filled with liquid, for example water, which is to be supplied via the liquid inlet port 14 into the container 100, when the suction pump is running, thereby creating a negative pressure inside the container 100. In addition, a backflow preventer 16 is arranged inside the connection nozzle 15. The backflow preventer 16 allows the liquid from the tank to enter through the liquid inlet port 14 into the container 100, but prevents backflow of liquid from the container to the tank. Backflow preventer 16 may be passive, for example in the form of a simple non-return damper e.g. having a simple mechanical flaps mechanism preventing backflow, or active, e.g. in the form of a solenoid backflow valve allowing control of backflow preventer 16 by e.g. the control unit of the apparatus.

[0063] The gas inlet port 13 of the cover plate 11 comprises a tube 17 connected to the cover plate 11, wherein said tube 17 is directed towards the container 100, when the container 100 is used with the apparatus 1. Moreover, the tube 17 protrudes into the container 100. The tube 17 comprises a nozzle 18 at its distal end which is thus also arranged inside the container 100. In the depicted state, the container 100 and more precisely a opening 101 of the container 100 comprising a thread for a lid or the like is pushed against a seal 19 which is provided at the filling head 10, thereby forcing a second surface 20 of the seal 19 towards a first surface 21 of the seal 19, wherein in this specific embodiment, said first surface 21 is fixed to the cover plate 11 by means of screws. However, as explained above, any fastening means may be used for fixing first surface 21 to cover plate 11, and fixing may also be realized by forming first surface 21 and cover plate 11 as one integral part.

[0064] Here, the cover plate 11 comprises two components, a first component 22 having the inlet and outlet ports 12, 13 and 14 and a second component 23 coupled by screws to said first component 22. The disclosed filling head 10 additionally comprises a spring element 24, which is placed between the second component 23 of the cover plate 11 and a spring guiding element 25 coupled to the seal 19. In the disclosed state, in which the opening 101 of the container 100 is pressed against the second surface 20 of the seal 19, the spring element 24 is compressed, thereby forcing the second surface 20 of the seal 19 away from the cover plate 11. Further, the seal 19 comprises an inner sealing lip 26, which is protruding into the opening 101 of the removable container 100. Figures 5 and 6 show the respective sealing lips 26 and 28 in more detail.

[0065] In Figure 2, the upper part of the apparatus 1 from Figure 1 is shown in an enlarged view so that the corresponding components, in particular the components of the filling head 10, can be better identified. Therefore, a contact surface 102 of the container 100,

which is arranged on the opening 101 of the container 100, can also be seen more clearly here. This contact surface 102 as a part of the opening 101 presses against the second surface 20 of the seal 19, thereby moving the second surface 20 towards the cover plate 11 formed by the respective first and second component 22 and 23. Due to the compression of the spring element 24 and a bellows 27, a force is exerted onto the second surface 20 of the seal 19. The force acting through the spring guiding element 25 on the seal 19, which is attached to the cover plate 11 by the first surface 21, and the second surface 20 of the spring element 24 is therefore pressed away from the cover plate 11 by said force. The direction of action of the force is indicated by an arrow F.

[0066] However, the use of the spring element 24 is not necessarily required to put the invention into practice and is therefore more of an additional improvement that can provide advantages at very high pressures as the force of the seal 19 being pressed towards the opening 101 of the container 100 is increased. Therefore, Figure 3 shows an embodiment without the corresponding spring element 24. Here, the force that pushes the second surface 20 of the spring element 19 away from the cover plate 11 is exerted by the compression of the bellows 27 of the seal 19. Otherwise, Figure 3 shown is identical to Figure 2. Moreover, the seal 19 itself, which depending on type of elastic material is also compressed, when the container 100 is pushed towards the filling head 10, exerts a force itself onto the opening 101 of the container 100. Therefore, even though not shown here, even the bellows 27 may be omitted.

[0067] Figure 4 shows another embodiment of an upper part of the apparatus 1, without the corresponding suction pump, pressure supply unit, control unit and tank, but with the additional feature of an outer sealing lip 28. The outer sealing lip 28 contacts an outer surface 103 of the container 100. As soon as air is sucked out of the container 100 and a negative pressure is generated inside the container 100 via the gas outlet port 12, the outer sealing lip 28 is pressed against the outer surface 103 of the container 100. The other components are identical to those of the previous Figures. However, due to the enlarged view additional sealing elements which are provided between the first and second component 22 and 23 of the cover element 11 as well as between the connection nozzle 15 and the liquid inlet port 14 may be seen better here. Those sealing elements additionally improve the sealing of the filling head 10.

[0068] As shown here as well as in the other Figures, the seal 19 may be stepped, wherein the seal 19 comprises a first tubular portion with a larger diameter D1 in a contact area with the cover plate 11, i.e., in the area of the first surface 21, than a second tubular portion with a diameter D2 in the area of the second surface 20. The diameters D1 and D2 are only indicated in Figure 3. This stepped shape may be selected so that the step that forms a flange-like pressure surface 29 is larger than the second surface 20, especially larger than the part of the

second surface 20 exposed to the increased pressure in the container 100 during carbonation. Thus, when the pressure inside the container increases, the force pressing against the pressure surface 29 is significantly greater than the force pressing against areas of the second surface 20. Depending on the selected dimensions, the force with which the seal 19 presses against the opening during an enrichment process can, therefore, be significantly increased. Especially, as the space between the pressure surface 29 and the cover plate 11 is in fluid communication with the interior of the container, the second surface 20 of the seal is pressed with an increasing force against the spout of the container as the pressure rises in the container during carbonation.

[0069] The stepped shape of the seal 19 may be supported by additional components, which may be fixed to the seal 19 as shown here. Therefore, the pressure surface 29 may also be formed by said components providing said stepped shape of the seal 19 as it is the case in the Figures shown here.

[0070] Figure 5 and Figure 6 show a close-up view of seal 19 and its second surface 20 being in contact with the contact surface 102 and the opening 101 of the container 100. In this regard, Figure 5 shows the respective seal 19 with inner sealing lip 26, wherein Figure 6 additionally shows outer sealing lip 28. The inner sealing lip 26 of the seal 19 projects into the container 100 and touches an inner surface 104 of the container 100, wherein the outer sealing lip 28 extends past the opening 101 outside of the removable container 100. Consequently, in Figure 6 the contact surface 102 of the container 100 is arranged between the two sealing lips 26 and 28.

[0071] In Figure 5 and Figure 6, the letter W indicates a wall thickness (width) W of the seal 19 in the area of the second surface 20, i.e., a material strength of the seal 19 in the area of the second surface 20. It can be seen very clearly that the wall thickness W of the seal 19 in this embodiment is different in this area of the second surface 20 than further in the direction towards the cover plate 11, which is not shown. The second surface 20 is formed by the surfaces of the sealing lips 26 and 28 directed towards the inner surface 104 and outer surface 103 of the opening 101 of the container 100. Therefore, the second surface 20 forms the distal surface of the seal 19 that is in direct contact with the opening 101 or the distal surface of the seal 19 which is directed towards the opening 101 of the container 100.

[0072] Figure 7 shows a portion of the filling head 10 together with the opening 101 of the container 100 in a similar configuration as in Figure 5. The seal 19 is configured with bellows 27 and has an inner sealing lip 26 at the second surface 20, while the first surface 21 is fixed to the cover plate 11. The area of the flange-like pressure surface 29 is larger than the area of the opening 101 of the container 100, such that the second surface 20 of the seal 19 is pressed with an increasing force against the spout (opening 101) of the container 100 as the pressure rises in the container 100 during carbona-

tion.

[0073] A distance between the first surface 21 of the seal 19 and the second surface 20 of the seal 19 is thus determined from the most distal point of the seal 19 of the second surface 20, that is, the most distal point of the second surface 20 seen from the cover plate 11, to the most distal point of the first surface 21, wherein the first surface 21 is defined by being fixed to and in contact with the cover plate 11.

[0074] When the filling head 10 or the apparatus 1 comprising said filling head 10 is used, the user must first place the removable container 100 or the container to be filled in the receptacle 3 of the apparatus and then close the bayonet coupling 4 between the upper housing portion 2 and the receptacle 3 or the user has to couple the container 100 to the filling head 10, for example by coupling means provided on the opening 101 of the container 100 and the filling head 10 respectively. The user then may select desired liquid settings, i.e., e.g., the filling quantity or the enrichment level of gas inside the liquid, e.g., medium sparkling. The control unit, which is not shown here, receives a corresponding signal and starts the suction pump, not shown, which is connected to the gas outlet port 12. Alternatively, the user may start the suction pump manually, i.e., directly by pressing a respective button 100. As the container 100 is pressed with its opening 101 or the contact surface 102 against the second surface 20 of the seal 19, the suction pump generates a negative pressure in the container 100. In this state, the backflow preventer 16 is open so that liquid can flow in from a tank, which is not shown here. The backflow preventer 16 may therefore be opened by the control unit. In the present, specific embodiment depicted in the present Figures, preferably, a backflow preventer 16 in the form of a non-return damper e.g. having a simple mechanical flaps mechanism preventing backflow is applied for costs reasons. Optional additional passive or active backflow preventers, such as solenoid valve(s), are not needed in this embodiment and thus not shown in the Figures. The suction pump continues to suck, wherein as soon as the container 100 is sufficiently filled, the suction pump stops and/or the backflow preventer 16 at the connection nozzle 15 closes. The container 100 is now filled with liquid. If a pressure compensation valve is provided, it may be opened in order to carry out pressure compensation. Alternatively, the enrichment process of the liquid to enrich the liquid with gas may also be started directly.

[0075] During the enrichment process, gas, for example CO₂ gas, is introduced into the container 100 via the gas inlet port 13. Here, the gas provided by a pressure supply unit comprising gas with a pressure of, for example, 70 bar, flows through the tube 17 and out of the nozzle 18, which are located in the liquid, directly into said liquid. The pressure supply unit may comprise a pressure regulator to control the amount of gas leaving the pressure supply unit. Such pressure regulator is not necessary e.g. in case of the so-called "batch-type" carbonation, i.e.

carbonation were the pressure from the gas cylinder is directly applied onto the liquid in the removable container 100 without pressure reduction of the gas. However, in other carbonation types, e.g. when the gas is applied in multiple pulses and/or the gas is circulated within the apparatus, a pressure regulator may be applied for reducing the pressure within the apparatus to around 8 bar. Consequently, an overpressure of 8 bar, for example, is now generated inside the container 100 in order to carbonate the liquid. To prevent excessive pressure, means such as a pressure relief valve may be provided which may operate when the pressure exceeds 8 bar, for example. As soon as the enrichment process is complete, which may be detected using predefined time parameters, etc., the control unit stops the gas supply.

[0076] Once the enrichment process is finished and if necessary, the control unit may open the pressure compensation valve again to compensate the overpressure inside the container 100. The bayonet coupling 4 may then be opened and the container 100 filled with liquid enriched by gas, can be removed from the apparatus 1. The user may then consume the liquid or place it in the refrigerator. The apparatus 1 offers the user a convenient way to carry out the filling and enrichment process.

[0077] Therefore, the filling head 10 and the apparatus 1 using said filling head 10 allow to fill the removable container 100 at underpressure, and allow to carbonate the liquid into the container 100 at overpressure.

30 Reference signs

[0078]

- | | |
|-------|------------------------|
| 1 | apparatus |
| 35 2 | upper housing portion |
| 3 | receptacle |
| 4 | bayonet coupling |
| 10 | filling head |
| 40 11 | cover plate |
| 12 | gas outlet port |
| 13 | gas inlet port |
| 14 | liquid inlet port |
| 15 | connection nozzle |
| 45 16 | backflow preventer |
| 17 | tube |
| 18 | nozzle |
| 19 | seal |
| 20 | second surface |
| 50 21 | first surface |
| 22 | first component |
| 23 | second component |
| 24 | spring element |
| 25 | spring guiding element |
| 55 26 | inner sealing lip |
| 27 | bellow |
| 28 | outer sealing lip |
| 29 | pressure surface |

100	removable container
101	opening
102	contact surface
103	outer surface
104	inner surface
D1	diameter (at the first surface)
D2	diameter (at the second surface)
F	force
W	wall thickness (width) of seal 19

Claims

1. An apparatus for filling a liquid into a removable container (100) and for enriching said liquid inside said removable container (100) with gas, e.g. by carbonating, said apparatus comprising

a filling head (10), the filling head comprising

a cover plate (11) for closing the opening (101) of the container (100), in which cover plate a liquid inlet port (14), a gas outlet port (12) and a gas inlet port (13) are provided, and

a seal (19) for sealing the cover plate (11) with respect to the opening (101) of the container (100), wherein the seal comprises a first surface (21) fixed to the cover plate (11) and a second surface (20) elastically movable relative to the cover plate (11),

a suction pump connected to the gas outlet port (12),

a pressure supply unit connectable to the gas inlet port (13),

a tank to be filled with liquid and connectable to the liquid inlet port (14),

and a control unit configured to operate the suction pump to lower a gas pressure inside said removable container (100) below a gas pressure acting on the liquid inside the tank.

2. The apparatus according to claim 1, wherein the seal (19) is provided either as one part comprising both first and second surface (20, 21), or as two parts in which a first part comprises the first surface (21) and a second part comprises the second surface (20).
3. The apparatus according to claim 1 or 2, wherein the seal (19) has an annular or tubular shape with a wall thickness (W) being smaller than the distance between the first surface (21) and the second surface (20) of the seal.
4. The apparatus according to any one of the preceding claims, wherein the seal (19) comprises a bellows

(27), which is elastically compressible when the second surface (20) of the seal is moved towards the cover plate (11), e.g., by the opening (101) of the container (100).

5. The apparatus according to claim 4, further comprising a spring element (24) arranged to bias the bellows (27) away from the cover plate (11).

6. The apparatus according to any one of the preceding claims, wherein the lower part of the second surface (20) of the seal (19) comprises an inner sealing lip (26) configured to protrude into the opening (101) of the removable container (100).

7. The apparatus according to any one of the preceding claims, wherein the lower part of the second surface (20) of the seal (19) comprises an outer sealing lip (28) configured to enclose the opening (101) from the outside of the removable container (100).

8. The apparatus according to any one of the preceding claims, wherein the seal (19) comprises a flange-like pressure surface (29) connecting two portions of different diameter of the seal (19), wherein a space is formed between the flange-like pressure surface (29), an upper part of the second surface (20) of the seal (19) representing one of said portions of different diameter, and the cover plate (11), which space is in fluid communication with the gas inlet port (13), and wherein the area of the flange-like pressure surface (29) is larger than the area of the opening (101) of the container (100).

9. The apparatus according to any one of the preceding claims, wherein a water filter is arranged in between an outlet of the tank and the liquid inlet port (14) of the cover plate (11), preferably the water filter comprises at least one of the components selected from activated carbon filter, ceramic filter for removing viruses and/or bacteria and ion exchange resins, more preferably a combination thereof.

10. The apparatus according to any one of the preceding claims, further comprising a pressure compensation valve configured to be operated by the control unit before the liquid inside the container (100) is enriched with the gas.

11. The apparatus according to any one of the preceding claims, wherein the apparatus has one or more of the following features i) to v):

- i) the control unit is configured to control flow of gas from the pressure supply unit into the container (100) in order to enrich the liquid filled into the removable container (100) with the gas;
- ii) the apparatus further comprises a measuring

unit configured to determine an amount of liquid filled inside the removable container (100);

iii) the tank is removably connectable to the apparatus;

iv) the apparatus further comprises a receptacle (3) for receiving the container (100) and configured to be coupled to the filling head (10) of the apparatus (1); and 5

v) the receptacle (3) and the filling head (10) each comprise mating coupling portions, preferably bayonet coupling portions (4). 10

12. A method for filling a liquid into an attached removable container (100) and for enriching said liquid inside said removable container (100) with a gas, e.g. by carbonating, using the apparatus (1) according to any one of the preceding claims, wherein the method comprises the following steps a.i) and b): 15

a.i) signaling to the control unit to operate the suction pump to lower a gas pressure inside the removable container (100) below a gas pressure acting on the liquid inside the tank connected to the liquid inlet port thereby filling said container (100) with liquid from said tank; and thereafter 20

b) signaling to said control unit to operate the pressure supply unit to supply pressurized gas to the liquid of said removable container (100) when the liquid is fully filled into the container (100) thereby enriching said liquid filled into the container (100) with said gas. 25 30

13. The method according to claim 12, wherein the method additionally comprises between steps a.i) and b) the steps of: 35

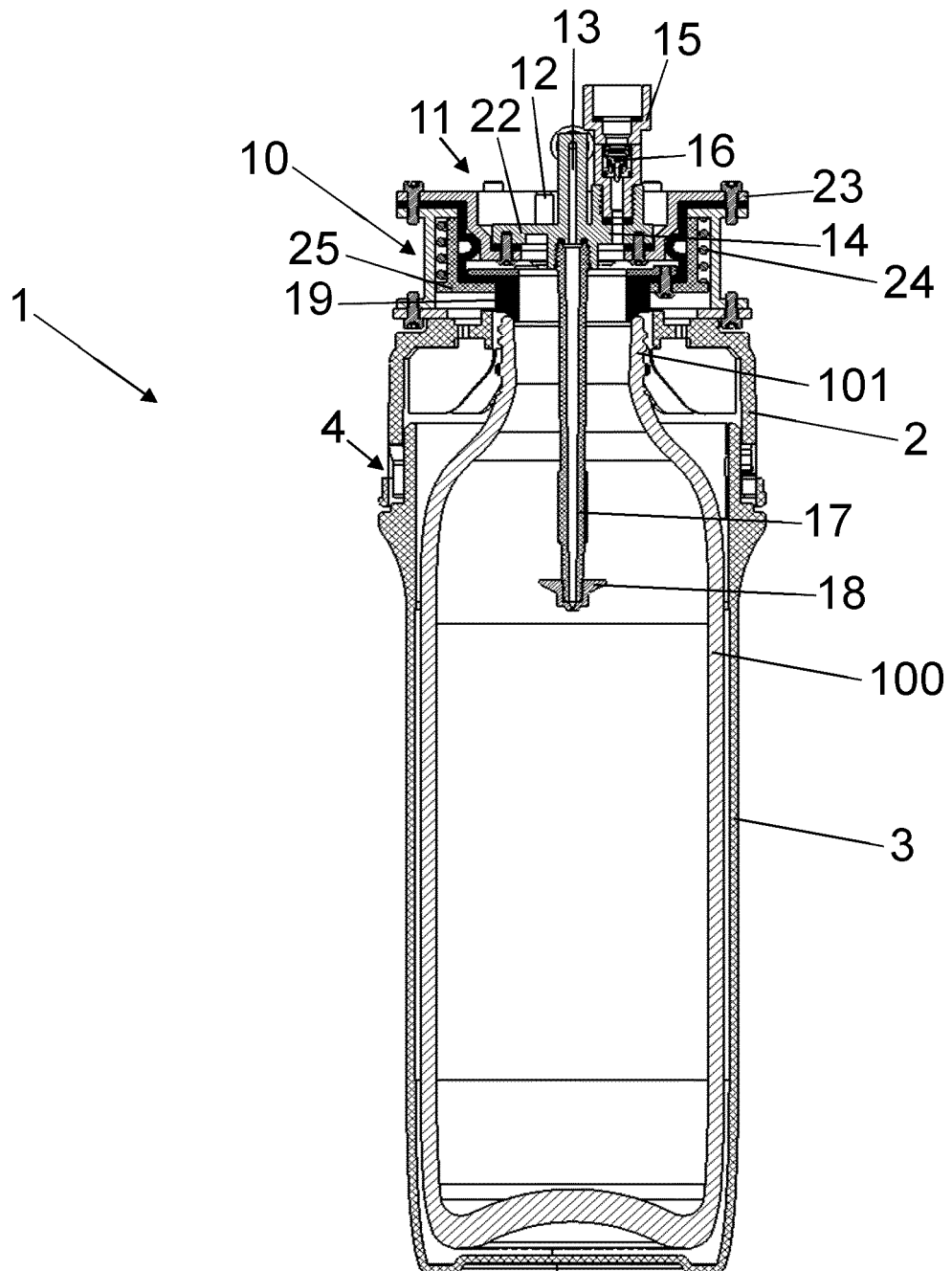
a.ii) determining when an amount of liquid filled inside said removable container (100) reaches a predetermined liquid level; and

a.iii) signaling to the control unit that the predetermined liquid level is reached, thereby operating the pressure compensation valve and stopping the suction pump. 40

14. The method according to claim 12 and 13, wherein steps a.i) and b) are automatically processed by the control unit after the user presses a single button of the apparatus, preferably steps a.i), a.ii), a.iii) and b) are automatically processed by the control unit after the user presses a single button of the apparatus. 45 50

55

Figure 1



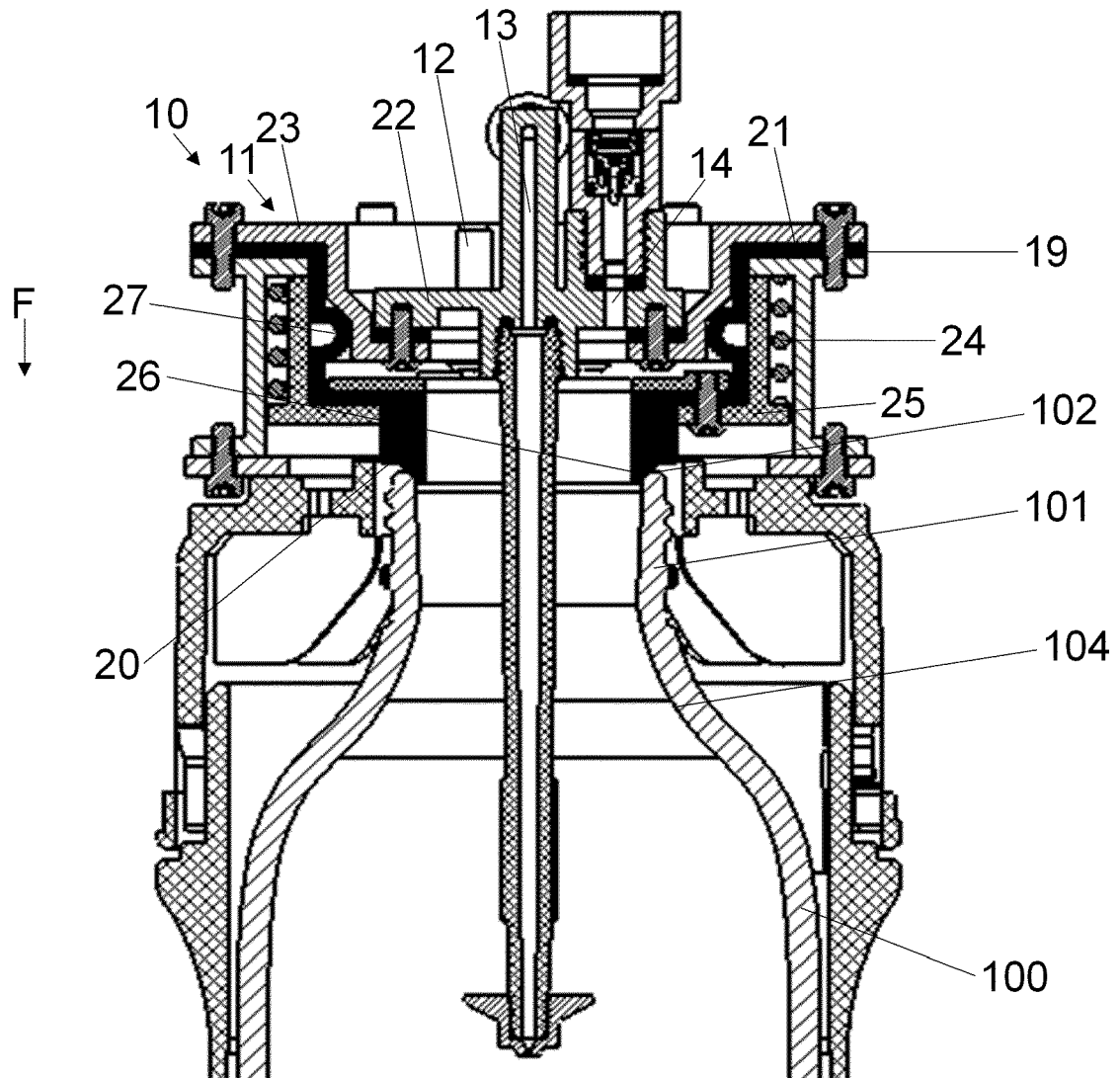


Figure 2

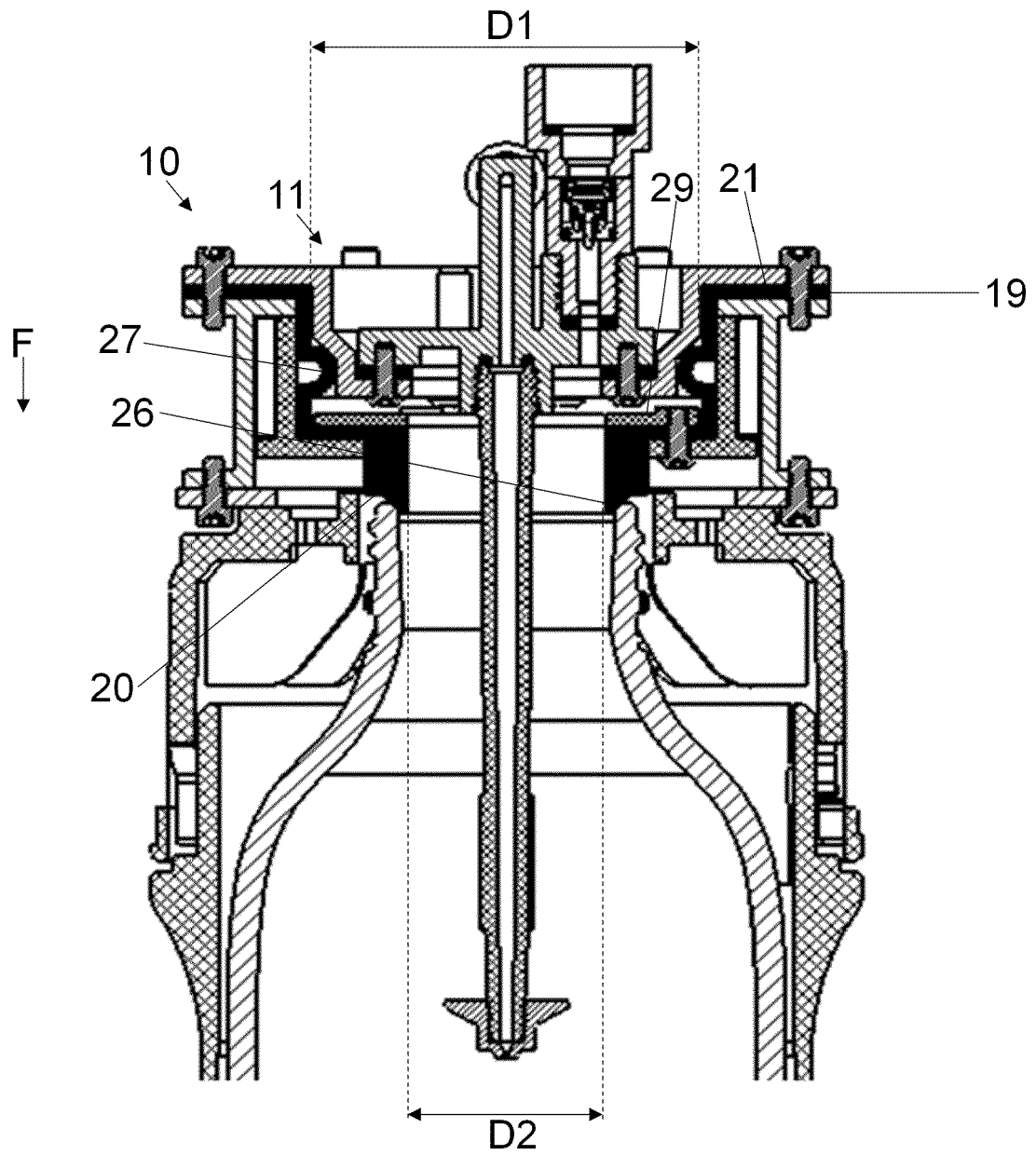


Figure 3

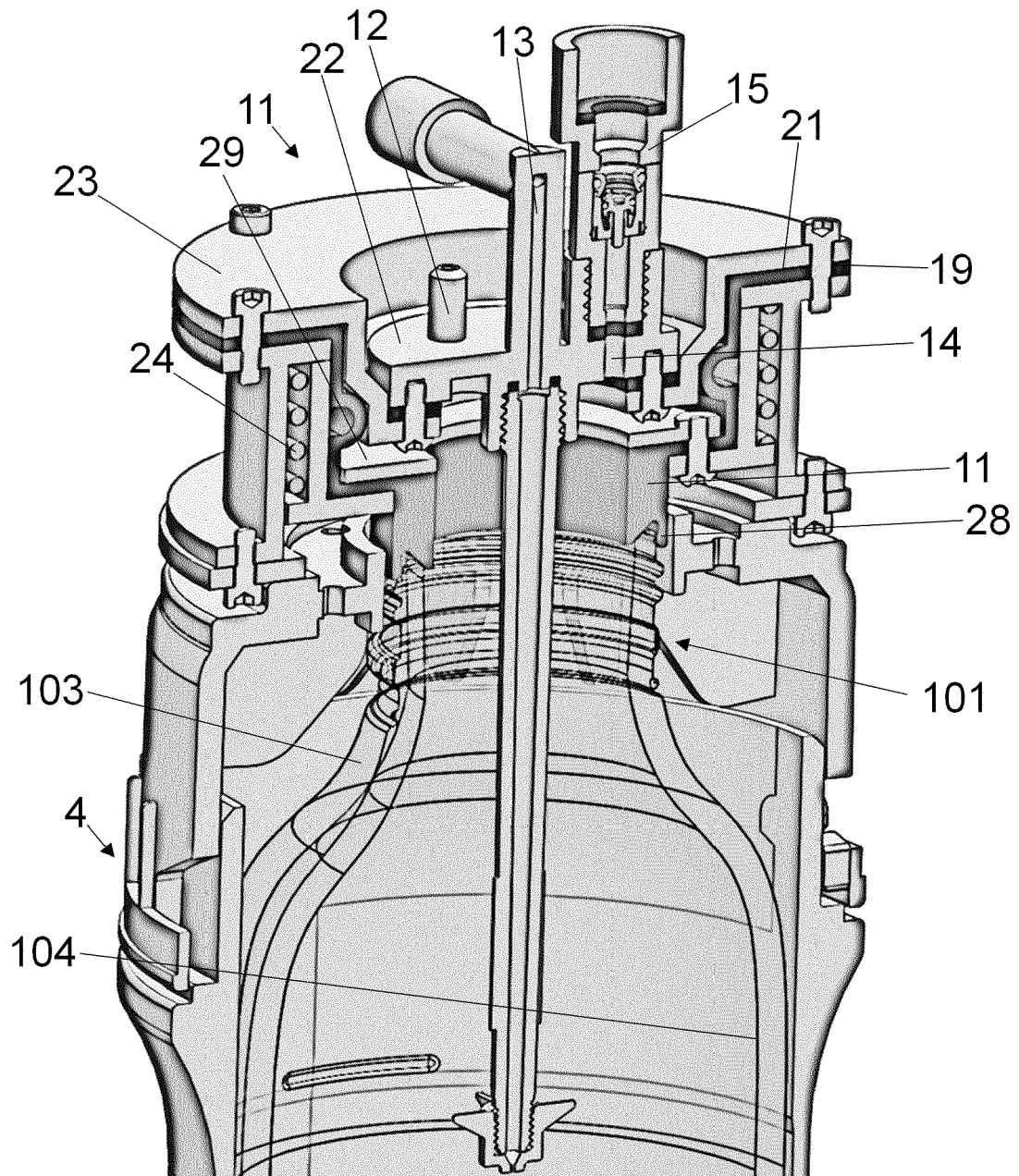


Figure 4

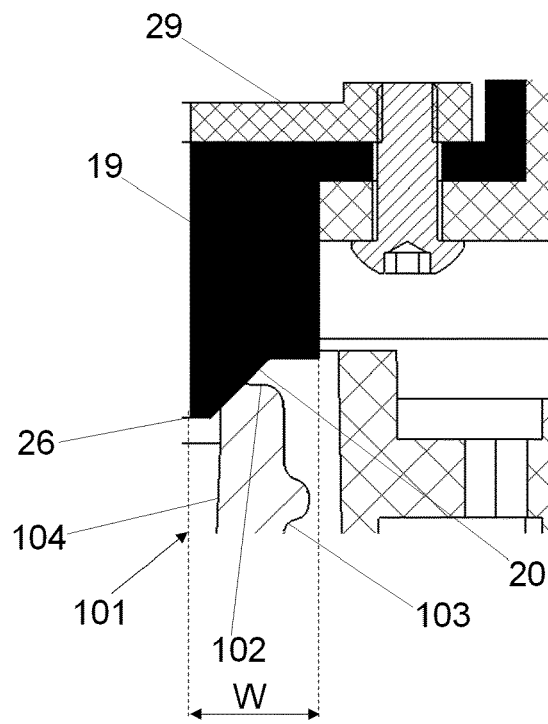


Figure 5

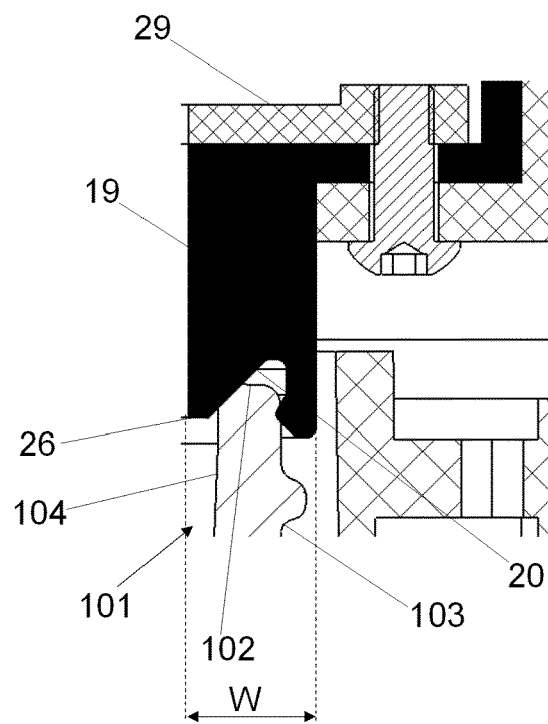
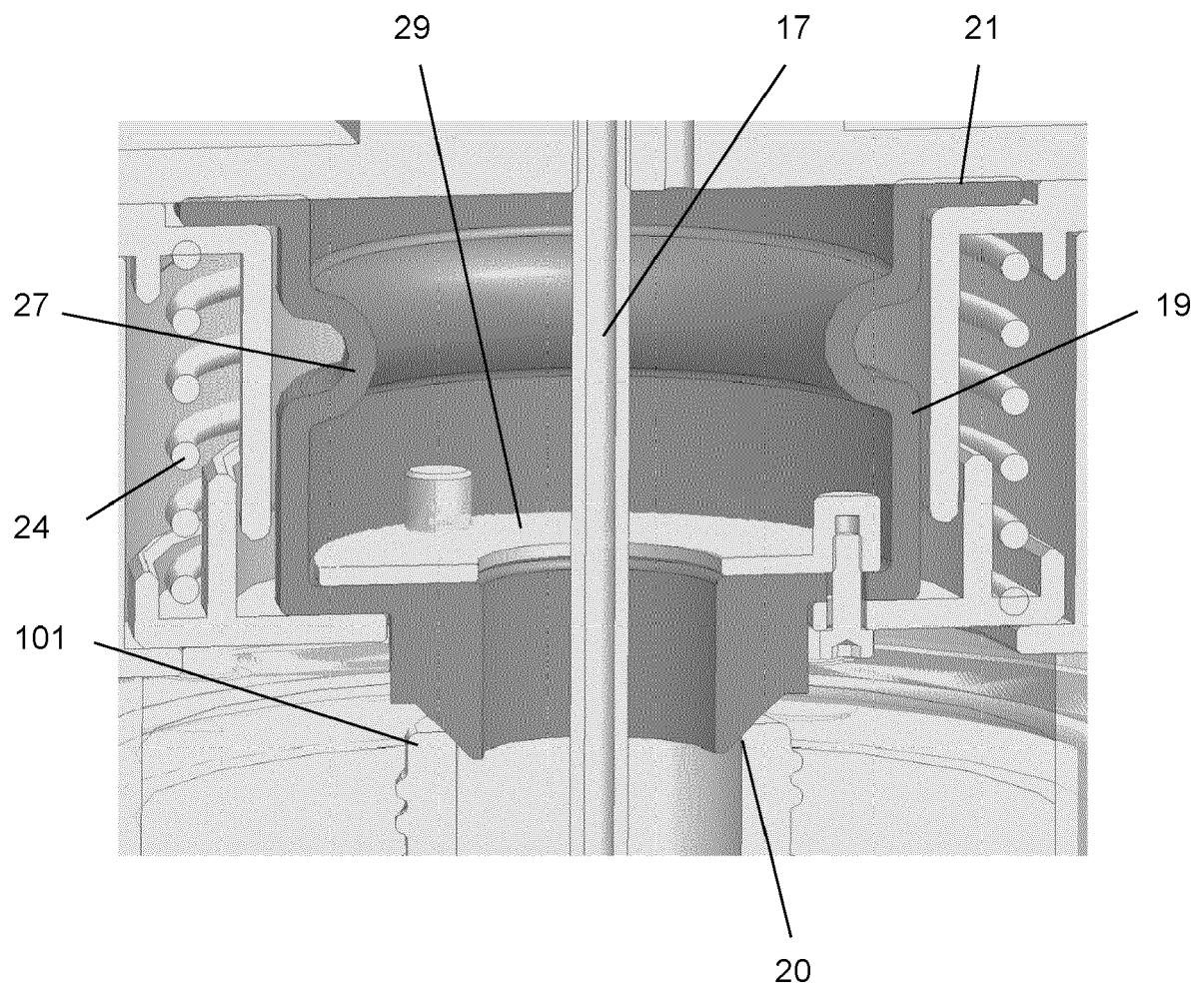


Figure 6

Figure 7





EUROPEAN SEARCH REPORT

Application Number

EP 22 15 5359

5

10

15

20

25

30

35

40

45

50

55

1

EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2013/124236 A1 (EUROP S R L K [IT]) 29 August 2013 (2013-08-29) * page 2, line 18 - page 3, line 23 * * page 4, line 2 - line 11 * * page 4, line 21 - page 5, line 9 * * page 6, line 6 - page 7, line 10 * * figures * -----	1-14	INV. B01F23/2361 B01F35/71
A	US 4 676 283 A (CALDWELL MICHAEL C [US]) 30 June 1987 (1987-06-30) * column 1, line 6 - line 10 * * column 2, line 16 - line 49 * * column 7, line 6 - line 26 * * column 10, line 23 - line 52 * * figures * -----	1-14	TECHNICAL FIELDS SEARCHED (IPC) B01F B67D A23L
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 11 July 2022	Examiner Real Cabrera, Rafael
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 22 15 5359

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-07-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2013124236 A1	29-08-2013	AU 2013224222 A1	04-09-2014
		EP 2817254 A1	31-12-2014
		US 2015028502 A1	29-01-2015
		WO 2013124236 A1	29-08-2013
US 4676283 A	30-06-1987	NONE	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 10752483 B1 [0005]
- US 5992684 A [0009]