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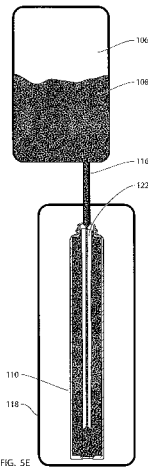
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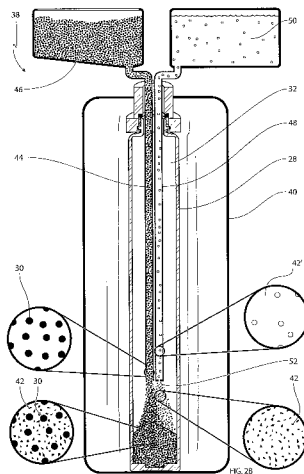
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(54) Title: METHOD OF MANUFACTURING A BEVERAGE DISPENSING SYSTEM INCLUDING A GAS SUPPLY



(57) Abstract: Manufacturing a gas supply device 26 for a beverage container 12 by providing an elongated canister 28, filling an inner space thereof partly with a granulated adsorbing substance 30, compressing said granulated substance with a cone-shaped packing rod, establishing a cavity within said inner space and filling said cavity with a second amount of said granulated substance. Manufacturing a beverage dispensing system 10 including a gas supply device 26, wherein the inner space of a canister 28 is maintained below the triple point pressure of the propellant gas, a granulated solid adsorbing substance 30 is introduced into the canister 28 simultaneously with a propellant gas 42. The granulated substance 30 and the propellant gas 42 are mingled within the canister 28. A seal 54 is applied over the opening of the canister 28, which is fluidly connected to a beverage container 12.



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METHOD OF MANUFACTURING A BEVERAGE DISPENSING SYSTEM INCLUDING A GAS SUPPLY

The present invention relates to a method of manufacturing a gas supply device, a gas supply device, a beverage dispensing system and a system for manufacturing a gas supply device.

Introduction

10 Carbonated beverages, such as beer and soft drinks, are typically provided under elevated pressure in pressure-proof containers such as cans or kegs. Once the keg or can has been opened, the pressure reduction in the container will cause the carbon dioxide dissolved in the beverage to escape. After some time, such as a few hours, the escape of carbon dioxide (CO₂) will cause the beverage to become unsuitable for drinking for the beverage consumer, since it will assume a flat and less flavoured taste. For non-professional users, such as households and similar private users, carbonated beverages are typically provided in small containers such as bottles or cans which are suitable for a single serving of beverage and have a volume around 0.25-1.5 litres. The consumer is expected to finish the can or bottle within a few hours and preferably less, since, when the beverage container has been opened, CO₂ will start escaping the beverage. Additionally, oxygen (O₂) will enter the beverage. The oxygen entering the beverage container causes the beverage to deteriorate and will decrease the storage time of the beverage inside the opened beverage container. Typically, the quality of the beverage and the intensity of carbonisation will have reached unacceptably low levels within a few hours or at most a few days depending on external conditions after opening the beverage container and the possibility of re-sealing the beverage container.

Professional users such as bars and restaurants and similar establishments having a large turnover of carbonated beverages may use a beverage dispensing system intended for multiple servings of beverage instead of individual bottles and cans. Professional beverage dispensing systems typically use large beverage containers such as kegs, which are connected to a carbon dioxide source for carbonating the beverage and for maintaining a pressure inside the beverage container while dispensing the beverage through a tapping device. Thus, the level of carbon dioxide in the beverage may be held constant while at the same time oxygen is prevented from

entering the container. Thus, a beverage inside a beverage container connected to a beverage dispensing system may be kept in suitable drinking condition for weeks, since the beverage dispensing system is effectively compensating for the loss of carbon dioxide from the beverage, substituting the dispensed beverage volume for
5 maintaining an elevated pressure inside the beverage container as well as keeping the drink free from oxygen, which would otherwise deteriorate the flavour of the beverage. Beverage dispensing systems may also include a cooling device for keeping the beverage at a suitable drinking and storage temperature and are typically reusable, i.e. when a beverage keg is empty, the beverage dispensing system may be opened, and
10 a new full beverage keg may be installed.

Professional beverage dispensing systems typically operate with large containers or kegs, which may contain 10-50 litres or more of beverage. Smaller and portable beverage dispensing systems for private or professional use may typically contain 5-
15 10 litres of beverage. One example of a beverage dispensing system is the DraughtMaster™ system provided by the applicant company and described in the PCT applications WO2007/019848, WO2007/019849, WO2007/019850, WO2007/019851 and WO2007/019853. The DraughtMaster™ system seals the beverage container from the surrounding oxygen and provides pressurisation and cooling to avoid loss of
20 carbon dioxide and deterioration of the beverage.

Some consumers prefer to use a so-called mini-keg or party-keg when providing beverage at minor social events, such as private parties, family events and conferences, etc. Mini-kegs may also be used in professional beverage dispensing
25 establishments, such as in small professional establishments, establishments lacking access to pressurisation sources and establishments where highly pressurised containers may be unsuitable, such as in airplanes and other means of transportation. A mini-keg is a cheap and single-use beverage dispensing system for providing a larger amount of beverage than allowed in a can while not requiring the consumer to
30 invest in a reusable beverage dispensing system. The mini-keg allows multiple beverage servings without loss of carbonisation or flavour even if some time is allowed to pass between the servings. It also gives the user the option of choosing the amount of beverage for each serving. Typically, state of the art mini-kegs constitute single use beverage dispensing systems and include a tapping device for dispensing the
35 beverage, and a carbon dioxide canister for keeping the beverage in the mini-keg in a suitable drinking condition over an extended time period such as several days or

weeks, even if the mini-keg has been opened. For avoiding loss of carbonisation and flavour, mini-kegs include a carbonisation canister for keeping a pressurised carbon dioxide atmosphere inside the keg and compensate for pressure loss due to beverage dispensing. Such mini-kegs typically have a volume ranging between the professional
5 kegs and the single-use cans, such as 2-15 litres or 3-10 litres and in particular 5 litres. Furthermore, mini-kegs are known in which no carbon dioxide regulation is included.

Some examples of self-pressurising beverage containers are found in European patent publications EP 1 737 759 and EP 1 170 247. Both the above known
10 technologies make use of commercially available CO₂ canisters containing pressurised CO₂ (carbon dioxide) and a pressure regulation mechanism. The CO₂ canisters release CO₂ via the pressure regulator, which is used for pressurising the beverage and the beverage container as the pressure is reduced due to the dispensing of the beverage as well as due to leakage during storage of the beverage container in-
15 between servings. The canister will occupy space, which cannot be used for beverage. Therefore, the canister should preferably be small in relation to the volume of the beverage container. To be able to generate a suitable amount of CO₂ from a small canister to pressurise a significantly larger beverage container the canister must have a high pressure. The above-mentioned publications EP 1 737 759 and EP 1 170 247
20 suggest the use of a filler material such as activated carbon for reducing the pressure inside the canister.

The above-mentioned technologies have some drawbacks. The high pressure in the canisters of the above-mentioned technologies may constitute a safety hazard due to
25 the risk of explosion, especially in case the canister is heated. The above technologies further include a mechanical pressure-reducing regulator, which may jam or break. The CO₂ canister and the pressure regulator must typically be made of metal to withstand the high pressures. Some mini-kegs may therefore be made entirely out of metal or a combination of metal and plastic. While many plastic materials may be
30 disposed of in an environment-friendly manner by combustion, metal should be recycled in order to be considered an environment-friendly material. However, in many cases the above metal mini-kegs are not suitable for recycling since they differ from normal recyclable metal cans and kegs as they may contain a multitude of different plastic materials, which may not be separable and recyclable or disposed of in an
35 environment-friendly manner. There is thus a risk that such mini-kegs will not be properly recycled.

Most beverage containers and kegs are provided in the form of cylindrical drums. The cylindrical shape is preferred since it will allow a stable positioning. Cylindrical bodies further provide a large inner volume in relation to the outer surface, thus allowing less material to be used. It is well known that the optimal dimensions for maximizing the volume while minimizing the outer surface is achieved when the diameter of the container is about the same as the height of the container. Further, the mouth of the beverage container should be kept as small as possible for reducing the leakage from the beverage container. Typical beverage containers therefore have a height roughly corresponding to the diameter and a small mouth opening. Such containers have been produced for years and a change of the dimensions will, in addition to resulting in a less optimal container, require costly modifications to the production line. The above restrictions in relation to the length of the container and the diameter of the mouth constitute technical restrictions of the permissible dimensions of the CO₂ canister. The canister is filled with fine active carbon granulates in order to reduce the pressure inside the canister. Active carbon granulates constitute a non-compressible but substantially flowable material which may be compacted by physical means e.g. a rod or piston. The problem is thereby that the length and the opening of the canister, which must be defined by the beverage container, is mostly not sufficient for allowing a sufficient amount of CO₂ to be stored in the CO₂ canister.

20

Filling of canisters including activated carbon with pressurized CO₂ causes the activated carbon to increase in temperature due to an exothermal process in relation to the adsorption of gas in the activated carbon. In case the filling is performed quickly and by high pressure, the activated carbon is not allowed to cool and the temperature of the activated carbon will become very high. A high temperature of the activated carbon may cause desorption of the CO₂ and even thermal destruction of both the canister and the activated carbon. The applicant has found out that quick filling of canisters using a pressure of 5 bar or more of CO₂ will not be possible due to the above-mentioned problem which is particular critical when using plastic canisters which may melt at temperatures exceeding 50°C. It is therefore an object of the present invention to provide technologies for filling of canisters including activated carbon with pressurized CO₂ to a pressure above 5 bar without suffering from the above-mentioned temperature dependent drawbacks.

35 The international application WO2011/157786 A1 filed by the present applicant company, suggests two alternative modes for filling carbon dioxide into the canister

without experiencing any of the above mentioned heating of the activated carbon. The first mode is to use carbon dioxide in liquid phase, since the evaporation cooling energy caused by the phase transition of the carbon dioxide from liquid phase to gaseous phase is about equal to the adsorption heat caused by the adsorption of the gaseous carbon dioxide. The second mode is to fill the canister by using gaseous carbon dioxide at high pressure at two separate instances and allowing the canister and the activated carbon to cool down in-between the fillings.

The first mode, i.e. the filling of liquid carbon dioxide into the canister has the drawback that due to the phase change characteristics of carbon dioxide, the liquid phase is only present at pressures above 5 standard atmospheres. Liquid carbon dioxide is not well adsorbed by activated carbon, and thus most carbon dioxide will be adsorbed after a transition to gaseous phase. The filling of liquid carbon dioxide into the canister must thus take place at a high pressure, which may contribute to heating the activated carbon. The second mode, i.e. to allow the canister and activated carbon to cool down, will make the filling process more time consuming and complicated.

The problem of adsorbing a sufficient amount of carbon dioxide within a short period of time has been intensively studied in the prior art. The prior art includes DE 26 52 269 which discloses a canister having a gas adsorbing solid body. US 4,321,069 discloses a multiple vessel cascade gas enrichment adsorber. US 4,539,020 discloses a process for separating carbon monoxide from a feed gas comprising carbon monoxide and carbon dioxide using at least two adsorption columns. FR 2 690 142 discloses an aerosol can including a liquid component and a capsule including a pressurization gas and an adsorbant. WO 99/47451 discloses a device for dispensing fluid having a compartment arranged for receiving a fluid and another compartment arranged for receiving a propellant and fillers for adsorbing or absorbing at least a part of the propellant. US2012/0318830 discloses a gas delivery system including a gas adsorbing material which is wetted with a non-polar release promoting agent. EP 1 686 062 discloses a container including activated carbon and carbon in the solid state of aggregation. EP 2 081 855 and EP 1 706 335 both disclose a method of filling dispensing canisters with pressurized gas, in which the gas is introduced in liquid phase producing a mixture of carbon dioxide snow and gas. EP 1 686 062 discloses a method for filling a container with carbon dioxide in which the carbon dioxide is provided in the form of pellets.

Professional beverage filling stations have a throughput of several thousand beverage containers per hour. In order to not slow down the filling process, there is a very limited amount of time available for filling each container. Preferably, the filling of the carbon dioxide canisters should be incorporated in the beverage fill line and thus the time
5 required for filling a carbon dioxide canister should not exceed the time needed for filling the beverage containers with beverage. It is therefore a further object of the present invention to reduce the time needed for filling the canisters.

Summary of the invention

10

The above need and the above object together with numerous other needs and objects which will be evident from the below detailed description are according to a first aspect of the present invention obtained by a method of manufacturing a beverage dispensing system including a gas supply device, the method comprising the
15 steps of:

providing a beverage container,
providing a canister, the canister defining an inner space and an opening,
providing a propellant gas filling system, the propellant gas filling system
comprising a supply of granulated adsorbing substance and a supply of propellant gas,
20 maintaining the inner space of the canister at a low pressure, the low pressure being below the triple point pressure of the propellant gas,
introducing a first amount of granulated solid adsorbing substance from the supply of granulated adsorbing substance into the inner space via the opening,
and simultaneously introducing a second amount of propellant gas from the supply of
25 propellant gas into the inner space via the opening, such that the first amount of granulated solid adsorbing substance and the second amount of propellant gas become mingled within the inner space of the canister,
applying a seal over the opening of the canister, and
fluidly connecting the canister and the beverage container.

30

The present gas supply device including the canister is preferably used to provide the driving pressure in a minikeg or other small beverage dispensing system. The gas supply device is primarily intended for use together with a beverage container for pressurizing the beverage container. The beverage container is filled with beverage.
35 The canister is typically positioned inside the beverage container; however, it may also be external. The supply of granulated adsorbing substance should be kept separated

from the surrounding atmosphere in order to prevent the granulated adsorbing substance from adsorbing atmospheric contaminants such as oxygen. The granulated adsorbing substance may e.g. be kept under a protective atmosphere. The supply of granulated adsorbing substance further comprises a dosing system, such as a pipe, 5 capable of dosing the first amount of adsorbing substance into the inner space of the canister, i.e. an amount capable of adsorbing the second amount of propellant gas. The second amount of propellant gas should be capable of replacing the entire beverage in the beverage container and retaining a sufficient dispensing pressure within the container. The supply of granulated adsorbing substance may e.g. be kept 10 under an elevated pressure in order to achieve a supply pressure. Alternatively, a mechanical supply is used.

The supply of propellant gas may keep the propellant gas at any state of aggregation. Propellant gas in the present context merely indicates the state of aggregation at 15 standard pressure and temperature. In case the carbon dioxide is kept in solid state, the filling system may include a dosing mechanism capable of dosing the solid of propellant gas at a suitable granulated form and in a suitable amount sufficient for adsorbing a sufficient amount of propellant gas to replace all of the beverage in the beverage container and retaining a sufficient dispensing pressure. In case the 20 propellant gas is kept in liquid or gaseous phase, the propellant gas may be transformed to solid phase by appropriate changes in pressure and/or temperature.

By introducing both the granulated adsorbing substance and the solid propellant gas simultaneously and ensuring that they mingle or mix, the solid propellant gas will be 25 accommodated in the spaces in-between the granulated adsorbing substance. In this way, the granulated adsorbing substance will be capable of adsorbing the propellant gas very quickly since the surface area exposed between the solid of propellant gas and the granulated adsorbing substance is very large. Further, the time required for introducing the propellant gas and the granulated adsorbing substance will be 30 reduced. Since both the insertion and removal of the dosing mechanism and the dosing itself must only be performed once, the total time for filling the gas generating device is effectively reduced to 50% of the time needed for performing a sequential filling, i.e. filling granulated adsorbing substance and propellant gas at different times. The mingling or mixing of the granulated adsorbing substance and the solid propellant 35 gas may be achieved by positioning the separate dosing mechanisms for the

granulated adsorbing substance and the solid propellant gas adjacent each other or even pointing towards each other.

In order to keep the propellant gas in solid form, the temperature should be below the
5 freezing point and the pressure below the triple point. In this way, the solid propellant
gas will sublime into gaseous phase when heated, thereby bypassing the liquid phase.
As the solid propellant gas sublimates, it is adsorbed by the granulated adsorbing
substance. It is contemplated that the temperature of the solid propellant gas is slowly
10 increasing to room temperature whereas the pressure in the canister increases only
slightly as the temperature induced pressure increase is counteracted by the
adsorbing of additional solid propellant gas by the granulated adsorbing substance.

The seal may be e.g. a pierceable seal or a valve and should be gas tight. The seal
may be applied on the opening of the canister alone. This may be advantageous in
15 case the canister is provided as an accessory for later placement in a beverage
container. Alternatively, in case the canister is to be used directly in a beverage
container, the seal may be applied onto the canister so that it also seals the beverage
container. The seal may also be constituted by a weld. By "fluidly connecting" is meant
establishing a fluid connection between the inner space of the canister and the interior
20 of the beverage container such that the propellant gas within the inner space may be
used for pressurizing the beverage within the container.

According to a further embodiment of the first aspect of the present invention, the
supply of propellant gas of the propellant gas filling system comprises a tank including
25 liquefied carbon dioxide stored at a high pressure, the high pressure exceeding 5,1
standard atmospheres. By storing the carbon dioxide in liquid phase, it is stored in a
compact and flowable state. It is thereby simple to dose. Liquid carbon dioxide does
not exist below 5,1 standard atmospheres. By appropriately reducing the pressure
from above 5,1 standard atmospheres to below 5,0 standard atmospheres, a phase
30 change from liquid to solid may be achieved and thereby at the time of the introduction
into the canister, the carbon dioxide is present in solid form. In order to be present in
solid form, the temperature should be below minus 60°C and in order to achieve a
sublimation from solid to gas, the pressure should be below 5.1 standard
atmospheres.

According to a further embodiment of the first aspect of the present invention, the liquefied carbon dioxide is kept in the tank at a pressure between 5,1 standard atmospheres and 500 standard atmospheres, preferably between 40 and 80 standard atmospheres, most preferably between 50 and 70 standard atmospheres. By storing
5 the carbon dioxide in liquid phase at a high pressure, the carbon dioxide may be changed into solid state by simply reducing the pressure. By reducing the pressure, e.g. by allowing the liquid carbon dioxide to flow out of a nozzle, it will instantaneously form a carbon dioxide snow or powder.

10 According to a further embodiment of the first aspect of the present invention, the liquefied carbon dioxide is kept in the tank at a temperature of between -5 °C and 40 °C, preferably between 15 °C and 25 °C .By storing the carbon dioxide at or near room temperature, no additional cooling will be required. In this way, the carbon dioxide may be stored at a high pressure at room temperature, and instantaneously form solid
15 phase when the pressure is reduced

According to a further embodiment of the first aspect of the present invention, the liquefied carbon dioxide is introduced into the inner space via the opening, the liquefied carbon dioxide thereby changing aggregation state from liquid to solid due to
20 the expansion of the carbon dioxide caused by the pressure difference between the tank and the inner space. Upon entering the inner space of the canister, the liquid carbon dioxide may pass an expansion nozzle at which the pressure is reduced and the liquid carbon dioxide transforms into solid state in the form of a snow or powder. Simultaneously, the granulated carbon dioxide adsorbing substance may be supplied
25 such that the solid carbon dioxide occupies the space in-between the granulated carbon dioxide adsorbing substance. The granulated carbon dioxide adsorbing substance and the solid carbon dioxide is thereby efficiently mixed.

According to a further embodiment of the first aspect of the present invention, the
30 liquefied carbon dioxide is introduced into an intermediate space located outside the canister before being introduced into the inner space via the opening, the liquefied carbon dioxide thereby changing aggregation state from liquid to solid due to the expansion of the carbon dioxide caused by the pressure difference between the tank and the intermediate space. The liquid carbon dioxide must not necessarily be injected
35 directly into the inner space. The solid carbon dioxide may form a separate intermediate chamber and the solid carbon dioxide may thereafter be injected into the

canister together with the granulated adsorbing substance. Optionally, the granulated adsorbing substance and the solid carbon dioxide may be mixed in the intermediate space and thereafter injected together into the inner space a common nozzle.

5 According to a further embodiment of the first aspect of the present invention, the granulated adsorbing substance define a particle size at least ten times larger than the particle size of the carbon dioxide in solid granular form. In this way, the solid carbon dioxide may occupy the spaces naturally occurring in-between the granulated adsorbing substance. The principle of the 10 to 1 packing is well known from the
10 previous application WO2011/157786 in which activated carbon was introduced in two different sizes in order to improve the packing of the activated carbon granulates. As an additional advantage, when the solid carbon dioxide has sublimed and been adsorbed by the granulated carbon dioxide adsorbing substance, the granulated adsorbing substance will not collapse but retain its shape.

15

According to a further embodiment of the first aspect of the present invention, the granulated adsorbing substance is activated carbon. Activated carbon is the preferred adsorbing substance due to its low price and its excellent carbon dioxide adsorbing capabilities.

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According to a further embodiment of the first aspect of the present invention, the inner space defines a volume of between 0,1 and 5 liters, preferably between 0,2 and 1 liter, more preferably between 0,3 and 0,7 liters. The size of the canister should preferably be small in order to not occupy too much space inside the beverage container. Any
25 space inside the beverage container which is not used by the canister may be used for accommodating beverage.

According to a further embodiment of the first aspect of the present invention, the canister is made of a polymeric material, preferably plastics. A plastic material is
30 preferred over metal since it is both light and recyclable.

According to a further embodiment of the first aspect of the present invention, the seal comprises a valve for releasing the carbon dioxide from the inner space. The valve may be e.g. an overpressure valve or a spring loaded valve. The valve may also form
35 part of the beverage dispensing valve for dispensing the beverage from the beverage container

According to a further embodiment of the first aspect of the present invention, the method comprises the initial step of flushing the inner space of the canister with propellant gas. The flushing step is often required for removing any gaseous contaminants, such as in the present case oxygen, which may reside inside the inner space of the canister.

According to a further embodiment of the first aspect of the present invention, the granulated adsorption substance is kept below the self destructing and/or self desorbing temperatures of said granulated adsorbing substance. Preferably, the adsorption enthalpy and the sublimation enthalpy of the propellant gas should be equal, such that the granulated adsorbing substance maintains a substantially constant temperature, i.e. no net heating or cooling. The capability of activated carbon to adsorb carbon dioxide gas decreases with increasing temperature. A high temperature of the granulated adsorbing substance may cause it to desorb a substantial amount of adsorbed gas. Even higher temperatures may prevent any adsorption at all and the adsorption material may even to destruct itself such that it will be useless for adsorbing or desorbing any gas. Granulated activated carbon which is exposed to a temperature above 800 °C may sinter, which will reduce the adsorption capabilities. If mixed with carbon dioxide over 800 °C, the activated carbon and carbon dioxide may form carbon monoxide, which is highly toxic.

The above need and the above object together with numerous other needs and objects which will be evident from the below detailed description are according to a second aspect of the present invention obtained by a beverage dispensing system manufactured according to the first aspect of the present invention, wherein the inner space defines a pressure between 2,0 and 5,0 standard atmospheres, preferably between 3,0 and 4,0 standard atmospheres. The pressure of the final sealed canister in room temperature should be between 2,0 and 5,0 standard atmospheres in order to allow a safe dispensing pressure, all pressures taken at room temperature e.g. between 0°C and 30°C.

The above need and the above object together with numerous other needs and objects which will be evident from the below detailed description are according to a third aspect of the present invention obtained by a system for manufacturing a gas supply device, the system comprising:

a canister, the canister defining an inner space and an opening, the system maintaining the inner space of the canister at a low pressure, the low pressure being below 5,0 standard atmospheres,

a propellant gas filling system comprising a supply of granulated
5 adsorbing substance and a supply of propellant gas, the propellant gas filling system being capable of introducing a first amount of granulated adsorbing substance from the supply of granulated adsorbing substance into the inner space via the opening, and simultaneously, introducing a second amount of propellant gas in solid granular form from the supply of propellant gas into the inner space via the opening such that
10 the first amount of granulated solid adsorbing substance and the second amount of propellant gas become mingled within the inner space of the canister, and a seal for being applied over the opening of the canister.

The system according to the third aspect of the present invention is preferably used to
15 carry out the method according to the first aspect.

The above need and the above object together with numerous other needs and objects which will be evident from the below detailed description are according to a fourth aspect of the present invention obtained by a method of manufacturing a gas
20 supply device for a beverage container, the method comprising the steps of:

providing an elongated canister defining a partly open first end, a closed second end and a cylindrical wall interconnecting the first end and the second end, the canister defining an inner space,

providing a filling system, the filling system comprising a supply of
25 granulated adsorbing substance,

filling the inner space by a first amount of the granulated adsorbing substance from the supply of granulated adsorbing substance via the partly open first end,

introducing a cone-shaped packing rod through the opening for
30 compressing the granulated adsorbing substance within the inner space establishing a cavity within the inner space, and

filling the cavity within the inner space by a second amount of the granulated adsorbing substance from the supply of granulated adsorbing substance via the partly open first end.

The present gas supply device is preferably used together with a beverage container for generating a dispensing pressure capable of dispensing all of the beverage in the beverage container and maintaining the pressure in the beverage container. For this purpose the granulated adsorbing substance may adsorb a sufficient amount of
5 propellant gas. The beverage in the beverage container is typically a carbonated beverage. The canister, which is typically of a plastic material, has an elongated cylindrical shape with one end closed at one end open for being able to access the adsorbed gas.

10 It is evident that is desirable to keep the canister as small as possible in order to be able to introduce as much beverage as possible into the beverage container. However, a small canister may accommodate a smaller amount of granulated adsorption substance which may not be sufficient for allowing the beverage to be replaced by the carbon dioxide released by the granulated adsorption substance. In the present
15 context the inventors have found out that the granulated adsorption substance may be compacted by physical means in order to fit more granulated absorption substance into the canister, i.e. increasing the density of the granulated adsorption substance in the canister.

20 The specific density of any granulated adsorption substance will be low for the reasons that firstly all adsorption substances are porous materials which define cavities in which gases and liquids may adhere, i.e. adsorb, and secondly the granulates will define spaces in-between themselves. Further, the present inventors have found out that the particles constituting the granulated adsorption substance typically are
25 charged or will accumulate a charge when introduced into the canister. As equally charged particles repel each other, the density of the introduced granulated adsorption substance will be lower than for non-charged particles since the space inbetween the particles will be larger. The compression of the first amount of the granulated adsorbing substance by the cone-shaped packing rod will cause the charged particles
30 to approach each other and thereby allow a second amount of the granulated solid adsorbing substance to be introduced.

By using a cone-shaped packing rod instead of a flat piston, it can be ensured that also the layers of granulated solid adsorbing substance adjacent the closed second
35 end will be sufficient compacted. In case a flat piston is used instead of the cone-shaped packing rod, only the upper layers adjacent the first end will be compacted. In

the present context it should also be mentioned that the pressure applied to the cone-shaped packing rod should not exceed the pressure at which the granulated adsorbing substance particles sinter together or self destruct by collapsing the internal cavities in the adsorbing substance since this would lead to a substantial loss of the capability to
5 adsorb gas.

According to a further embodiment of the fourth aspect, the granulated adsorbing substance is pre-loaded by carbon dioxide. As the adsorption process will require some time, it may be beneficial to use a pre-loaded granulated adsorbing substance.
10 With pre-loaded should in the present context be understood that the granulated adsorbing substance first be subjected to vacuum in order to remove any adsorbed gas particles thereafter the granulated adsorbing substance is flushed under pressure by carbon dioxide and thus the granulated adsorbing substance will absorb carbon dioxide before being introduced into the canister.

15 According to a further embodiment of the fourth aspect, the method further comprises the step of introducing carbon dioxide through the partly open first end at an elevated pressure. Instead of or in addition to pre-loading the granulated solid adsorbing substance by carbon dioxide, the carbon dioxide may be introduced directly into the
20 canister after introducing the granulated adsorbing substance.

According to a further embodiment of the fourth aspect, the elevated pressure ranges between 1 bar and 5 bar above ambient pressure, preferably between 2 bar and 4 bar above ambient pressure, preferably 3 bar above ambient pressure. The elevated
25 pressure should preferably correspond to the dispensing pressure and/or the carbonation pressure of the carbonated beverage.

According to a further embodiment of the fourth aspect, during the introduction of carbon dioxide through the partly open first end, the canister being cooled to dissipate
30 heat generated by adsorption of carbon dioxide by the adsorption substance. The adsorption process will generate a substantial amount of heat which must be dissipated. In case the granulated solid adsorbing substance is subjected to elevated temperatures, it may sinter and/or self destruct.

35 According to a further embodiment of the fourth aspect, the amount of carbon dioxide introduced through the opening and/or preloaded is measured. The amount of carbon

dioxide adsorbed by the granulated solid adsorbing substance may be estimated by measuring the amount of carbon dioxide introduced during preloading or into the canister. As the same amount of carbon dioxide may be desorbed during dispensing, the amount of beverage which the gas supply device may replace may be derived.

5

According to a further embodiment of the fourth aspect, the method further comprises the step of vibrating the canister during the filling of the inner space by the first amount of the granulated adsorbing substance and/or the second amount of the granulated adsorbing substance. Prior to the compression by the cone-shaped packing rod, the canister may be vibrated in order to achieve a good distribution of the granulated solid adsorbing substance within the canister. Cavities and gas bubbles may thereby be avoided and a more efficient compression by the cone-shaped packing rod may be achieved.

15 According to a further embodiment of the fourth aspect, the granulated adsorbing substance is activated carbon. Activated carbon is the preferred adsorbing substance due to its low price and its excellent carbon dioxide adsorbing capabilities.

According to a further embodiment of the fourth aspect, the cone-shaped packing rod compacts the adsorbing substance within the inner space to a density of between 20 $0,6\text{g/cm}^3$ and $0,8\text{g/cm}^3$, ideally $0,7\text{g/cm}^3$. Typically, the above values of density are achievable by the compression of the granulated solid adsorbing substance by the cone-shaped packing rod. Typically, by just introducing the granulated solid adsorbing substance particles, a density of about $0,4\text{g/cm}^3$ will be achieved by applying no 25 further measures. The density may be increased to $0,5\text{g/cm}^3$ by vibrating the canister and thereby avoid any cavities or gas bubbles within the canister. To achieve between $0,6\text{g/cm}^3$ and $0,8\text{g/cm}^3$, compression will be necessary in order to counteract the charge of the particles. A higher compression force will yield a more dense packing of the granulated solid adsorbing substance particles. It should be mentioned that a 30 density of about $0,7\text{g/cm}^3$ may be considered ideal since further compression may cause sintering or destruction of the granulated solid adsorbing substance particles.

According to a further embodiment of the fourth aspect, the method further comprises the step of applying a seal over the opening of the canister. In order to prevent the 35 escape of gas during handling and transport, a seal may be applied over the opening of the canister.

According to a further embodiment of the fourth aspect, the granulated solid absorbing substance defines granulates ranging in size over one order of magnitude. In this way an optimal packing may be achieved since the smaller particles may occupy the space
5 in-between the larger particles.

The above need and the above object together with numerous other needs and objects which will be evident from the below detailed description are according to a fifth aspect of the present invention obtained by a method of producing a beverage
10 dispensing system, comprising the steps of:

providing a beverage container,

including in the beverage container a gas supply device manufactured as described above, and

fluidly connecting the canister and the beverage container.

15

It is evident that a beverage dispensing system may be produced using the gas supply device of the fourth aspect.

According to a further embodiment of the fifth aspect, the gas supply device is
20 connected to a bag located within the beverage container. In order to avoid contact between the beverage and the propellant gas, the gas supply device may be configured to supply gas to a bag inside the container instead of just letting the propellant gas directly into the container. The bag is flexible and thus the bag will also apply a sufficient dispensing pressure to the beverage.

25

The above need and the above object together with numerous other needs and objects which will be evident from the below detailed description are according to a sixth aspect of the present invention obtained by a beverage container including a first amount of beverage and a gas supply device, the gas supply device comprising a
30 canister defining a partly open first end, a closed second end and a cylindrical wall interconnecting the first end and the second end, the canister defining an inner space, the inner space being filled by an granulated adsorbing substance having adsorbed a second amount of gas, the second amount of gas being sufficient for replacing the first amount of beverage, the granulated adsorbing substance defining within the inner
35 space a first volume and a second volume, the first volume being larger than the second volume and defining a higher density than the second volume.

The beverage container according to the sixth aspect may preferably be manufactured using the method according to the fifth aspect. This will yield a distribution of the granulated adsorption substance within the canister. The first volume which has been compacted by the cone-shaped rod will define a higher density than the second volume which constitutes the granulated adsorption substance which has been introduced to fill up the cavity resulting from the compacting of the first volume and thus the second volume has not been compacted and thus defines a lower density than the first volume.

10

According to a further embodiment of the sixth aspect, the granulated adsorbing substance in the inner space defining in the first volume a density of between $0,6\text{g/cm}^3$ and $0,8\text{g/cm}^3$, ideally $0,7\text{g/cm}^3$, whereas the granulated adsorbing substance in the inner space defining in the second volume a density of between $0,4\text{g/cm}^3$ and $0,6\text{g/cm}^3$, ideally $0,5\text{g/cm}^3$. As stated above, the compacted granulated adsorption substance defines a density of about $0,7\text{g/cm}^3$ whereas the non-compacted granulated adsorption substance defines a density of about $0,5\text{g/cm}^3$

20

Brief description of the drawings

FIG. 1 is a perspective view of a beverage dispensing system.

FIG. 2 is a series illustrating the manufacturing of the beverage dispensing system.

FIG. 3 is a view of an alternative filling mode.

FIG. 4 is a phase diagram of carbon dioxide.

25 FIG. 5 is a series describing a high density filling mode of adsorption substance

Detailed description of the drawings

FIG. 1 shows a perspective view of a beverage dispensing system 10 according to the present invention. The beverage dispensing system 10 comprises a beverage container 12 including a beverage 14, preferably constituting a carbonated beverage. The beverage container 12 comprises a dispensing device 16. The dispensing device 16 includes a dispensing valve 18 controlled by a handle 20. The dispensing valve 18 is controlled by a handle in order for a user to be able to selectively dispense the beverage 14 within the beverage container 12. The dispensing device 16 may be covered by a cover 22. The beverage 14 is dispensed via a pipe 24.

The beverage container 12 further includes a gas supply device 26. The gas supply device 26 comprises a canister 28 including activated carbon 30. The activated carbon has adsorbed an amount of carbon dioxide sufficient for replacing the beverage 14 within the container and providing a sufficient dispensing pressure. The gas supply device is in fluid communication with the interior of the beverage container 12 via the dispensing device 16. The beverage dispensing system is preferably entirely made of plastic materials.

10 FIG. 2A shows a side view illustrating the flushing of an inner space 32 of the canister 28 of the gas supply device 26. The canister 28 defines an inner space 32 which may be accessed via an opening 34. The inner space 32 is flushed by carbon dioxide by introducing a flushing pipe 36 into the inner space 32 of the canister 28. The flushing pipe 36 is supplied by a carbon dioxide filling system 38. Any contaminants, such as oxygen, may be flushed out of the inner space 32 by supplying a sufficient amount of carbon dioxide gas into the inner space 32 and out through the opening 34 as illustrated with the arrows. Any residual oxygen may possibly increase microbiological activity of the beverage.

20 FIG. 2B shows a side view of the filling step of the manufacturing of the gas supply device. The empty canister 28 is located within a filling chamber 40 of the carbon dioxide filling system 38. The filling chamber 40 maintains a carbon dioxide pressure of below 5 standard atmospheres. The inner space 32 of the canister 28 is simultaneously filled with activated carbon 30 and solid carbon dioxide 42. The solid carbon dioxide 42 is provided in the form of snow or fine powder. The activated carbon 30 is supplied via an activated carbon filling pipe 44 which is connected to a supply of activated carbon 46. The supply of activated carbon 46 is kept under a protective carbon dioxide atmosphere. The activated carbon 30 is supplied in granular form. The canister 28 may be shaken in order to allow the granulated activated carbon 30 to flow.

The solid carbon dioxide 42 is supplied via a carbon dioxide filling pipe 48 which is connected to a supply of carbon dioxide 50. The supply of carbon dioxide 50 includes carbon dioxide in liquid form 42', preferably stored at room temperature at a high pressure. The supply of carbon dioxide 50 thus typically constitutes a tank. The carbon dioxide filling pipe 48 includes a nozzle 52 at which the pressure is reduced from the

supply pressure over 5,1 standard atmospheres to a pressure below 5 standard atmospheres within the filling chamber 40. When the pressure of the liquid carbon dioxide 42' is reduced at the nozzle 52, the temperature of the carbon dioxide 42' will fall and the carbon dioxide 42' will solidify into a snow or powder of carbon dioxide 42.

5 The solid carbon dioxide 42 will mix with the activated carbon 30 and occupy the space in-between the granulates of activated carbon 30. This is shown in the lower left close-up.

FIG. 2C shows a side view of the filled canister 28. The complete inner space 32 is
10 filled with a mixture of activated carbon 30 and solid carbon dioxide 42. The solid carbon dioxide 42 keeps the activated carbon at a low temperature. The canister 28 is kept within the filling chamber 40.

FIG. 2D shows a side view of the filled canister 28. The inner space 32 of the canister
15 28 has been sealed off by a lid 54 applied onto the opening 34. At the same time, the solid carbon dioxide 42 is starting to sublime and form gaseous carbon dioxide. The gaseous carbon dioxide is adsorbed by the activated carbon 30. The adsorption process generates heat, which causes additional solid carbon dioxide to sublime. After some time, most of the solid carbon dioxide has been sublimated, and the
20 activated carbon 30 has adsorbed the major part thereof without an excessive heating of the activated carbon caused by adsorption heat, since the heat of adsorption approximately corresponds to the heat of sublimation.

FIG. 2E shows a side view of the finished canister 28. After sealing the inner space 32
25 of the canister 28 by the lid 54, the canister 32 may be removed from the filling chamber 40 and be immediately introduced into a filled up beverage container. It is understood that the filling chamber 40 may be omitted in case the filling of the canister is made in a suitable oxygen free environment such as in a beverage filling plant.

30 FIG. 3 shows a side view of a different filling mode using an alternative carbon dioxide filling system 38'. The present filling mode is similar to the filling mode described in connection with FIG. 2B, however, the activated carbon 30 and the solid carbon dioxide 42 are mixed in an intermediate chamber 56 before being led through a common filling pipe 58 into the inner space 32 of the canister 28. In this way, an
35 improved mixing between the activated carbon 30 and the solid carbon dioxide 42 may be achieved.

FIG. 4 shows a phase diagram illustrating the states of aggregation of carbon dioxide at different temperatures and pressures. The area designated A represents the carbon dioxide in solid phase, the area designated B represents the carbon dioxide in liquid phase and the area designated C represents the carbon dioxide in gaseous phase. From the diagram can be deduced that liquid carbon dioxide does not exist below 5,1 standard atmospheres (atm). At room temperature, carbon dioxide will be liquid above approximately 60 standard atmospheres. This point is in the phase diagram designated the reference numeral 60 and corresponds to the situation in which the liquid carbon dioxide is stored in a tank in the carbon dioxide supply.

When the liquid carbon dioxide is released into the inner space of the canister, which is maintained at a pressure below 5 standard atmospheres, the liquid carbon dioxide assumes a low temperature of about -70 °C and instantly solidified. This point in the phase diagram is designated the reference numeral 62. When the canister has been sealed, the solid carbon dioxide will start subliming onto gaseous carbon dioxide which may be adsorbed by the activated carbon. Slowly, the temperature will approach room temperature, while the pressure increases only slightly. This situation is designated the reference numeral 64.

20

FIG. 5A shows a side view of a carbon dioxide preloading station 100. The carbon dioxide preloading station 100 comprises a carbon dioxide supply line 102 which is controlled by a gas valve 104 leading to a carbon dioxide preloading chamber 106 in which the activated carbon 108 is introduced. Prior to introducing carbon dioxide into the carbon dioxide preloading compartment 106 the compartment 106 including the activated carbon 108 is evacuated of gas particles in order to remove any previously adsorbed particles from the activated carbon 108. The amount of activated carbon 108 and the amount of carbon dioxide introduced into the carbon dioxide preloading compartment may be measured in order to derive a relation between amount of activated carbon and amount of preloaded carbon dioxide. In this way the amount of activated carbon required for replacing a certain amount of beverage may be derived.

FIG. 5B shows a side view of the canister 110 during carbon dioxide flushing. The canister comprises an opening 112 through which a flushing line 114 extends. The flushing line 114 flushes the canister 110 by carbon dioxide before introduction of the

activated carbon in order to remove any gas particles, in particular oxygen, from the interior of the canister.

FIG. 5C shows a side view of the canister 110 when being filled by preloaded
5 activated carbon 108. The activated carbon preloading compartment 106 and the
canister 110 are interconnected gas tight by an activated carbon filling line 116. The
canister is located within a carbon dioxide filling compartment 118. A specific amount
of preloaded activated carbon 108 is introduced into the canister 110 via the activated
10 carbon filling line 116 while the canister 110 is being shaken in order to avoid any
large cavities within the canister 110. A density of 0.5 g/cm^3 may be achieved by
shaking alone.

FIG. 5D shows a side view of the canister 110 when the activated carbon is being
packed by introducing a cone-shaped packing rod 120 into the canister 110. The cone-
15 shaped packing rod 120 will compact the activated carbon substantially uniformly
along the length of the canister 110 achieving a density of the activated carbon of
about 0.7 g/cm^3 .

FIG. 5E shows a side view of the canister 110 when the cone-shaped packing rod has
20 been removed. A cavity 122 will remain after the compression by the cone-shaped
packing rod. This cavity 122 is filled by activated carbon defining a density of 0.4 g/cm^3
which by shaking the canister 110 may be increased to 0.5 g/cm^3 .

FIG. 5F shows a side view of the canister 110 when carbon dioxide is being introduced
25 into the carbon dioxide filling compartment 118 via a carbon dioxide filling line 102'
controlled by a valve 104'. The amount of carbon dioxide introduced into the carbon
dioxide filling compartment 118 may be measured and taking account any preloading
of the activated carbon, the amount of beverage which the carbon dioxide adsorbed by
the activated carbon may replace can be derived. The canister 110 should be cooled
30 by the provision of a cooling element 124 for dissipating the heat generated by
adsorption.

FIG. 5G shows a side view of the canister 110 when the open end of the canister is
sealed off by applying a cap 126.

Although the present invention has been described with reference to specific embodiments of the gas supply device, it is evident that the present gas supply system may be modified by the skilled person. In the above detailed description of the invention, carbon dioxide together with a carbon dioxide adsorbing substance is
5 introduced into the inner space of the canister. It is evident to the skilled person that also other gases may be used.

List of parts with reference to the figures

10. Beverage dispensing system	100. Carbon dioxide preloading station
12. Beverage container	102. Carbon dioxide supply line
14. Beverage	104. Gas valve
16. Dispensing device	106. Carbon dioxide preloading compartment
18. Dispensing valve	108. Activated carbon
20. Handle	110. Canister
22. Cover	112. Opening
24. Pipe	114. Flushing line
26. Gas supply device	116. Activated carbon filling line
28. Canister	118. Carbon dioxide filling compartment
30. Activated carbon	120. Cone-shaped packing rod
32. Inner space	122. Cavity
34. Opening	124. Cooling element
36. Flushing pipe	126. Cap
38. Carbon dioxide filling system	
40. Filling chamber	
42. Carbon dioxide (liquid/solid)	
44. Activated carbon filling pipe	
46. Supply of activated carbon	
48. Carbon dioxide filling pipe	
50. Supply of carbon dioxide	
52. Nozzle	
54. Lid/Seal	
56. Intermediate chamber	
58. Common filling pipe	
60. Liquid carbon dioxide at room temperature and high pressure	
62. Solid carbon dioxide at low temperature and low pressure	
64. Gaseous carbon dioxide at room temperature and low pressure	

Claims

1. A method of manufacturing a gas supply device for a beverage container, said method comprising the steps of:
- 5 providing an elongated canister defining a partly open first end, a closed second end and a cylindrical wall interconnecting said first end and said second end, said canister defining an inner space,
- providing a filling system, said filling system comprising a supply of granulated adsorbing substance,
- 10 filling said inner space by a first amount of said granulated adsorbing substance from said supply of granulated adsorbing substance via said partly open first end,
- introducing a cone-shaped packing rod through said opening for compressing said granulated adsorbing substance within said inner space establishing
- 15 a cavity within said inner space, and
- filling said cavity within said inner space by a second amount of said granulated adsorbing substance from said supply of granulated adsorbing substance via said partly open first end.
- 20 2. The method according to claim 1, wherein said granulated adsorbing substance is pre-loaded by carbon dioxide.
3. The method according to claim 2, wherein the amount of carbon dioxide preloaded is measured.
- 25 4. The method according to any of the preceding claims, further comprising the step of introducing carbon dioxide through said partly open first end at an elevated pressure.
- 30 5. The method according to claim 4 wherein said elevated pressure ranges between 1 bar and 5 bar above ambient pressure, preferably between 2 bar and 4 bar above ambient pressure, preferably 3 bar above ambient pressure.
- 35 6. The method according to any of the claims 4 and 5, wherein during said introduction of carbon dioxide through said partly open first end, said canister being

cooled to dissipate heat generated by adsorption of carbon dioxide by said adsorption substance.

7. The method according to any of the claims 4-6, wherein the amount of
5 carbon dioxide introduced through said partly open first end is measured.

8. The method according to any of the preceding claims, further comprising
the step of vibrating said canister during the filling of said inner space by said first
amount of said granulated adsorbing substance and/or said second amount of said
10 granulated adsorbing substance.

9. The method according to any of the preceding claims, wherein said
granulated adsorbing substance is activated carbon.

15 10. The method according to any of the preceding claims, wherein said cone-
shaped packing rod compacting said adsorbing substance within said inner space to a
density of between $0,6\text{g/cm}^3$ and $0,8\text{g/cm}^3$, ideally $0,7\text{g/cm}^3$.

11. The method according to any of the preceding claims, further comprising
20 the step of applying a seal over said partly open first end of said canister.

12. The method according to any of the preceding claims, wherein said
granulated adsorbing substance define granulates ranging in size over one order of
magnitude.

25

13. A method of producing a beverage dispensing system, comprising the
steps of:

providing a beverage container,
including in said beverage container a gas supply device manufactured
30 according to any of the preceding claims, and
fluidly connecting said canister and said beverage container.

14. A beverage container including a first amount of beverage and a gas
supply device, said gas supply device comprising a canister defining a partly open first
35 end, a closed second end and a cylindrical wall interconnecting said first end and said
second end, said canister defining an inner space, said inner space being filled by an

granulated adsorbing substance having adsorbed a second amount of gas, said second amount of gas being sufficient for replacing said first amount of beverage, said granulated adsorbing substance defining within said inner space a first volume and a second volume, said first volume being larger than said second volume and defining a higher density than said second volume.

15. The beverage container according to claim 14, wherein said granulated adsorbing substance in said inner space defining in said first volume a density of between $0,6\text{g/cm}^3$ and $0,8\text{g/cm}^3$, ideally $0,7\text{g/cm}^3$, whereas said granulated adsorbing substance in said inner space defining in said second volume a density of between $0,4\text{g/cm}^3$ and $0,6\text{g/cm}^3$, ideally $0,5\text{g/cm}^3$.

16. A method of manufacturing a beverage dispensing system including a gas supply device, said method comprising the steps of:

15 providing a beverage container,
providing a canister, said canister defining an inner space and an opening,
providing a propellant gas filling system, said propellant gas filling system comprising a supply of granulated adsorbing substance and a supply of propellant gas,
20 maintaining said inner space of said canister at a low pressure, said low pressure being below the triple point pressure of said propellant gas,
introducing a first amount of granulated solid adsorbing substance from said supply of granulated adsorbing substance into said inner space via said opening, and simultaneously introducing a second amount of propellant gas from said supply of propellant gas into said inner space via said opening, such that said first amount of granulated solid adsorbing substance and said second amount of propellant gas become mingled within said inner space of said canister,
25 applying a seal over said opening of said canister, and
fluidly connecting said canister and said beverage container.

30

17. The method according to claim 16, wherein said supply of propellant gas of said propellant gas filling system comprises a tank including liquefied carbon dioxide stored at a high pressure, said high pressure exceeding 5,1 standard atmospheres.

35 18. The method according to claim 17, wherein said liquefied carbon dioxide is kept in said tank at a pressure between 5,1 standard atmospheres and 500 standard

atmospheres, preferably between 40 and 80 standard atmospheres, most preferably between 50 and 70 standard atmospheres.

19. The method according to any of the claims 17-18, wherein said liquefied
5 carbon dioxide is kept in said tank at a temperature of between -5 °C and 40 °C, preferably between 15 °C and 25 °C .

20. The method according to any of the claims 17-19, wherein said liquefied
10 carbon dioxide is introduced into said inner space via said opening, said liquefied carbon dioxide thereby changing aggregation state from liquid to solid due to the expansion of the carbon dioxide caused by the pressure difference between said tank and said inner space.

21. The method according to any of the claims 17-19, wherein said liquefied
15 carbon dioxide is introduced into an intermediate space located outside said canister before being introduced into said inner space via said opening, said liquefied carbon dioxide thereby changing aggregation state from liquid to solid due to the expansion of the carbon dioxide caused by the pressure difference between said tank and said intermediate space.

20

22. The method according to any of the claims 16-21, wherein said granulated adsorbing substance defines a particle size at least ten times larger than the particle size of said propellant gas in solid granular form.

25 23. The method according to any of the claims 16-22, wherein said granulated adsorbing substance is activated carbon.

24. The method according to any of the claims 16-23, wherein said inner
30 space defines a volume of between 0,1 and 5 liters, preferably between 0,2 and 1 liter, more preferably between 0,3 and 0,7 liters.

25. The method according to any of the claims 16-24, wherein said canister is made of a polymeric material, preferably plastics.

35 26. The method according to any of the claims 16-25, wherein said seal comprises a valve for releasing said carbon dioxide from said inner space.

27. The method according to any of the claims 16-26, wherein said method comprises the initial step of flushing said inner space of said canister with propellant gas.

5 28. The method according to any of the claims 16-17, wherein said granulated adsorbing substance is kept below the self destructing and/or self desorbing temperatures of said granulated adsorbing substance.

29. A beverage dispensing system manufactured according to any of the
10 claim 16-28, wherein said inner space defines a pressure between 2,0 and 5,0 standard atmospheres, preferably between 3,0 and 4,0 standard atmospheres.

30. A system for manufacturing a gas supply device, said system comprising:
a canister, said canister defining an inner space and an opening, said
15 system maintaining said inner space of said canister at a low pressure, said low pressure being below 5,0 standard atmospheres,

a propellant gas filling system comprising a supply of granulated
adsorbing substance and a supply of propellant gas, said propellant gas filling system
being capable of introducing a first amount of granulated adsorbing substance from
20 said supply of granulated adsorbing substance into said inner space via said opening,
and simultaneously, introducing a second amount of propellant gas in solid granular
form from said supply of propellant gas into said inner space via said opening such
that said first amount of granulated solid adsorbing substance and said second
amount of propellant gas become mingled within said inner space of said canister, and
25 a seal for being applied over said opening of said canister.

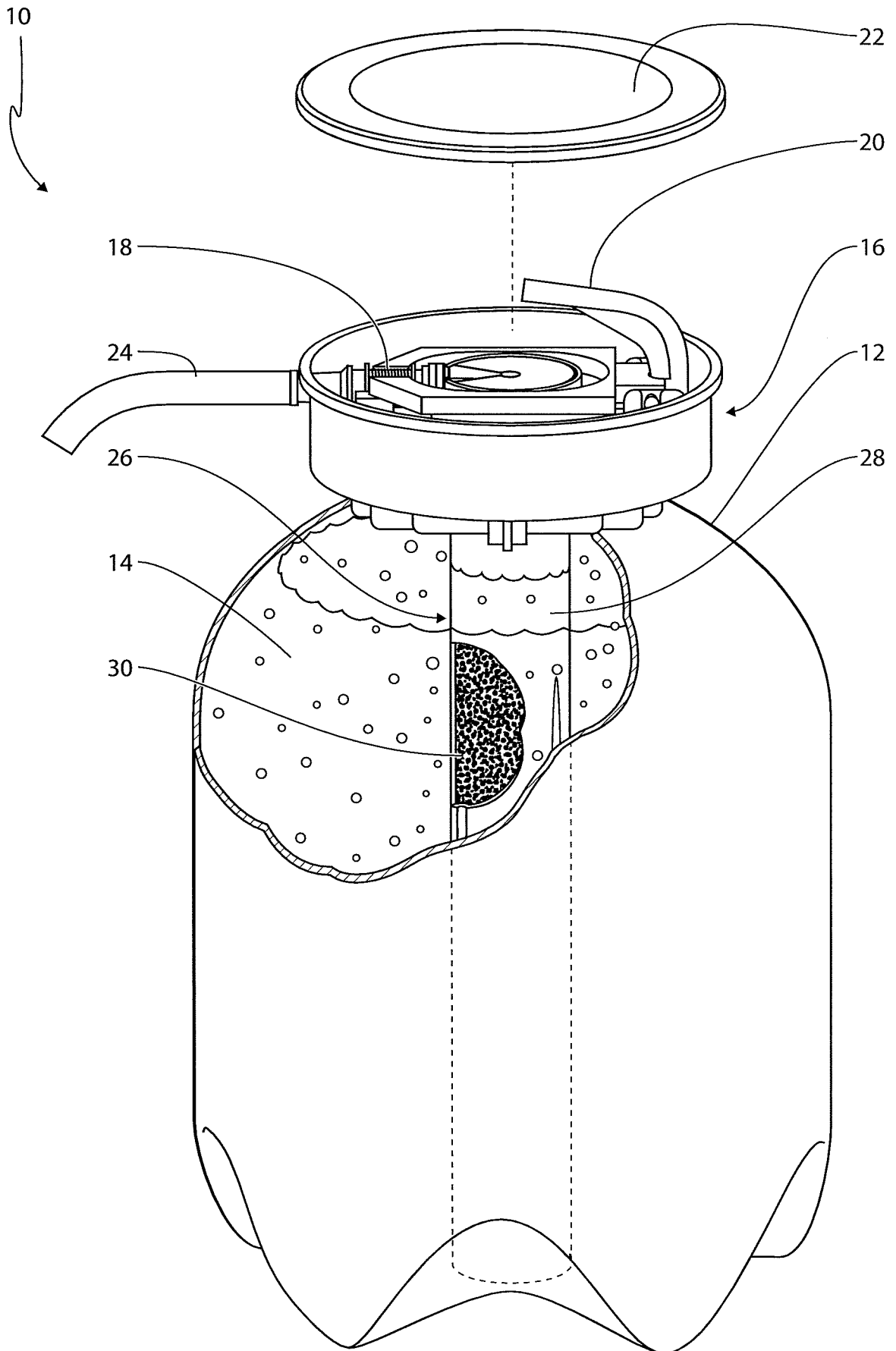
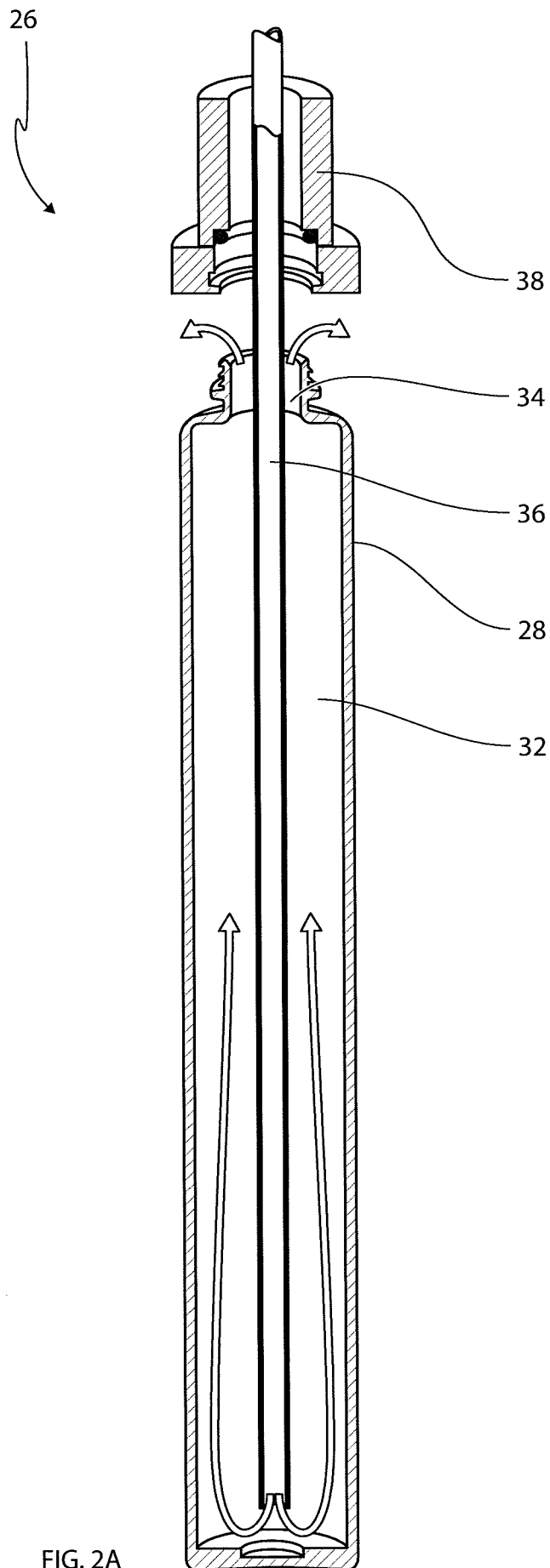


FIG. 1



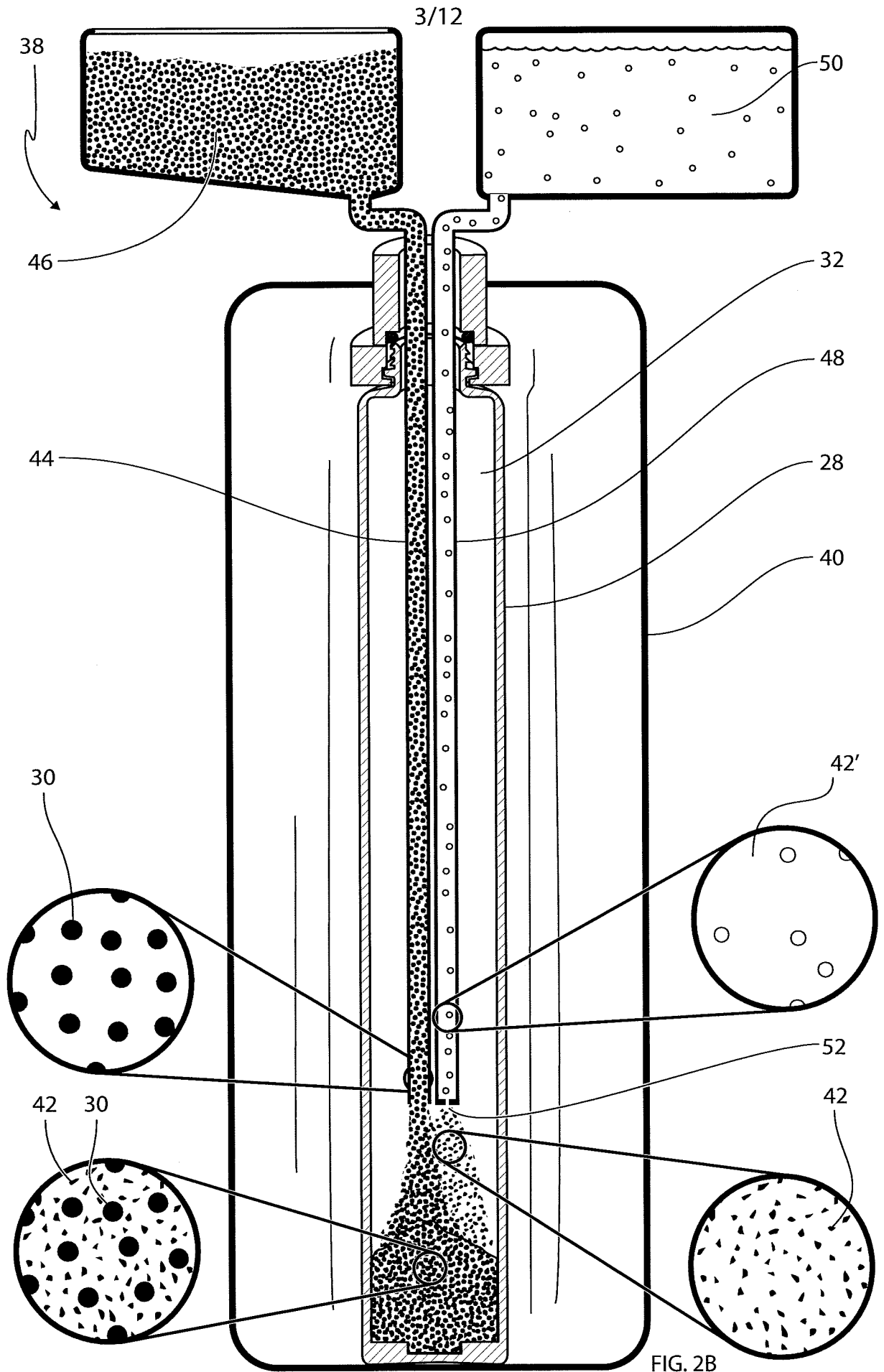


FIG. 2B

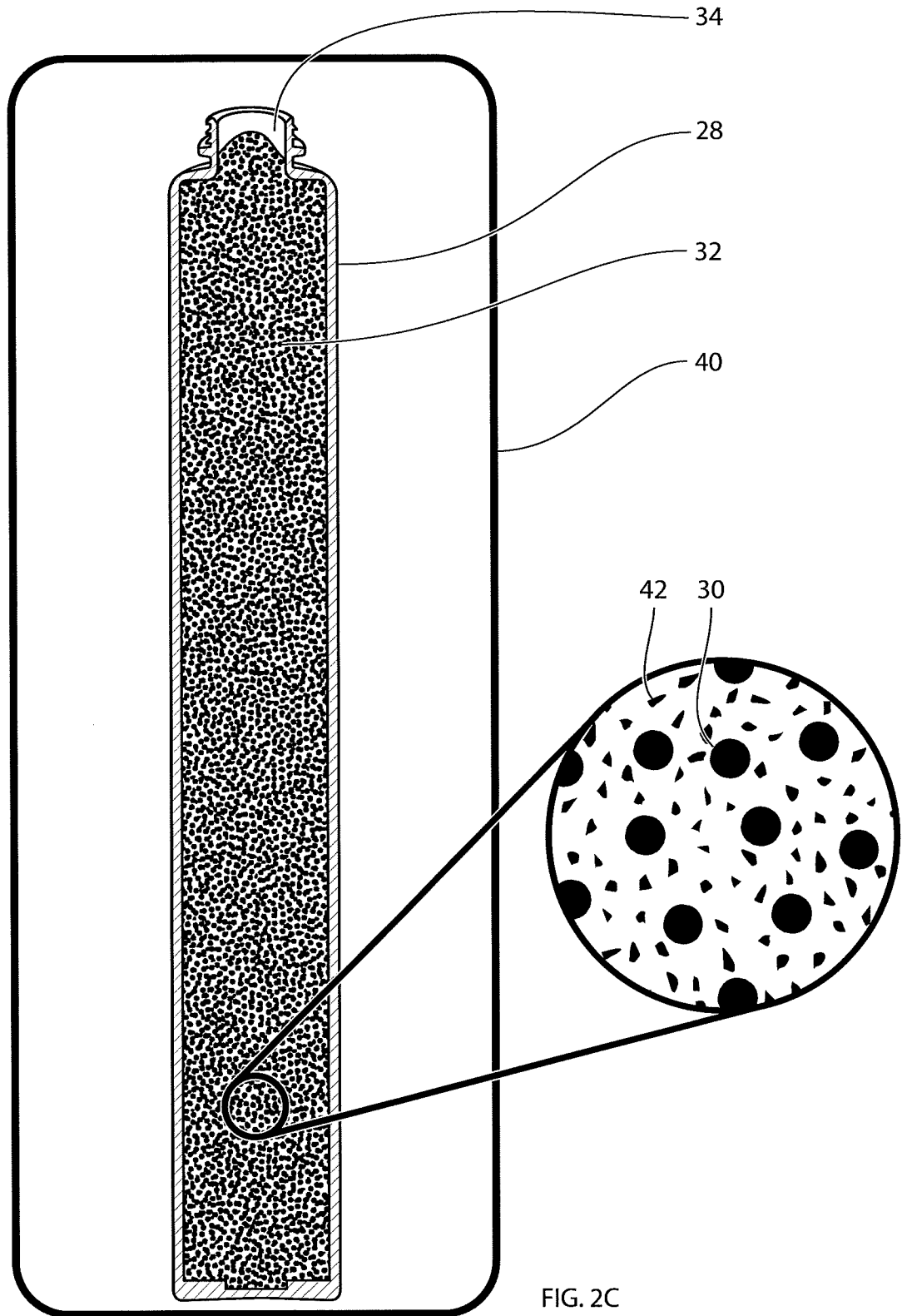


FIG. 2C

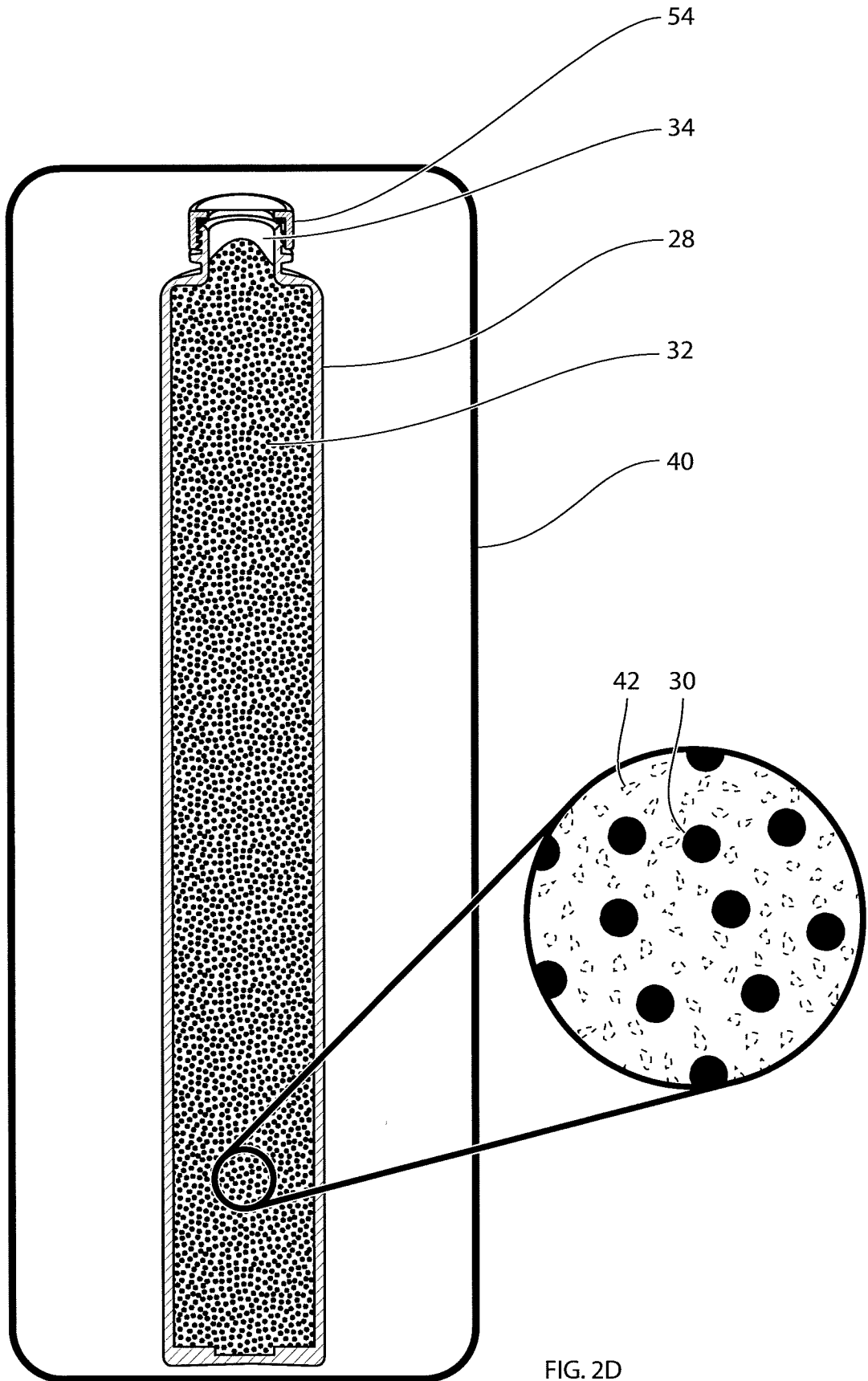


FIG. 2D

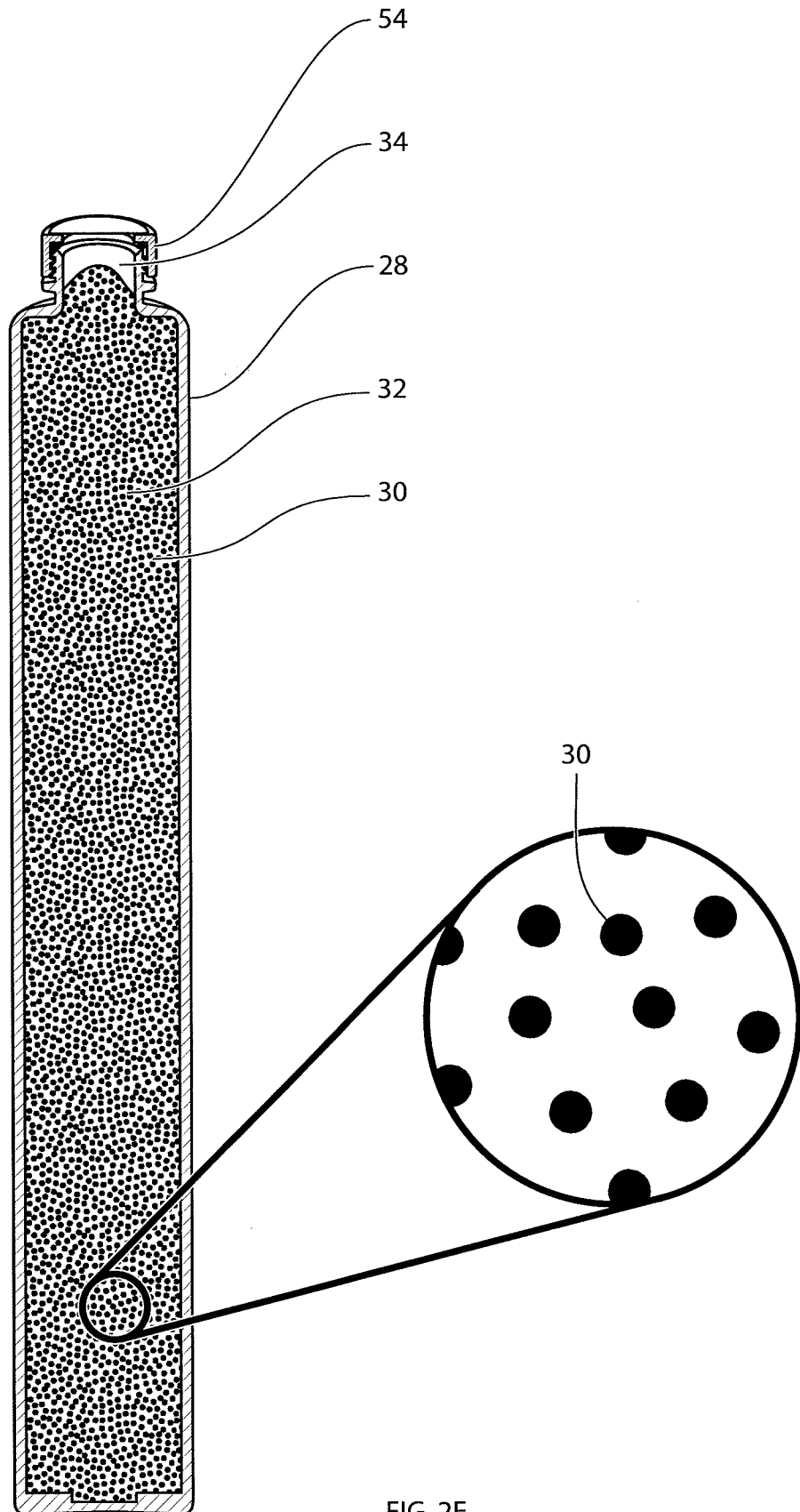


FIG. 2E

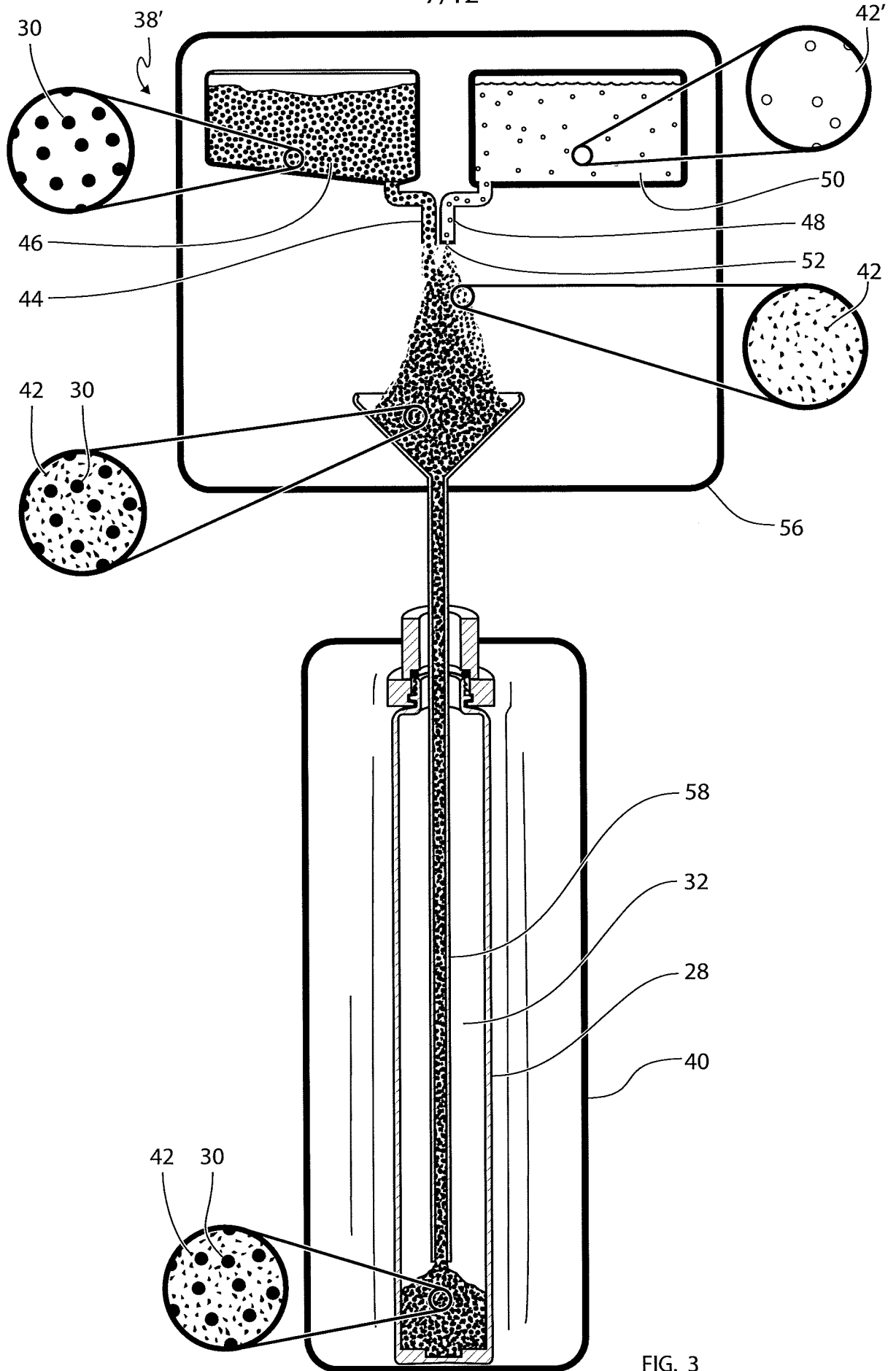


FIG. 3

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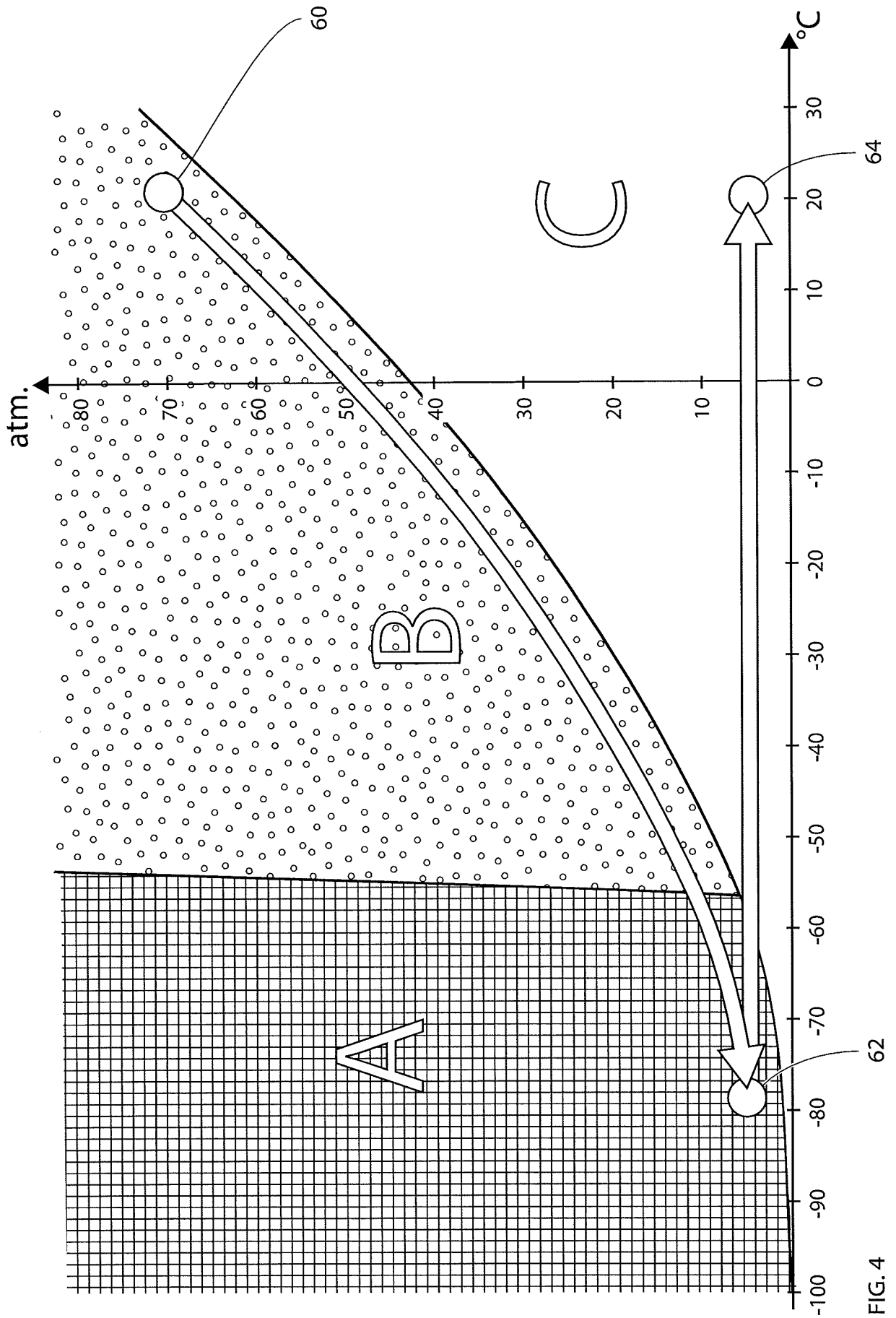


FIG. 4

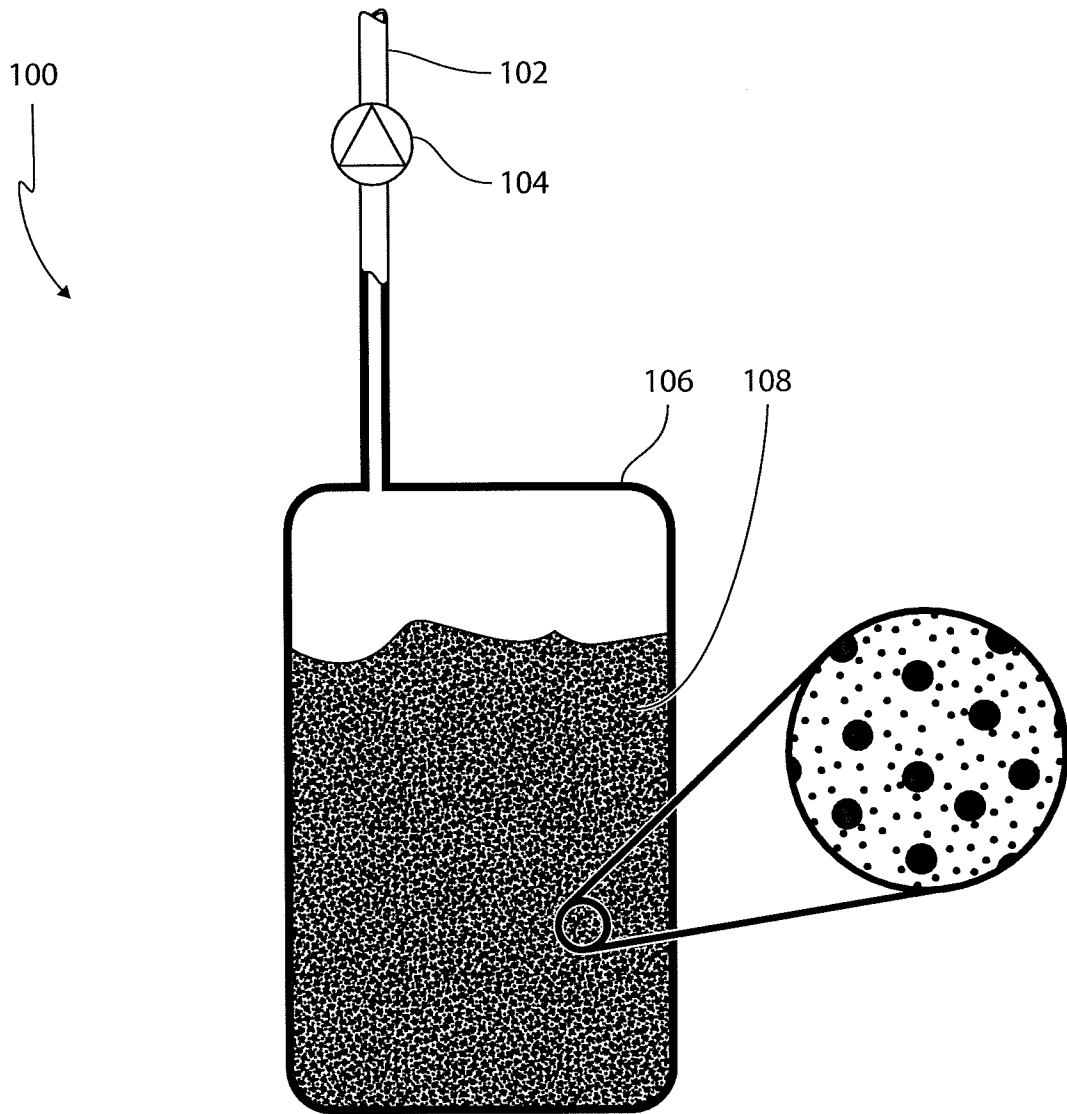


FIG. 5A

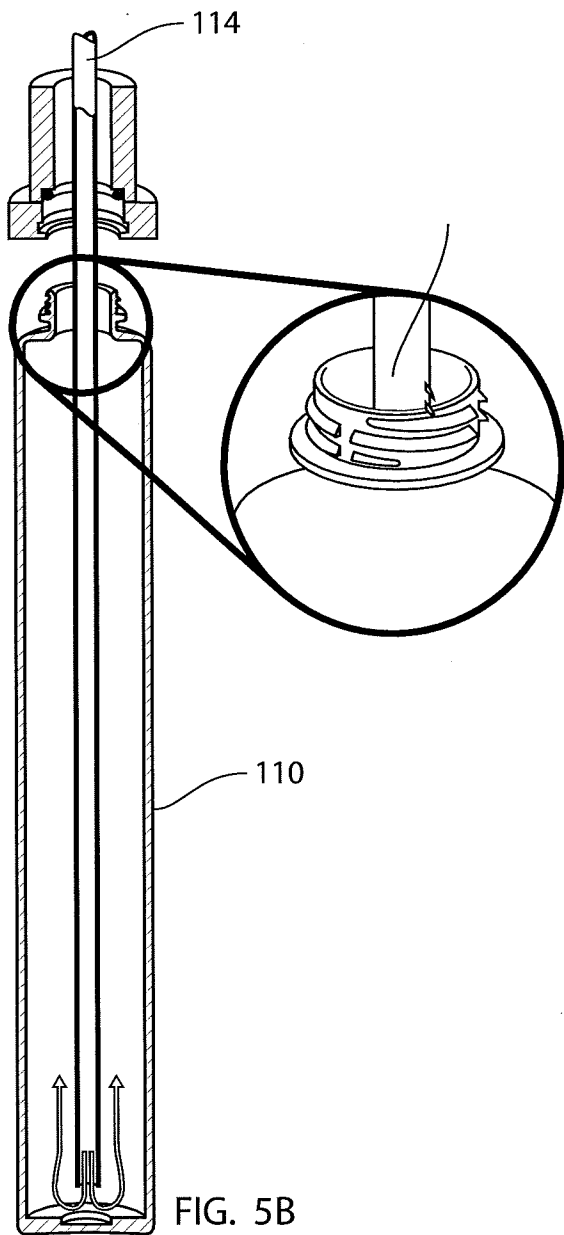


FIG. 5B

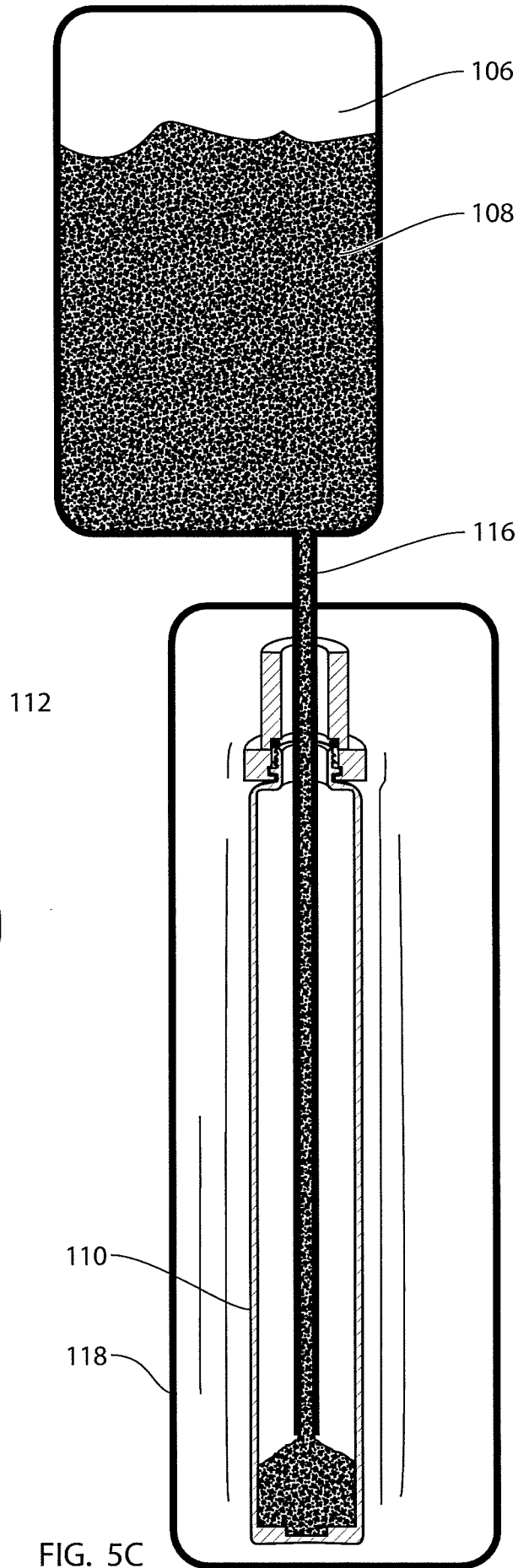


FIG. 5C

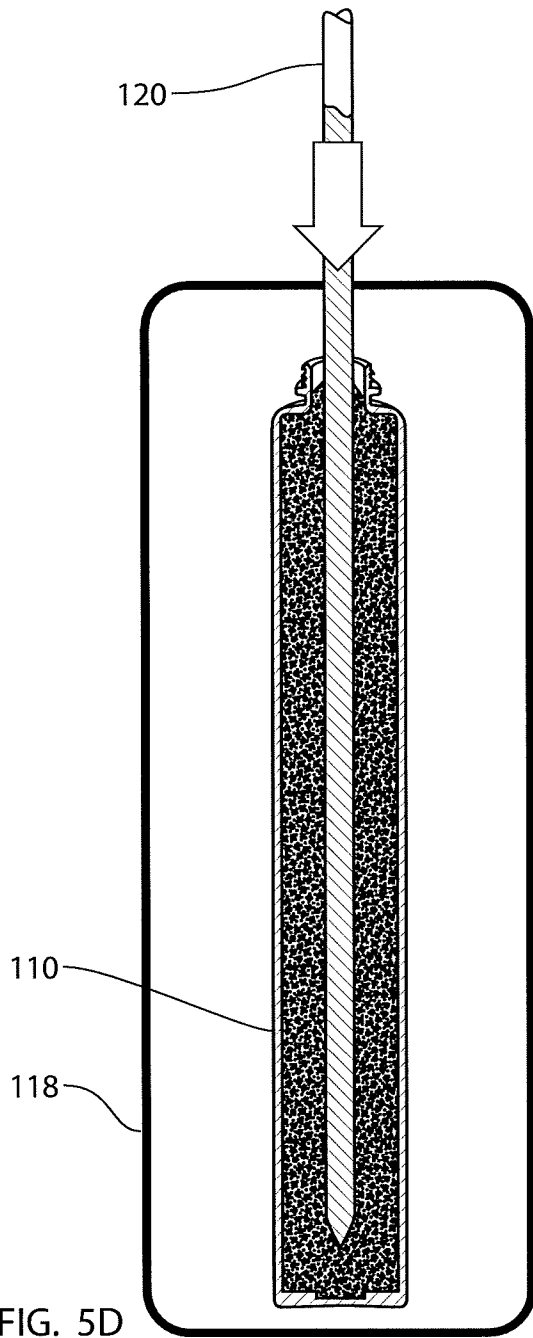


FIG. 5D

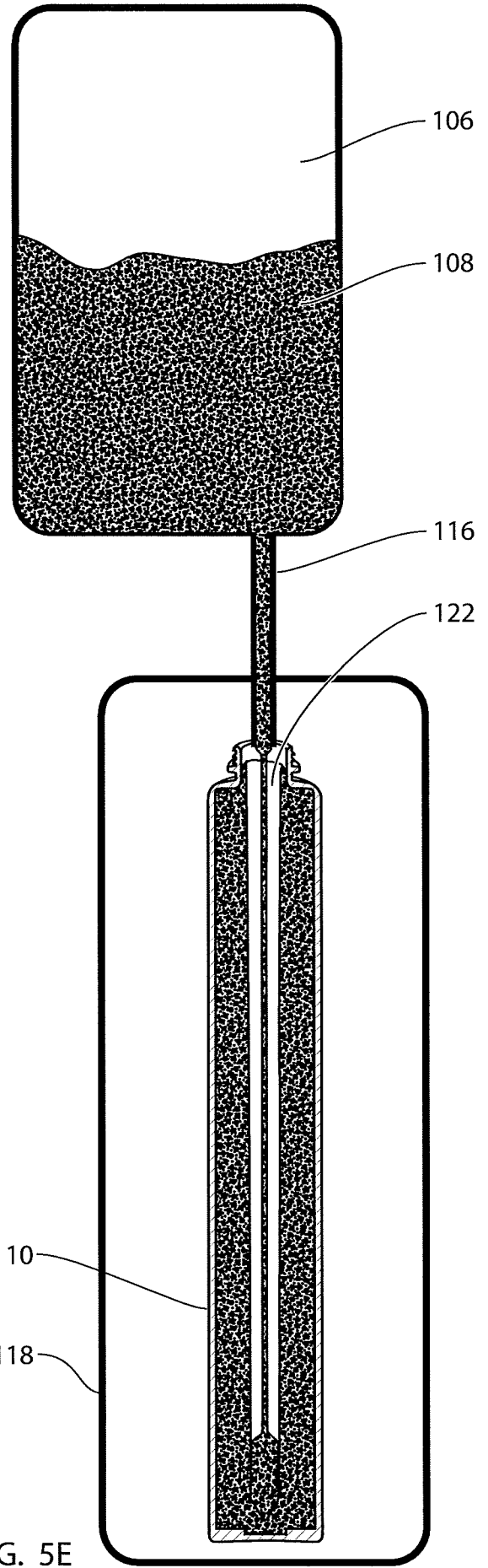


FIG. 5E

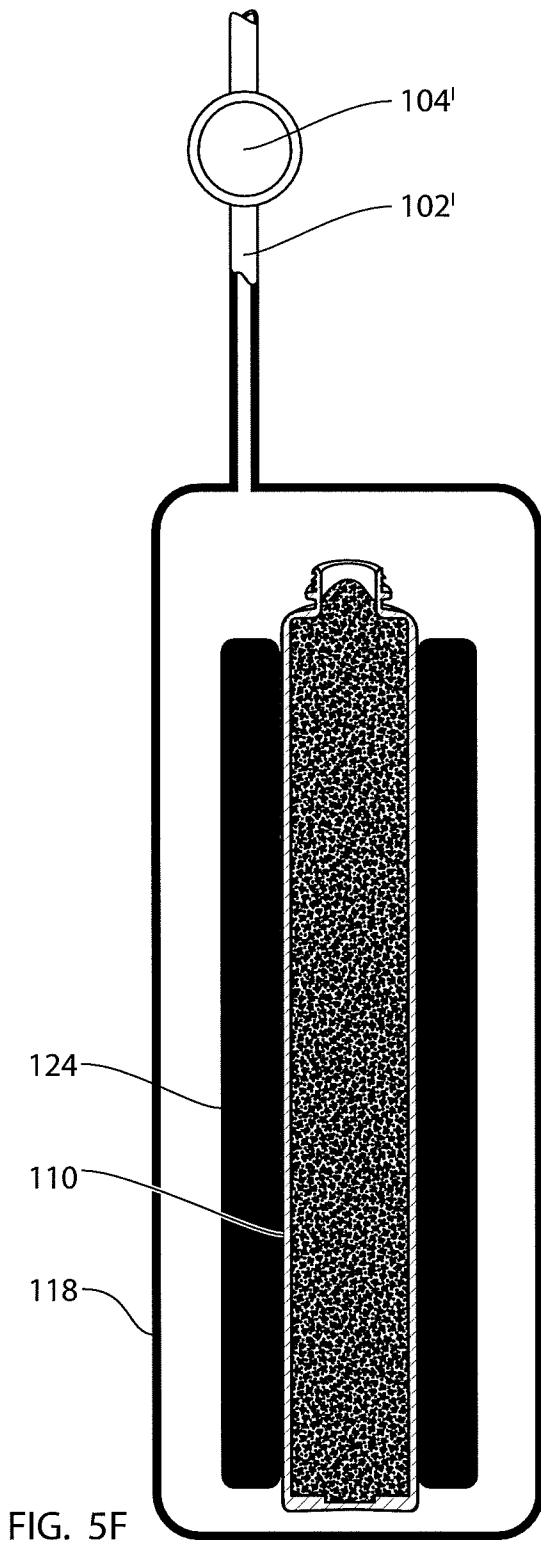


FIG. 5F

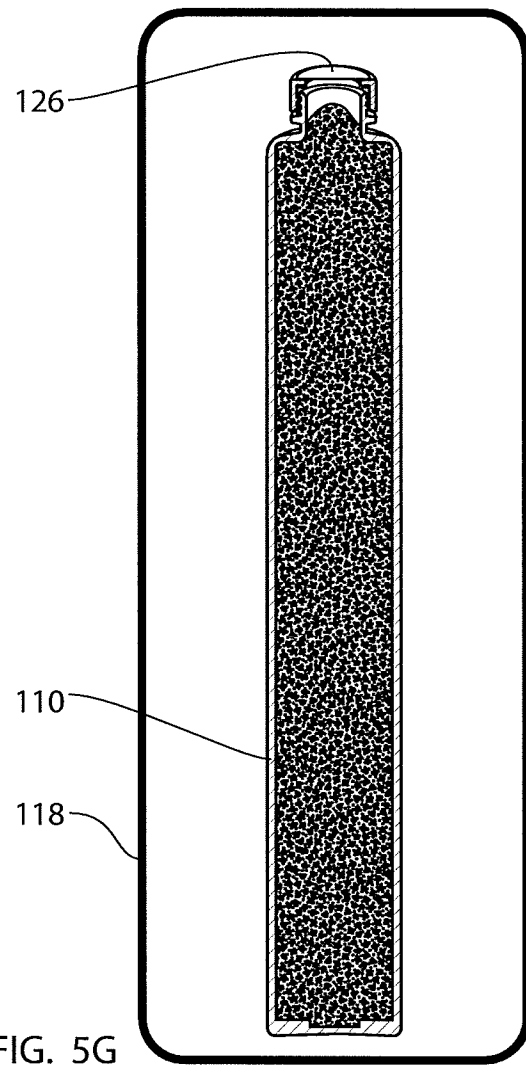


FIG. 5G

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/060009

A. CLASSIFICATION OF SUBJECT MATTER
INV. B67D1/00 B67D1/04 B65B31/10 F17C11/00
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)
B67D B65B F17C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2011/157786 A1 (CARLSBERG BREWERIES AS [DK]; RASMUSSEN JAN NOERAGER [DK]; VESBORG STEE) 22 December 2011 (2011-12-22) cited in the application page 19, line 35 - page 20, line 10 page 20, line 28 - line 35 page 62, line 23 - line 27; claim 1 -----	1-16,29,30
A	US 5 858 067 A (MCMANUS JAMES V [US]) 12 January 1999 (1999-01-12) claim 16 -----	1,13,14
A	DE 10 2009 046960 A1 (BOSCH GMBH ROBERT [DE]) 26 May 2011 (2011-05-26) paragraph [0008] -----	1,13,14
	-/--	

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 6 October 2014	Date of mailing of the international search report 15/10/2014
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Desittere, Michiel
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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/060009

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2008/053216 A1 (KBIG LTD [GB]; GARRETT MICHAEL ERNEST [GB]) 8 May 2008 (2008-05-08) page 1, line 14 - line 16 page 11, line 14 - line 17 page 12, line 21 - line 25 page 13, line 8 - line 14 page 18, line 1 - line 27 -----	16-21, 23-28,30
Y	EP 1 686 062 A1 (CZEWO FULL SERVICE FILLING SER [DE]) 2 August 2006 (2006-08-02) cited in the application paragraph [0007] - paragraph [0008] paragraph [0015] - paragraph [0019] -----	16-21, 23-28,30
A	WO 2010/016406 A1 (NIPPON TANSAN GAS CO LTD [JP]; KADOWAKI MAKOTO [JP]; HASHIMOTO NOBUHIR) 11 February 2010 (2010-02-11) paragraph [0011] - paragraph [0016] -----	16,29,30

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2014/060009

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-15

Method for packing a granulated substance in a canister with a cone-shaped rod; beverage dispenser and beverage container with such a canister.

2. claims: 16-30

Method for filling a canister with an adsorbing substance and a liquefied propellant gas; beverage dispenser and system with such a canister.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/EP2014/060009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011157786 A1	22-12-2011	CN 103068718 A EA 201291148 A1 EP 2582614 A1 US 2013074978 A1 WO 2011157786 A1	24-04-2013 28-06-2013 24-04-2013 28-03-2013 22-12-2011

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