METHOD AND APPARATUS FOR DISPENSING BEVERAGES, ESPECIALLY CARBONATED BEVERAGES

A beverage pressure control device, comprising a pressure regulating chamber and a pressure sensing chamber, separated by a movable or deformable wall part, wherein at least one gas inlet channel is provided for feeding gas under pressure into the pressure sensing chamber and at least one gas outlet channel for feeding gas from the gas sensing chamber, wherein the gas inlet channel can be closed by a valve operated by the movable or deformable wall part, depending on a pressure difference over said movable or deformable wall part, wherein an operating device is provided for regulating the flow through the at least one outlet channel.

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Title: Method and apparatus for dispensing beverages, especially carbonated beverages.

The invention relates to a dispensing unit and a method for dispensing a liquid under pressure.

The document EP 1064221 discloses a device for dispensing a liquid, wherein the device comprises a container having a first compartment, and a second compartment, the first compartment being arranged for receiving the liquid to be dispensed, and the second compartment being arranged for receiving a propellant gas, wherein, at least during use, an opening is provided between the first and the second compartment. The device further comprises a pressure control means arranged for controlling, during use, the pressure of the propellant gas flowing from the second compartment into the first compartment. The pressure control means are provided within the first compartment.

An object of the present invention is to provide for a container unit or pressure control device in an alternative manner. Another object is to provide a container unit in which a pressure control device can easily be provided for, especially easily be mounted. A still further object of the present invention is to provide for a dispensing unit that can easily be mounted to a beverage container. Another object can be to provide a pressure control device with which pressure can be regulated by an operating device.

Another object of the present invention is to provide for a method for forming and/or filling a beverage container, especially a self pressurising beverage container and for a method for pressurising and/or dispensing beverages.

One or more of these and other objects can be obtained, individually or in combination, by the present invention.
In a first aspect a beverage pressure control device according to the present disclosure can be characterised by a pressure regulating chamber and a pressure sensing chamber, separated by a movable or deformable wall part. At least one gas inlet channel is provided for feeding gas under pressure into the pressure sensing chamber and at least one gas outlet channel for feeding gas from the gas sensing chamber. The gas inlet channel can be closed by a valve operated by the movable or deformable wall part, depending on a pressure difference over said movable or deformable wall part. An operating device is provided for regulating the flow through the at least one outlet channel.

In a second aspect a method for dispensing a liquid under pressure according to the present disclosure can be characterised by the liquid being stored in a liquid container with a propellant gas at a first regulated pressure, and additional propellant gas is stored in a gas container at a second pressure substantially higher than the first pressure, and the liquid is dispensed by means of a dispensing unit coupled to said liquid container and said gas container, wherein the method comprises the steps of:

a) reducing the first pressure of the liquid container to a third pressure, wherein the third pressure is at least the ambient pressure,

b) opening a liquid dispensing path of the dispensing unit and settling the flow area of said liquid dispensing path, and

c) while keeping the adjusted flow area of the liquid dispensing path unchanged, controlling the dispensing pressure of the propellant gas in the liquid container within a pressure range defined by the first pressure and the ambient pressure, thereby dispensing a first amount of liquid.

In a third and fourth aspect of the present disclosure a beverage container and a dispensing unit are disclosed.

Embodiments of the present invention shall be described, with reference to the drawings, for elucidation of the invention. These embodiments
should by no means be understood as limiting the scope of the invention in any way or form. In these drawings:

Figure 1a is a perspective view of a first preferred embodiment of the dispensing unit according to the invention in its initial state;

Figures 1b, 1c and 1d are a top plan view, a side view and a bottom plan view of the dispensing unit shown in Figure 1a, respectively, in an unfolded state;

Figure 2 is top plan view of the dispensing unit shown in Figure 1 in its initial state;

Figure 3 is a cross sectional view of the dispensing unit shown in Figure 1 taken along the line A-A;

Figure 4 is a cross sectional view of the dispensing unit shown in Figure 1 taken along the line B-B;

Figure 5 is a cross sectional view of the dispensing unit shown in Figure 1 taken along the line C-C;

Figure 6 is a cross sectional view of the dispensing unit shown in Figure 1 taken along the line D-D;

Figure 7 is perspective view of a dispensing device comprising the dispensing unit shown in Figure 1;

Figure 8 is a cross-sectional view of the dispensing device shown in Figure 7 taken along the line A-A of Figure 2, with the operating lever being in its initial position;

Figure 9 is a partial cross-sectional view of the dispensing device shown in Figure 7 taken along a the line D-D in Fig. 2, with the operating lever being in its initial position;

Figure 10 is a partial cross-sectional view of the dispensing device shown in Figure 7 taken along the line A-A of Figure 2, with the operating lever being in a first operating position;
Figure 11 is a partial cross-sectional view of the dispensing device shown in Figure 7 taken along the line D-D of Figure 2, with the operating lever being in the first operating position;

Figure 12 is a partial cross-sectional view of the dispensing device shown in Figure 7 taken along the line B-B of Figure 2, with the operating lever being in the first operating position;

Figure 13 is a partial cross-sectional view of the dispensing device shown in Figure 7 taken along the line D-D of Figure 2, with the operating lever being in a second operating position;

Figure 14 is a partial cross-sectional view of the dispensing device shown in Figure 7 taken along the line D-D of Figure 2, showing a second embodiment of the dispensing unit with the operating lever being in the initial position;

Figure 15 is a partial cross-sectional view of the dispensing device shown in Figure 7 taken along the line D-D of Figure 2, showing the second embodiment of the dispensing unit with the operating lever being in its first operational position;

Figure 16 is a partial cross-sectional view of the dispensing device shown in Figure 7 taken along the line D-D of Figure 2, showing the second embodiment of the dispensing unit with the operating lever being in its second operating position;

Figure 17 schematically a dispensing unit according to the description, from a side facing the beverage container;

Figure 18 schematically a third embodiment of a container unit;

Figure 19 schematically a fourth embodiment of a container unit;

Figure 20 schematically a fifth embodiment of a container unit; and

Figure 21 schematically a sixth embodiment of a container unit.

In this description and the drawings the same or similar elements have the same or similar reference signs. In this description the invention shall specifically be described with reference to.
In this description by way of example container units and pressurising units, as well as methods are described with reference to carbonated beverages, especially beer.

In this description a pressure regulating means or pressure control device has to be understood as at least including a device or assembly for controlling pressure inside a beverage container, based on a pressure prevailing in a first compartment comprising the beverage to be dispensed, by feeding gas from a high pressure propellant gas container or second compartment. In this description embodiments are described in which the beverage container is made of plastic, for example blow moulded, especially stretch blow moulded from a preform, in any suitable manner, such as known in the art. However, similarly beverage containers can be used made partly or entirely of metal. In the embodiments described and shown specifically, a gas container is described made of plastic, for example PET or PEN or blends thereof, or another thermoplastic material. The gas container can be made by injection moulding and/or blow moulding, for example similar to blow moulding of a beverage container, and can have a basic shape of a blow mould perform for forming a bottle, and can also be made of PET, PEN or blends thereof or another thermoplastic material. However, such gas container can also be made differently and/or of different materials, for example metal.

In embodiments of the present invention an aspect can be that a dispensing unit is used, comprising dispensing means and pressure regulating means, with which both a gas container comprising high pressure propellant gas and the beverage container can be closed.

In embodiments of the present disclosure an aspect of the present invention can be based on the idea that during dispensing, instead of maintaining a regulated constant pressure in the liquid container and controlling the flow rate of the liquid by controlling the flow area of the dispensing channel or dispensing outlet for the liquid, the flow area of the dispensing channel or outlet is rather maintained at a constant value,
preferably at a maximum value, and the pressure in the liquid container is controlled within a predetermined pressure range so as to control the flow rate of the liquid being dispensed. This allows to apply a relatively low pressure at dispensing for any kind of liquid, including both gaseous and non-gaseous beverages, while keeping the possibility to adjust the flow rate of the liquid by simply adjusting or even varying the desired pressure of the propellant gas in the liquid container. A further advantage of this solution can be that by controlling the pressure prevailing in the liquid container during dispensing, the flow path of the liquid from the liquid container through the dispensing unit may be formed free of any obstacle of flow, thus allowing to avoid the development of undesired turbulences in the liquid during dispensing.

In a container unit according to the present disclosure a beverage container 36 can be provided, with a body 50 and a neck portion 51, wherein at least the body portion 50 forms a first compartment for beverage. A pressure control device 53 is provided, for pressurising a beverage in the beverage container 36, which pressure control device 53 comprises or can be connected to a gas container 33 forming a second compartment for containing a propellant under pressure. A dispensing unit 10 can be provided in and/or on the neck portion 51 and the gas container 33 can be supported by the neck portion 51 and/or the dispensing unit 10, wherein pressure regulating means 54 of the pressure control device 53 are provided in the dispensing unit 10. In general the pressure control device therefore comprises at least the pressure regulating means 54 and the gas container 33 or a connecting means therefore. The gas container 33 preferably extends at least partly in the beverage container 36, preferably suspended in the neck portion 51 of the container 36 and extending at least partly into the inner space comprised in the body portion 52. The dispensing unit 10 can close off both the beverage container 36 and the gas container 33.

When the gas container 33 is injection moulded, it can have a gas container body portion 55 with a peripheral wall portion 56 which is radially
expandable within the first compartment by the propellant gas, for example under internal gas pressure between 4 and 20 bar absolute. This can be advantageous in that it can secure the dispensing unit 10 with the gas container 33 even better inside the beverage container 36. In embodiments the gas container 33 can be inserted into and at least partly through the neck portion 51 of the beverage container 36, wherein the neck portion 51 encloses an upper part of the gas container 33, providing for a passage 57 for gas between an inner surface of the neck portion 51 and an outer portion of the gas container 33, wherein preferably a dip tube 35 extends through said passage from the first compartment into the dispensing unit 10.

The dispensing unit 10 can comprise a first coupling means 40 and the neck portion 51 of the beverage container 36 can be provided with at least one coupling means for coupling to the first coupling means 40, preferably sealingly. Similarly the dispensing unit 10 can have at least one second coupling means 42 and the gas container 33 can have a neck portion comprising coupling means for cooperating with the second coupling means 42, preferably sealingly.

The beverage container can have a first, internal axial length, measured between an outer end of the neck portion 51 and an opposite end of the beverage container 36, and the gas container 33 can have a second, outer axial length measured between the dispensing unit 10 to which the gas container 33 is attached and an opposite end of the gas container 33, wherein the first axial length is slightly larger than the second axial length. Preferably the first axial length is between 1 and 1.2 times the second axial length, more preferably between 1 and 1.1 times the second axial length. This can provide for a relatively slim gas container, suitable to be inserted through the neck 51 or filling opening of a beverage container 36, having nevertheless a relatively large internal volume. This enables storage of a sufficient amount of propellant gas inside the gas container 33.
The dispensing unit 10 can comprise at least one passage 30, 25a through the pressure regulating means 53 to the first compartment, forming part of a gas passage between the first compartment and the second compartment, i.e. between the inner space of the beverage container 36 and the inner space of the gas container 33. The pressure regulating means 53 can further comprise at least one valve assembly for opening and closing said gas passage 30, 25a, based on pressure prevailing in the first compartment.

In a dispensing unit 10 for a beverage container 36, a pressure regulating means 54 and dispensing means can be comprised, wherein at a first side of the dispensing unit a first coupling means 40 and a second coupling means 42 are provided. The first coupling means can surround the second coupling means, which has to be understood as meaning at least but not limited to surrounding seen in a view substantially perpendicular to said first side of the dispensing means, as for example shown specifically in fig. 17. Within the second coupling means 42 at least one first gas passage 25a, which in all embodiments can also be referred to as a gas inlet channel, opens, said first passage 25a extending into a chamber 58 of the pressure regulating means 54, which in all embodiments can be referred to as a pressure sensing chamber, wherein between the first 40 and second coupling means 42 at least one second passage 25b opens, said second passage 25b extending into said chamber 58. The second passage can also be referred to in the embodiments disclosed as a gas outlet channel. A gas container 33 can be mounted to the second coupling means 42, which gas container 33 has an axial length $L_{gas}$ and extends within the second coupling means 41, seen in a direction of its axial length $L_{gas}$, which can be understood as meaning that seen in said axial direction, which can be substantially perpendicular to said first side of the dispensing unit, the gas container 33 has no part that extends beyond the first coupling means, as can be seen in fig. 17.

A valve stem 23 can extend through the first channel 25a and be connected to or part of a movable and/or flexible wall part 22 of said chamber.
58, which valve stem 23 can close off and open the first passage 25a, for example by a widening 24 of the stem 23, depending at least on a position of said wall part 22 of the chamber 58. Embodiments thereof shall be further elucidated. The wall part 22 can for example be a flexible membrane 22, as for example disclosed in the embodiments of fig. 1 - 16, or a piston, as is for example discloses as such in EP 1064221 and referred to in the embodiment of fig. 18. All combinations thereof should also be considered having been disclosed herein.

In Figure 1a, a first preferred embodiment of the dispensing unit 10 is illustrated in a perspective view. Although the dispensing unit 10 in Figure 1 is shown as a cap for a bottle, the dispensing unit may be designed in any other way, for example as a taping unit for a beer keg. The illustrated first embodiment of the dispensing unit 10 comprises a lower mounting part 11 and an upper covering part 12. The lower mounting part 11 and the upper covering part 12 are connected via a flexible hinge 13. The upper covering part 12 comprises a pivotable operating lever 14 used to control the flow rate of the liquid during dispensing. The operating lever 14 is provided with several once breakable joints 15 for fixing the operating lever 14 to an adjacent portion of the upper covering part 12. These joints 15 also have the function to demonstrate that the dispensing unit 10 has not been tampered with. Before the first use of the dispensing unit 10, these joints 15 are to be broken so that the operating lever 14 can be moved.

In Figures 1a, 1b an lc, the lower mounting part 11, the upper covering part 12, the operating lever 14 and the once breakable joint 15 of the dispensing unit 10 can be seen in different views of an unfolded state. In Figure 1d, a flexible dispensing tube 16 and a membrane 22 of a pressure regulating means are also shown, although these elements are arranged inside the dispensing unit 10.

In Figure 2, the dispensing unit 10 can be seen in a plan view using the same reference numbers as in Figures 1a to 1d. This figure also indicates
sectioning lines A-A, B-B, C-C and D-D along which cross-sectional views are taken and illustrated in at least the following Figures 3 to 6, in which the dispensing unit 10 is shown in its initial state, i.e. in the storage state, when the operating lever is in its initial position.

Figure 3 illustrates the dispensing unit 10 in a cross-sectional view taken along the line A-A indicated in Figure 2. Inside the dispensing unit 10, a dispensing tube 16 is arranged under the operating lever 14. The dispensing tube 16 is secured to the lower mounting part 11 and comprises an opening 17 that establishes a fluid communication with the internal space of the liquid container (not shown) to which the dispensing unit 10 is coupled. The dispensing tube 16 has an outer end portion 19 provided with an opening 19’ to allow the liquid to flow out from the liquid container during dispensing. In Figure 3, the outer end portion 19 of the dispensing tube 16 is entirely compressed by an eccentric front projection 18 of the operating lever 14, whereby the flow path of the liquid is closed.

As can be seen in Figure 4, the upper covering part 12 of the dispensing unit 10 is secured to the lower mounting part 11, for example, by snap fitting between a downward projection 20 of the upper covering part 12 and the rim 21 of a corresponding through-hole of the lower mounting part 11 adapted to receive said projection 20.

The dispensing unit 10 also comprises a pressure regulating means 54 to generate a constant regulated pressure for propellant gas in the liquid container. The pressure regulating means can also be referred to as pressure control device 54. In the illustrated preferred embodiments of the dispensing unit 10, the pressure regulating means 54 comprises a resilient membrane 22, preferably made of rubber, a valve stem 23 joined to a central portion of the membrane 22 at one end, a valve head 24 formed at the other end of the valve stem 23 and a fluid communicating path for the propellant gas, said fluid communicating path connecting the internal space of the gas container 33 and the internal gas space of the liquid container 36 (partly also referred to as head
space) through the pressure regulating means 54. In the illustrated embodiments of the dispensing unit 10, the fluid communicating path includes a first gas channel 25a in which the valve stem 23 is guided, and a second gas channel 25b or outlet channel (shown in Figure 6) and the chamber 58. The operation of the pressure regulating means 54 of the dispensing unit 10 will be described later. They form part of pressure control device 53.

As shown in Figure 5, the operating lever 14 has two coaxial pivots 26a and 26b serving as a shaft for the operating lever 14 around which it can be pivoted. On the lateral surface of the inner pivot 26a, there is a stud 27 arranged extending into a guiding hole 29 (shown in Figure 6) of a slide 28. The slide 28 is guided so that it can move horizontally between two end positions defined by the two end positions of the operating lever 14. When the operating lever 14 is pivoted, the stud 27, which is arranged eccentrically with respect to the rotational axis of the pivots 26a, 26b, moves along a circular path, thus forcing the slide 28 to move toward the central portion of the dispensing unit 10 or in the opposite direction, while the stud 27 moves up or down in the guiding hole 29. The slide is an embodiment of an operating device, or part thereof.

As clearly shown in Figure 6, the slide 28 partly covers the membrane 22, the extent of coverage depending on the position of the operating lever. Under the coverage area of the membrane 22, there is a third gas channel 30 formed to connect the internal space of the gas container with the head space of the liquid container through the pressure regulating means, through a chamber 58. The slide 28 is formed so as to be capable of varying the area of an upper aperture 31 of the third gas channel 30, which is also an outlet channel, thereby adjusting the amount of the propellant gas flowing from the gas container into the liquid container. By adjusting the flow rate of the gas flowing through the third gas channel 30, the pressure of the propellant gas can be varied in the liquid container during dispensing. Since the pressure regulating means 54 of pressure control device 53, as integrated
in the dispensing unit 10 is adapted to generate a predetermined pressure in
the beverage container 36, also referred to as liquid container 36, the variable
pressure range has an upper limit defined by said preset pressure of the
pressure regulating means 53. On the other hand, the lower limit value of the
variable pressure range can not decrease below the ambient pressure since the
closure of the third gas channel 30 will terminate the outflow of the liquid and
also prevent the ambient air from entering the liquid container 36.

The mechanism including the operating lever, the slide, the third
channel and pressure regulating means can together constitute or at least
form part of a means for adjusting the flow rate of the propellant gas flowing
from the gas container 33 into the liquid container 36, and can be referred to
as flow regulating means or operating device or parts thereof. By varying the
flow area of the third gas channel 30 by said mechanism, the pressure may be
adjusted in the liquid container 36, and thereby the flow rate of the liquid may
also be set during dispensing.

Figure 7 schematically illustrates an assembled dispensing device or
container unit 70 comprising the liquid or beverage container 36 (indicated by
dashed line), for example, a bottle containing a beverage, for example a
carbonated beverage such as beer, a gas container 33 containing a propellant
gas, for example carbon dioxide or nitrogen, at a high pressure, for example
between 2 and 20, more preferably between 4 and 14 bar, a dispensing unit,
such as the dispensing unit 10 according to the present invention, and
preferably a dip tube 35. The dispensing unit 10 is coupled to the liquid
container 36 and the gas container 33 in a gas-tight sealed manner. Although
in Figure 7, the gas container 33 is shown inside the liquid container 36, the
gas container 33 may equally be arranged externally to the liquid container 36.
The dip tube 35 is arranged inside the liquid container 36 and connected to a
corresponding dispensing channel of the dispensing unit 10.

In Figure 8, a cross-sectional view of the dispensing device 70 shown
in Figure 7 is illustrated with the operating lever 14 of the dispensing unit 10
being in its initial position. The cross-section is taken along the line A-A of Figure 2. In the dispensing device 70, the operating lever 14, which can also be referred to as operating means of the dispensing unit, is in its initial position that is normally applied during storage of the dispensing device 70. In this case, the front projection 18 of the operating lever 14 closes the outer end portion 19 of the dispensing tube 16, thereby preventing the dispensing of the liquid 32 from the liquid container 36. Due to the overpressure of the propellant gas 34 prevailing in the head space of the liquid container 36, the dispensing tube 16 also contains liquid 32 under pressure. The liquid 32 can enter the dispensing tube 16 through the opening 17 of the dispensing channel (not shown) formed within the dispensing unit 10.

In the partial cross-sectional view of Figure 9, an exemplary way of coupling the dispensing unit 10 to the liquid container 36 and the gas container 33 can be seen in more detail. According the present invention, the dispensing unit 10 has a first coupling means for coupling to the liquid container 36. As illustrated in the embodiment shown in Figure 9, the first coupling means may comprise a snap fitting portion 40 formed in the lower mounting part 11 of the dispensing unit 10, said snap fitting portion 40 being adapted to be sealingly attached to a corresponding coupling part of the liquid container 36. To this end, the first coupling means may comprise an elastic sealing ring 38 against which the corresponding coupling portion of the liquid container 36 bears after mounting the dispensing unit 10 onto the liquid container 36. Although in Figure 9, only a preferred embodiment of said first coupling means is illustrated, the dispensing unit 10 may according to the present invention be coupled to the liquid container 36 in other ways as well, for example by threaded fitting or gluing, the implementation of which alternative coupling modes is obvious for those skilled in the art.

According the present invention, the dispensing unit 10 further comprises a second coupling means for coupling to the gas container 33. As illustrated in the embodiment shown in Figure 9, the second coupling means
may comprise a snap fitting portion 42 formed also in the lower mounting part
11 of the dispensing unit 10, said snap fitting portion 42 being adapted to be
sealingly attached to a corresponding coupling part of the gas container 33. It
is preferred that the second coupling means comprises an elastic sealing ring
43 against which a corresponding coupling portion of the gas container 33
bears after attaching the gas container 33 to the dispensing unit 10. Although
in Figure 9, only a preferred embodiment of said second coupling means is
illustrated, the dispensing unit may be coupled to the gas container in other
ways as well, for example by threaded fitting or gluing, the implementation of
which alternative coupling modes is obvious for those skilled in the art.

As can be seen in fig. 17 the first and second coupling means can
both be substantially circular, provided in a first side 60 of the dispensing
device 10. The first coupling means can surround the second coupling means,
spaced apart therefrom, seen the view as presented in fig. 17. This view is
substantially perpendicular to the said side 60, or along the axis Lgas of the
gas container 33. As can be seen in fig. 17 the contour 33A of the gas container
33 extends, in the view of fig. 17, within the first coupling means. This
provided for the possibility of inserting the gas container 33 into the beverage
container 36 via the neck portion 51, through the coupling means provided
thereupon.

Figure 9 shows the dispensing unit 10 in its storage state when the
operating lever (not shown) is in its initial position. The slide 28 is now in its
inner end position where it presses the whole coverage area of the membrane
22 onto an upper surface of the lower mounting part 11, thereby entirely
closing the upper aperture 31 of the third gas channel 30. Under this
condition, the membrane 22 takes the form like a dome, and the valve head 24
closes the lower aperture of the first gas channel 25a. The pressure of the
propellant gas 34 acting to the bottom surface of the valve head 24 is
compensated by the counteracting resilient force of the elevated membrane 22.

In the gas space 58 defined by the membrane 22 and the upper surface of the
lower mounting part 11 of the dispensing unit 10, the pressure is equal to the pressure of the gas container 33, and due to the fluid communication path between the gas container 33 and the head space of the liquid container 36 through the second gas channel 25b, this pressure is also equal to the pressure prevailing in the liquid container 36, also referred to as a first pressure.

After finishing the dispensing of the liquid, the operating lever is moved again into its initial position, resulting in the same arrangement of the parts within the dispensing unit as shown in Figure 9. If the dispensing pressure was lower than said first pressure when the dispensing was terminated, the propellant gas tends to flow from the gas container 33 into the liquid container 36 through the second gas channel 25b until the first pressure is reached and set in the liquid container 36 by the pressure regulating means of the dispensing unit 10.

In Figure 10, the dispensing unit 10 can be seen with its operating lever 14 being in a vertical position wherein the dispensing tube 16 is open to the maximum extent, i.e. the outer end portion 19 of the dispensing tube 16 presents the largest possible flow area for the liquid. In this case, however, the third gas channel (not shown) is still closed. The liquid flows out from the liquid container 36 through the dispensing channel (not shown), then via the opening 17 and finally through the dispensing tube 16. If a dip tube 35 is also used (as shown in Figure 10), the liquid 32 is driven into the dispensing channel through the dip tube 35.

Figure 11 shows the same state of the dispensing unit 10 as shown Figure 10. The pressure regulating means is still under the same condition as described for the initial state of the dispensing unit 10, that is, the membrane 22 is elevated and the third gas channel 30 is closed. In the first preferred embodiment of the dispensing unit 10, this vertical operating position of the operating lever 14 shown in Figures 10 to 12 (also referred to as a first operating position) defines a boundary position between a first operating range of the operating lever 14 and a second operating range thereof, wherein the
first operating range is associated with the control of the flow area of the dispensing channel or outlet for the liquid (i.e. the dispensing tube 16, in the first embodiment), whereas the second operating range is associated with the control of the flow area of the third gas channel 30 for the propellant gas. By continuing to pivot the operating lever 14 counter-clockwise in Figure 11, the upper aperture 31 of the third gas channel 30 becomes gradually opened as the slide 28 moves toward the periphery of the lower mounting part 11.

As can be seen in the cross-sectional view of the dispensing device illustrated in Figure 12, the dispensing channel 44 establishes a fluid communication path for the liquid 32 between the internal space of the liquid container 36 and the flexible tube 16. To the lower end of the dispensing channel 44, a dip tube 35 may optionally be connected.

In Figure 13, the dispensing device 70 is shown in a partial cross-sectional view, wherein the operating lever 14 is moved to a second operating position to at least partially open the upper aperture 31 of the third gas channel 30. In the illustrated embodiment of the dispensing unit 10, this position of the operating lever 14 belongs to the second operating range of the operating lever 14, wherein the flow rate of the liquid 32 is controlled during dispensing by controlling the pressure of the propellant gas 34 in the liquid container 36. The more downward the operating lever 14 is pushed in the direction F indicated by an arrow in Figure 13, the larger area of the upper aperture 31 of the third gas channel 30 is released by the displacement of the slide 28, thus causing the elevation of an increasing area of the coverage portion of the membrane 22 above the aperture 31. Hence, by varying the opened area of the aperture 31, the amount of gas flowing from the gas container 33 into the liquid container 36 through the third gas channel 30 and, consequently, the driving force for the liquid 32 may be varied.

In order to minimize or even entirely to terminate the gas flow through the second gas channel 25b during dispensing, the second gas channel 25b is to be closed or alternatively, it is to be restricted so that a substantial
delay be presented at the generation of the first pressure in the liquid container 36 by the pressure regulating means. To this end, in a first embodiment of the dispensing unit 10, the second gas channel 25b has a restricted section 25c in which the gas flow rate, under normal operating conditions, is so small that only a negligible amount of propellant gas can flow there through into the liquid container 36 per time unit, and therefore the regulated first pressure can be generated by the pressure regulating means within a relatively long time with respect to the time period normally needed to dispense the desired amount of liquid. For example, if the first regulated pressure is 1.7-2 bars absolute, a diameter of approximately 100 µm for the restricted section 25c allows a regulation delay of approx. 5 to 15 minutes, which is a much longer time than the usual duration of filling a glass. After finishing the dispensing of the liquid, however, such a delay has no significance if the next dispensing action starts even later. Moreover, the regulated first pressure is in the liquid container 36 is greater than the equilibrium pressure of the liquid 32 stored in the liquid container 36, preferably only by a few tenths bar, thus providing an appropriate long term storage pressure for the liquid in the liquid container during storage.

On the other hand, the pressure regulating means 54 of the first embodiment of the dispensing unit 10 also limits the maximum pressure of the pressure range associated with the second operating range of the operating lever. When the third gas channel 30 is entirely opened, the pressure in the liquid container 36 increases quickly due to the large flow area of the aperture 31, but the pressure can rise only up to the first pressure since the pressure regulating means 54 prevents the pressure of the head space of the liquid container 36 from increasing further. In fact, upon reaching the first pressure in the liquid container 36, the valve head 24 will close the first gas channel 25a, thereby blocking the flow of any more propellant gas 34 from the gas container 33 into the liquid container 36.
In Figure 14, a partial cross-sectional view of a dispensing device 70' is illustrated with a second embodiment of the dispensing unit 110 according to the present invention. In this example, the operating lever 114 (indicated by dashed line) of the dispensing unit 110 is in its initial position used for storage of the liquid container 136. This second embodiment of the dispensing unit 110 comprises a common gas outlet channel 130 providing the function of both the first gas outlet channel and the second gas outlet channel used in the first embodiment of the dispensing unit. In order to properly control the gas flow through this common gas channel 130, the slide 128 as operating device or part thereof, is designed to have a recess 129 on its bottom sliding surface which allows the membrane 122 to have a local elevation 123 above the upper aperture 131 of the common gas channel 130. Under this local elevation 123, a limited flow rate for the propellant gas 134 is allowed, thus providing a substantial delay in the development of the first pressure in the liquid container 136.

As can be seen in Figure 15, which illustrates the second embodiment of the dispensing unit 110 with the operating lever 114 being in its first operating position, the slide 128 is moved to a position where it entirely closes the common gas channel 130. Similarly to the first embodiment of the dispensing unit (but not shown in Figure 15), in this position the operating lever 114 entirely opens the flexible dispensing tube of the dispensing unit 110.

Figure 16 illustrates the further embodiment of the dispensing unit 110 with the operating lever 114 being in a second operating position during dispensing where the inner end portion of the slide 128 at least partly opens the common gas channel 130 by allowing the main part of the membrane 122 to elevate above the upper aperture 131 of the common gas channel 130. In the second operating range of the operating lever 114, the common gas channel 130 is used only for controlling the pressure of the propellant gas in the liquid container 136 and thus also the flow rate of the liquid being dispensed.
As this embodiment of the dispensing unit 110 has no separate gas channel with a restricted section to feed propellant gas 134 from the gas container 133 into the liquid container 136, the relatively large flow area of the common gas channel 130 allows a rather quick development of the regulated first pressure in the liquid container 136 after finishing the dispensing of the liquid.

Fig. 18 shows an alternative embodiment of a beverage container 36, wherein the pressure regulating device 53 is suspended in the neck 51 of the container 36, part of the gas container 33 extending into the inner space of the body 52 of the beverage container 36. In this embodiment the pressure regulating device 53 is integrated with the dispensing device 10. The gas container 33 can rest on the free end 69 of the neck 51 by a flange 61. The dispensing device 10 is mounted on the neck 51, for example by press fitting or click means 40, such that the dispensing device 10 is pressed against the flange 61, thus pressing the flange 61 against the neck 51 and the gas container 33 is closed gas tightly. Suitable seals 38, 43 can be provided, if necessary.

A valve 62, for example an aerosol valve as described in EP1064221 is provided in a bottom 71 of the dispensing device 10, forming a connection between the inner space of the gas container 33 and the space 58 above the bottom 71, below the wall part 22, at which other side a pressure regulating chamber 63 is provided. The bottom 71 can be an integral part of the dispensing unit 10 or can be a separate part, which can for example be provided on the flange 61, for example by click means, gluing, welding, press fit or the like. At an opposite side of the space 58 a flexible wall part 22 of a pressure regulating means 54 is provided, resting against the valve 62, forming part of the wall of the pressure regulating chamber 63. If the pressure in the space 58 drops below a regulating pressure, the wall part 22 will be forced, by pressure in a pressure regulating chamber 63 above the wall 22, against the valve 62, opening the valve 62 and allowing gas to flow from the
gas container 33 into the space 58. At least one passage 25b is provided through the bottom 71 and the flange 61, into the inner space of the beverage container 36. Thus pressure equilibrium will exist substantially between the space 58 and the inner space of the beverage container 36. When the pressure in the beverage container 36 is back at the desired pressure, such as the equilibrium pressure, the wall part 22 will be pushed back and the valve 62 will close. The pressure regulating or control device 53 of all embodiments can be provided with a similar arrangement of chambers 58 and 63 and the intermediate wall part 22 for opening and/or closing the inlet channel 25a.

A dip tube 35 extends from the inner space of the beverage container 33 past the gas container 33 and through the flange 61 into the dispensing device 10. A dispense tube 63 is connected to the dip tube 35 by a valve 64, which in the embodiment shown can be a hose type valve, operatable by an arm 14 connected to an excenter 66. In fig. 18 the valve 64 is shown in closed position. By moving the arm 14 in the direction of the arrow 67 the valve 64 is opened and beverage can be expelled from the beverage container 36 through the dip tube 35 and the dispense tube 63. Pressure in the beverage container 36 will be regulated by the pressure regulating device 53, especially the means 54. Moving the arm 14 back then the valve 64 is closed again. Clearly other types of valves 64 can be provided, for example an in line valve. Other means for operating the valve 64 can be provided. In other embodiments the valve 64 can be dispensed with, where the dispense tube can be provided with or connected to a dispense unit or valve to cooperate with a valve unit of a dispense unit, as for example described in EP1289874.

In fig. 19 a further embodiment is shown of a beverage container 36, of which only an upper portion is shown, comprising a neck 51, on which a unit 10 is provided. A gas container 33 is provided outside the container 36, for example in a dent in the outer wall thereof, such that the longitudinal axis L_{gas} and L_{bottle} extend substantially parallel to each other. The gas container 33 is mounted in the unit 10, in any suitable manner, for example as disclosed
before in the other embodiments. Within the unit 10 a gas sensing chamber 58 and a gas regulating chamber 63 are again provided, as described before, separated by a deformable and/or displaceable wall or wall part 22. A gas inlet channel 25a extends from the gas container 33 into the pressure sensing chamber 58, through which a stem 23 extends, carrying a head 24 for closing off the channel 25a. The stem is connected to the wall part 22. In the unit 10 furthermore a dispense tube 16 is provided, extending from a dip tube 35 to an outlet end 19. The tube 16 is at least partly flexible, such that it can be closed by an excenter 66, as discussed with reference to fig. 18. A gas outlet channel 25b, 30 extends from the gas sensing chamber 58 to the inner space of the beverage container 36. This channel 25b, 30 has a relatively large cross section, preferably sufficient to allow, when fully open, an amount of gas to flow from the gas container and/or the gas sensing chamber 58 into the beverage container sufficient to restore substantially instantly a desired pressure inside the beverage container for dispensing beverage, during dispensing of the beverage at maximum flow. The channel 25b, 30 can have a cross section of for example half a square mm or more.

In the unit 10 an operating device 28 is provided, slidable in a channel 80 extending substantially perpendicular to the channel 25b, 30. A spring 81 is provided between a bottom 82 of the channel 80 and the device 28, biasing the device 28 in a direction outward from the channel 80. An opening 83 is provided in the device 28, substantially perpendicular to the direction of movement F, having a cross section similar to that of the channel 25b, 30. In a first position, as shown in fig. 19, the opening 83 will be open to the channel 25b, 30 only for a small part, preferably a very small part, for example such that the remaining passage through the channel 25b, 30 and opening 83 will be very small, for example well below 0.5 square mm, such that in this position a limited flow is possible from the chamber 58 to the beverage container 36, delaying pressure equilibrium during and/or after tapping beverage. By pushing the device 28 towards the closed end of the channel 80 the opening 83
will become more open to the channel 25b, 30, allowing for a greater flow of gas and thus a faster pressure raise in the beverage container 36.

In an alternative embodiment the operating device 28 and the operating means 14 for the beverage dispensing can again be integrated as shown before with for example reference to fig. 1 - 16, the gas container being positioned at least partly outside the container 36, as shown in fig. 19. Alternatively in all embodiments the gas container can be shaped and/or dimensioned differently and can for example be provided as a collar around the neck of the container, for example such that an outer side thereof will be about flush with or within the perimeter defined by the body of the beverage container.

In fig. 20 a further embodiment is schematically shown, wherein a beverage pressure control device is provided on a gas container 33, both of which are confined within the inner space of the beverage container 36, which is here shown as a keg or barrel type container, by way of example only. The pressure control device is mounted against an inner side of a lid 84 of the beverage container 36, the operating device 28 extending through the lid 84, such that it can be operated from outside the beverage container 36. The device 28 can for example be arranged similar to the device of fig. 19. A dispensing unit can be provided in the lid or in another position, and can for example comprise a valve, such as an aerosol valve as discussed before, provided in the lid 84 between a dip tube 35 and a dispensing channel 16.

Fig. 21 further discloses schematically an embodiment similar to the embodiment of e.g. fig. 9, wherein the gas container 33 is however of a different shape. In this embodiment the gas container 33 is provided at an upper portion of the beverage container 36, and is for example substantially ball shaped, donut shaped, dome shaped or the like, having a cross section $D_g$ substantially perpendicular to the longitudinal axis $L_{gas}$ and an axial length $Z$ parallel to said axis $L_{gas}$. In embodiments the cross section $D_g$ can be larger than an internal cross section $D_{neck}$ of the neck of the beverage container 36,
such that the gas container 33 cannot be pulled out of the beverage container 36 through the neck 51. In embodiments as disclosed a gas container 33 as shown in fig. 21 can be used having a cross section Dg substantially equal to for example at least half of the internal cross section Db body of the beverage container 36, preferably at least 3/4\textsuperscript{th} of said cross section Db and for example about the same cross section Db, such that the gas container 33 abuts the inside of the wall of the body and/or of a shoulder portion of the beverage container, for example directly below the neck 51. In embodiments the length Z of the gas container 33 can be less than half of the axial length L of the beverage container 36, preferably less than 1/4\textsuperscript{th} of said axial length L, for example about 1/5\textsuperscript{th} of said axial length. In embodiments the length Z is about minimal for providing sufficient volume in said gas container 33 for holding sufficient amounts of gas for dispensing the entire volume of beverage from the beverage container, at a desired maximum pressure of said gas in said gas container.

In embodiments of the present disclosure, for example with a gas container 33 as shown in fig. 21, the gas container can be a plastic container, which is injection moulded or otherwise formed as a preform, which is blown into a desired final shape at least partly within the beverage container, after at least partial insertion of the gas container into the container in the said form of a preform. The preform can be blow moulded at least partly prior to insertion into the beverage container, or can be blow moulded completely inside the beverage container. The blow moulding can be achieved at least partly by the pressure of the gas introduced into or formed inside the gas container 33. Especially when, as will be described hereafter, dry ice is used for providing at least part of the desired amount of pressure gas inside the gas container 33, this can be advantageous.

In embodiments of the present description the gas container 33 can be provided in a top half portion of the beverage container 36 when position with the neck 51 or at least the dispensing unit 10 at a top thereof. Preferably
the gas container 33 is provided about directly below the neck 51 and/or dispensing unit 10, in for example within an upper quart or upper fifth of the internal volume of the beverage container 36. This means that the volume of beverage comprised with the beverage container will be in the lower portion of the gas container, substantially or, preferably, about entirely below the gas container 33. This means that the centre of gravity G of the entire assembly, comprising the unit 10, the beverage container 36 with beverage and the gas container 33 will be shifted downward compared to its position when the gas container 33 is provided as shown in for example fig. 9, having a larger length and smaller cross section. This increases the stability of the assembly.

According to an aspect a method for providing a beverage container unit is described, wherein a beverage container 36 is filled with a beverage trough a filling opening, for example a neck portion 51. A gas container 33 is furthermore provided, comprising a predetermined amount of gas or gas generating means. This can for example be CO2 gas or dry ice, and is predetermined such that a pressure is build up in the gas container well above the dispensing pressure for the beverage, for example well above 2 bar, preferably above 4 bar absolute, such as for example but not limited to between 4 and 15 bar. The gas container can be mounted in the dispensing opening or neck portion 51 such that it extends into and through the filling opening into the inner space of the beverage container 36. This is preferably done after filling the beverage container with the beverage. A dispensing unit 10 is provided, comprising pressure regulating means 54, which dispensing unit 10 is mounted in and/or over the filling opening and is connected to the gas container 33.

In an embodiment the dispensing unit 10 can for example be any one the previously disclosed embodiments. It can be mounted after filling of the beverage container, wherein propellant gas under pressure is provided in the gas container. In an embodiment the gas container 33 can be mounted to the dispensing unit 10 separate from the beverage container 36 and placed on the
beverage container 36 as one unit. Alternatively the gas container can be suspended in or on the beverage container 36, for example but not limited to by said flange 61, where after the dispensing unit can be placed and coupled to the first and second coupling means. In such embodiment the gas can be fed into the gas container after placing in or on the beverage container 36.

In an aspect, the present invention also relates to a novel method of dispensing a liquid under pressure from a liquid container in which the liquid is stored under pressure by a propellant gas at a first regulated pressure. Preferably, in such method the first pressure exceeds the equilibrium pressure of the liquid, for example but not limited to by a few tenths bar. So as to provide the first regulated pressure in the liquid container, additional propellant gas is stored in a gas container at a second pressure substantially higher than the first pressure. The propellant gas stored in the second gas container is also used for controlling the flow rate of the liquid during dispensing.

In a method according to the invention, the dispensing can started by reducing the first pressure of the liquid container to a third pressure, wherein the third pressure is at least the ambient pressure. Depending on the design of the particular dispensing apparatus used for dispensing, the third pressure may be higher than the ambient pressure. After the overpressure of the liquid container is partly or wholly released, the dispensing path for the liquid is opened and the flow area of the entire dispensing path is settled. Opening of the dispensing path of the liquid may be carried out along an internal dispensing duct or at a dispensing outlet.

Finally, while keeping the settled flow area of the dispensing path for the liquid unchanged, the pressure of the propellant gas in the liquid container can be controlled within a pressure range defined by the first pressure and the ambient pressure, thereby dispensing a first amount of liquid. This first amount preferably corresponds to the entire dose of the liquid to be dispensed at one run. It is preferred that the overpressure prevailing in
the liquid container during dispensing does not exceed the ambient pressure by a few tenths bar, e.g. 0.1-0.2 bar, in order keep the flowing rate of the liquid at a rather low level and thereby not to allow excess frothing of the liquid.

Alternatively, the step of reducing the overpressure in the liquid container and the step of opening and settling the flow area of the dispensing path for the liquid may be executed simultaneously. In this case a second amount of liquid may additionally be dispensed in this step, but this second dispensed amount of liquid preferably is very limited. It is preferred that the second amount is smaller than 10 to 15% of the entire amount of liquid to be dispensed in one dose.

During dispensing, the dispensing pressure of the propellant gas in the liquid container can in embodiments of the invention preferably be controlled by controlling the flow rate of the propellant gas flowing from the gas container into the liquid container. For controlling the pressure in the liquid container during dispensing may, however, be carried out in other ways as well, for example by using an additional gas supply, optionally an external gas container, to provide the necessary amount of gas for this purpose.

Although in the foregoing, several preferred embodiments of the dispensing unit and the dispensing method according to the invention have been illustrated, the present invention is not in any way limited to the exemplary embodiments shown in the description and the drawings and many variations thereof are possible within the scope of the invention defined by the attached claims.

In particular, the single operating lever of the dispensing unit may be carried out by providing two independent operating levers or other operating means for each operating range mentioned above, i.e. a first operating lever for controlling the flow area of the dispensing path for the liquid and a second operating lever for controlling the flow area of the third gas channel (or the common gas channel) for the propellant gas. Moreover, instead of levers, any other kind of tool, such as a push button, a rotatable knob, etc.
may be used as an operating means for controlling the flow rate of the liquid. The slider element 28 can be simplified, for example be replaced by a resilient piece of plastic, which can be forced onto and/or from the membrane by the lever 14 for opening and/or closing the relevant channel(s), such as channel 30.

The pressure regulating means may also be designed differently from the exemplary pressure regulator described above with reference to the drawings, while providing the same function of generating a regulated first pressure in the liquid container. Such pressure regulating means are well-known in the art.

The dispensing unit 10 could be designed to fit within a neck portion of a beverage container, or could at least partly be integrated with a beverage container. The beverage container could be of a bag in container design, wherein the beverage can be contained within a flexible bag suspended in the beverage container, for example connected to the dispensing device 10, surrounding the second mounting means, which can contain the gas container 33, wherein the second channel 25b, 30, 130 opens into a space between the bag and the beverage container. The dispense tube 64 or 19 can be elongated and extended well beyond the periphery of the beverage container, and can be provided with an in line valve or the like.

These and many other variants, including but not limited to all combinations of parts of embodiments described and discussed, are considered to have been disclosed herein and fall within the scope of the present disclosure and/or claims as appending to this description.
Claims

1. A beverage pressure control device, comprising a pressure regulating chamber (63) and a pressure sensing chamber (58), separated by a movable or deformable wall part (22), wherein at least one gas inlet channel (25a) is provided for feeding gas under pressure into the pressure sensing chamber (58) and at least one gas outlet channel (30) for feeding gas from the gas sensing chamber (58), wherein the gas inlet channel (25a) can be closed by a valve (24), (62) operated by the movable or deformable wall part (22), depending on a pressure difference over said movable or deformable wall part (22), wherein an operating device (28, 128) is provided for regulating the flow through the at least one outlet channel (30).

2. A beverage pressure control device of claim 1, wherein the operating device is designed to regulate the flow between a minimum flow rate and a maximum flow rate, wherein the minimum flow rate is preferably substantially lower than the flow rate of the gas inlet channel when fully open and preferably just above zero.

3. A beverage pressure control device of claim 1 or 2, wherein there are at least two outlet passages, wherein the operating device is provided for regulating the flow rate of a first of the at least two outlet passages, wherein preferably the other of the at least two outlet passages has a flow rate substantially smaller than the flow rate of the first of the two outlet passages, when fully opened.

4. A beverage pressure control device according to claim 3, wherein the flow rate of the first of the outlet passages can at least be set at substantially zero and/or at a flow rate substantially equal to the flow rate of the inlet channel, when fully opened.

5. A beverage pressure control device according to any one of the preceding claims, integrated with a beverage dispensing unit.
6. A beverage pressure control device according to any one of the preceding claims, wherein the operating device is connected to and/or integrated with an operating means of a beverage dispensing unit.

7. A beverage pressure control device according to any one of the preceding claims, wherein the movable or deformable wall part is made at least partly of a plastic or rubber material.

8. A beverage pressure control device according any one of the preceding claims, comprising a first and second outlet channel forming at least part of a first and second fluid communication path for the propellant gas between a gas container and a liquid container, the operating device being adapted to control the flow rate of the propellant gas flowing through said second fluid communication path from the gas container into the liquid container, and the first fluid communication path being adapted to provide a substantial delay in generating the first pressure in the liquid container, wherein preferably the fluid communication path is formed so as to provide at least a few minutes delay in the generation of a first pressure in the liquid container, such that substantially a pressure equilibrium is provided over said first communication path.

9. A beverage pressure control device according to claim 6, wherein the operating means of the dispensing unit and the second operating device are integrated into a single control mechanism having a first operating range to provide the function of the operating means of the beverage dispensing unit and a second operating range to provide the function of the operating device.

10. A beverage pressure control unit according to claim 6 or 9, wherein an external end portion of the beverage dispensing path comprises a flexible tube and the operating means of the beverage dispenser is adapted to control the flow rate of the liquid by adjusting the flow area of the flexible tube by the compression thereof.

11. A method for dispensing a liquid under pressure, wherein the liquid is stored in a liquid container with a propellant gas at a first regulated
pressure, and additional propellant gas is stored in a gas container at a second pressure substantially higher than the first pressure, and the liquid is dispensed by means of a dispensing unit coupled to said liquid container and said gas container, the method comprising the steps of:

a) reducing the first pressure of the liquid container to a third pressure, wherein the third pressure is at least the ambient pressure,

b) opening a liquid dispensing path of the dispensing unit and settling the flow area of said liquid dispensing path, and
c) while keeping the adjusted flow area of the liquid dispensing path unchanged, controlling the dispensing pressure of the propellant gas in the liquid container within a pressure range defined by the first pressure and the ambient pressure, thereby dispensing a first amount of liquid.

12. The method of dispensing a liquid according to claim 11, wherein the dispensing pressure of the propellant gas in the liquid container is controlled by controlling the flow rate of the propellant gas flowing from the gas container into the liquid container, wherein the step of reducing the first pressure to the third pressure and the step of opening the liquid dispensing path are preferably performed simultaneously, thereby dispensing a second amount of liquid, said second amount being substantially less than said first amount.

13. A beverage container, comprising a beverage pressure control device according to any one of claims 1 - 10 or for performing a method of claim 11 or 12.

14. A dispensing unit for dispensing a liquid under pressure, the dispensing unit comprising a first coupling means for coupling to a liquid container, and a pressure regulating means comprising a pressure control device according to any one of claims 1 - 10, the pressure regulating means having a second coupling means for coupling to a gas container.

15. A dispensing unit according to claim 14, wherein the first coupling means is for coupling to a liquid container adapted to store the liquid to be
dispensed and a propellant gas at a first pressure, and the second coupling means for coupling to a gas container adapted to store propellant gas at a second pressure substantially higher than said first pressure.
## INTERNATIONAL SEARCH REPORT

### A. CLASSIFICATION OF SUBJECT MATTER

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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)

- B65D
- B67D
- G01F

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 practical, search terms used)
  - EPO-Internal, WPI Data

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

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### Date of the actual completion of the international search

26 August 2011

### Date of mailing of the international search report

02/09/2011

### 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

Schork, Willi
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