



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.06.2009 Bulletin 2009/25

(51) Int Cl.:
B01F 3/04 (2006.01) **B01F 5/04** (2006.01)
A23L 2/54 (2006.01) **B67D 1/00** (2006.01)
F25D 23/12 (2006.01)

(21) Application number: **07023987.6**

(22) Date of filing: **11.12.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
 Designated Extension States:
AL BA HR MK RS

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(54) **Beverage dispenser**

(57) A beverage dispenser comprising a liquid beverage supply line (2) fluidly connected to a water source (3), a gas supply line (4) fluidly connected to a pressurized gas source (5), at least one mixing device (6) for mixing the gas with the liquid beverage, at least one inlet port (7) fluidly connecting the gas supply line (4) to the liquid beverage supply line (2) or to the mixing device (6)

for introducing the gas into the liquid beverage, a dispenser point (8) for dispensing liquid beverage mixed with gas, the flow cross-section dimension of said inlet port (7) is such that fluid resistance is generated for reducing the velocity of the gas flow entering into the liquid beverage supply line (2) or into the mixing device (6) to a predetermined value.

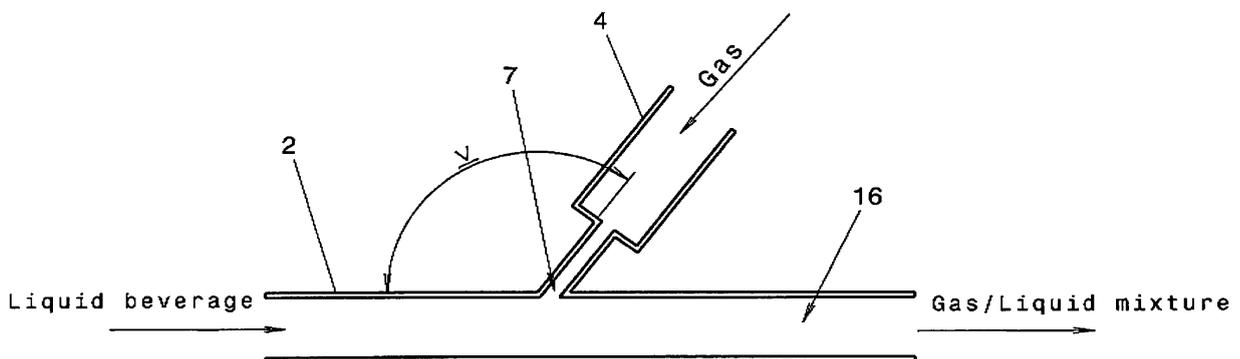


Fig. 3

Description

[0001] The present invention concerns a beverage dispenser provided with a water/liquid beverage carbonation system and an appliance comprising such a dispenser.

There are various carbonation systems known in the art, which permits the production of carbonate water on a demand basis.

Commonly on demand systems utilize specialized apparatus, so called in-line carbonator (where the carbonation is carried out at the time of dispensing the beverage), for combining water and carbon dioxide (CO₂) (or any other gas, for example oxygen or to enhance the mixing and/or area of contact there between.

[0002] US 6,060,092 discloses a device for carbonation of drinking water in a continuous in-line process comprising a water supply line provided with a pressurizing pump adapted to feed an injector nozzle which projects into a mixing tube fluidly connected to a CO₂ supply line having a predetermined low working pressure, into which CO₂ is sucked and then mixed with the water. Because of the high intake pressure of the injector the flow velocity of the water in the injector nozzle is increased so greatly that CO₂ is sucked in by the reduced pressure that results at the end of the nozzle and is delivered under turbulence conditions into the mixing tube.

This in-line carbonator is extremely complex. It requires high pressure in the water supply line and low pressure in the CO₂ supply line and most of all a predetermined difference between such pressures is needed in order to ensure the effective operation of the carbonator. Hence the right pressures balance has to be maintained during the usage of the system.

[0003] WO 98/47812 discloses a water carbonation system comprising a source of pressurized CO₂ connected to a gas line having a flow restrictor adapted to deliver CO₂ at a predetermined pressure above that of the water to a T-fitting. A pump is connected to a source of potable water and serves to pump the water along the water line to the T-fitting. The CO₂ and water are initially mixed at the T-fitting and flow therefrom through an in-line carbonator and along the carbonated water line to the dispenser point.

[0004] Other on demand system, as disclosed in WO 2005/105279 and WO 2006/114086, utilize in-line carbonator comprising structures filled with bulky material to enhance the mixing between CO₂ and water.

[0005] A drawback of these carbonation systems is that at the liquid/gas mixing point a predetermined and precise gas working pressure value is required with respect to the liquid working pressure value for effectively introducing the gas into the liquid.

In practise, the carbonation system has to supply the gas to the liquid/gas mixing point with a determined pressure value according to the pressure value of the liquid which is delivered to liquid/gas mixing point.

For this reasons, the CO₂ supply line of these carbonation

systems include check valve arranged upstream the liquid/gas mixing point for controlling and precisely adjusting the pressure value of the gas upon the installation of the carbonation system and for maintaining such a pressure value constant during usage of the latter. Therefore these carbonation systems are poorly flexible and need a continuous adjustment.

[0006] A further drawback of these carbonation systems is that a high liquid pressure value is needed at the liquid/gas mixing point for achieving a satisfactory level of carbonation. Therefore the liquid supply line must include a pressurizing or booster pump arranged upstream the liquid/gas mixing point in order to increase the pressure value of the liquid to be carbonated.

[0007] It is clear that all these pressure requirements make these carbonation systems complex and costly.

In addition, the components, which have to be used in order to comply with the above-mentioned pressure requirements (pumps and regulation valves), make these carbonation systems unreliable and subject to malfunctions.

[0008] It is therefore a main object of the present invention to provide a beverage dispenser, which is effective in reducing the above-noted drawbacks of the cited prior art.

[0009] According to the present invention, this aim, along with further ones that will become apparent in the following disclosure, is reached by a beverage dispenser incorporating the features and characteristics as defined and recited in the claims appended hereto.

[0010] Features and advantages of the present invention will anyway be more readily understood from the description that is given below by way of nonlimiting example with reference to the accompanying drawings, in which:

- Figure 1 is a schematic view of a beverage dispenser according to the present invention;
- Figure 2 is a schematic view of a beverage dispenser according to further embodiment the present invention;
- Figure 3 is an enlarged sectional view of the carbonation inlet port of figure 1;
- Figure 4 is an enlarged sectional view of the carbonation inlet port of figure 2;
- Figure 5 is a graph showing the CO₂ concentration of the dispensed liquid beverage in function of the CO₂ working pressure value in bar with and without the carbonation inlet port of figure 1 and 3;
- Figure 6 is a graph showing the CO₂ concentration of the dispensed liquid beverage in function of the CO₂ working pressure value in bar with and without the carbonation inlet port of figure 2 and 4;

[0011] With reference to the above-cited Figures, the beverage dispenser, as generally indicated with the reference numeral 1, comprises a liquid beverage supply line 2 fluidly connected to a water source 3, a carbon dioxide supply line 4 fluidly connected to a pressurized carbon dioxide source 5, at least one mixing device 6 for carbonating the liquid beverage, at least one carbonation inlet port 7 fluidly connecting the carbon dioxide supply line 4 to the liquid beverage supply line 2 or to the mixing device 6 for introducing carbon dioxide into the liquid beverage, a dispenser point 8 for dispensing the carbonated liquid beverage.

[0012] The carbonation inlet port 7 has reduced flow cross-section for generating frictional resistance adapted to reduce the velocity of the carbon dioxide flow entering into the liquid beverage supply line 2 or into the mixing device 6 to a predetermined value.

[0013] The liquid beverage supply line 2 of the beverage dispenser can be connected directly to the water supply mains (for example the municipal water supply mains) through a suitable connection or alternatively the water source 3 can be in the form of a pressurized tank. Normal building water pressure is sufficient

[0014] The liquid beverage supply line 2 provides for connecting the water source 3 to a water pressure reducer 9 which is adapted to reduce the water pressure to a specified working pressure value, for example of 2 to 3 bar, in order to have the same starting conditions for the processing procedure independent of the pressure value of the water supply mains.

[0015] In practice, the water pressure reducer 9 renders the pressure value of the incoming water constant so as to avoid the problems connected to the pressure value fluctuations which normally affect the municipal water supply mains.

[0016] It can however be most readily appreciated that in case the water is supplied via a pressurized tank, there is no need for a pressure reducer, since the pressurized tank is adapted to feed the liquid beverage supply line with water having a constant pressure value, for example of 2 to 3 bar, as in the aforementioned embodiment including the pressure reducer fluidly connected to the municipal water supply mains.

[0017] Expediently, but not necessarily, a cooling unit 10 is provided to cool down the liquid beverage to be carbonated or the carbonated beverage to be dispensed.

[0018] Preferably, the cooling unit 10 is fluidly connected to the water source 3 via the liquid beverage supply line 2 and it is provided upstream the carbonation inlet port 7 in order to decrease the temperature of the liquid beverage in order to enhance the amount of carbon dioxide that can be dissolved in the liquid beverage. As is known, lower temperature enhance the ability of water to absorb carbon dioxide.

[0019] The cooling unit 10 can be a compression cooling system operating in a known manner, namely with compressor, evaporator, and condenser, Alternatively a Peltier cooling system or other known cooling system

can be used.

[0020] Further, the liquid beverage supply line 2 can comprise at least one filter device for filtering the liquid beverage to be delivered to the carbonation inlet port 7.

[0021] Preferably, a non-return valve 11 is provided in the liquid beverage supply line 2 just upstream the carbonation inlet port 7, where the carbon dioxide is introduced into the liquid beverage, in order to prevent liquid beverage flowing back towards the cooling unit 10,

[0022] The carbon dioxide supply line 4 extends from the pressurized CO₂ source 5 to the carbonation inlet port 7 and it comprises a CO₂ pressure reducer 12 for reducing the pressure of the gas flowing through the carbon dioxide supply line 4 below an upper limit, for example 7 bar in order to ensure safety working conditions of the beverage dispenser according to the present invention.

[0023] The carbon dioxide supply line 4 comprises an electro-valve 13 arranged downstream the CO₂ pressure reducer 12 and adapted to fluidly connects, selectively, the CO₂ pressurized source 5 to the carbonation inlet port 7 in order to produce carbonated liquid beverage when it is required. Advantageously the electro-valve 13 is adapted to control and adjust the amount of CO₂ to be supplied to the carbonation inlet port 7 so that the CO₂ content of the liquid beverage to be dispensed can be varied according to the desired level selected by the user.

[0024] Preferably, a non-return valve 14 is provided in the carbon dioxide supply line 4 between the electro-valve 13 and the carbonation inlet port 7 for preventing CO₂ flowing back to the electro-valve 13.

[0025] In the embodiments being described here to mere exemplary purposes, the water working pressure, downstream the water pressure reducer 9, has a value of 1.5 to 3 bar depending on the intake pressure available from of the urban water supply mains, which in some country can be particularly low, around 2 bar.

[0026] In this connection, the pressurized tank simply ensures that slightly pressurized water at 1.5 to 3 bar, as in the case the liquid beverage supply line 4 is directly connected to the water supply mains, is delivered to the liquid/mixing point wherein carbonation takes place. In fact, for the carbonation to be carried out with better results (high carbonation level) a water pressure value slightly higher than the atmospheric pressure value would be preferable.

As regards the carbon dioxide side, in the embodiment being described here to mere exemplary purposes, the working pressure value of the CO₂ gas can vary in a range of 2 to 7 bar.

[0027] The beverage dispenser according to the present invention includes at least one liquid/gas mixing section 15 wherein the carbon dioxide is mixed with the liquid beverage. In particular the carbon dioxide supply line 4 comprises a carbonation inlet port 7 which is adapted to supply the CO₂ flow to the liquid/gas mixing section 15 for the carbonation to be carried out.

[0028] In a first configuration of the present invention

(see figure 1 and 3) the liquid/gas mixing section 15 comprises a junction point where the carbon dioxide supply line 4 fluidly intercepts or joints into the liquid beverage supply line 2 via the carbonation inlet port 7 in order to enable the CO₂ to be introduced into the liquid beverage supply line 2 and thereby to be mixed with the liquid beverage.

Further, the liquid/gas mixing section 15 comprises a mixing device 6 to be fed with the liquid/gas mixture emerging from the junction point in order to complete the absorption of CO₂ and then increase the final carbonation level.

[0029] In practise the junction point acts as a three-way connector where the carbon dioxide flow and the liquid beverage flow joint into and the resulting mixing flow is delivered to the mixing device 6.

[0030] In a second configuration of the present invention (see figure 2 and 4) the liquid/gas mixing section 15 comprises a mixing device 6 fluidly connected to the liquid beverage supply line 2 via a suitable connection fitting and to the carbon dioxide supply line 4 via the carbonation inlet port 7, which is adapted to introduce carbon dioxide directly into the mixing device 6.

[0031] The flow cross-section of the carbonation inlet port 7 has diameter dimension chosen, after exhaustive test runs, so that fluid frictional resistance is generated (when the CO₂ flows) which is adapted to reduce the velocity of the carbon dioxide flow passing through the carbonation inlet port 7 and entering into the liquid beverage supply line 2 or into the mixing device 7.

In practise, the fluid frictional force tends to lower the speed of the CO₂ flow to a reduced predetermined value, which is a value substantially constant, quite independently of the pressure value of the carbon dioxide passing through the carbonation inlet port 7.

[0032] In addition, increasing the length (i.e. the longitudinal extension perpendicular to the inlet port cross-section) of the reduced carbonation inlet port 7 will further decrease the amount of gas allowed to pass at each moment

[0033] Therefore the carbon dioxide working pressure value can vary widely during the operation of the beverage dispenser without affecting the velocity of the CO₂ flow entering into the liquid beverage supply line 2 or into the mixing device 6.

[0034] The reduced velocity of the CO₂ flow enables the gas to effectively mix with the liquid beverage so as to maximize the carbon dioxide absorption inside the mixing device.

In this way it is possible to achieve a high carbonation level in spite of carbon dioxide working pressure value does not remain constant during the usage or operation of the beverage dispenser or even if it varies in a wide, broad range and further even if the carbon dioxide working pressure has not been set correctly during the installation of beverage dispenser according to the present invention or due to component variation or change.

[0035] In other word there is no need to accurately control or adjust the CO₂ working pressure upon installation

or during usage of the beverage dispenser.

[0036] It has been found that fluid frictional resistance adapted to lower the velocity of the carbon dioxide flow is generated by using a carbonation inlet port having a diameter of about 0.1 to about 0.9 mm.

[0037] Better results can be achieved for a carbonation inlet port provided with a diameter varying in a range of about 0.3 to about 0.5 mm,

[0038] For both the aforementioned configurations the carbon dioxide supply line 4 is comprised of a conduit having an internal diameter less than 20 mm and a preferred diameter range of 6 to 8 mm. It can however be most readily appreciated that the above diameter dimensions of the carbon dioxide supply line 4 upstream the carbon inlet port 7 serves only to optimize and maximize the fluid frictional resistance effect determined by the restriction of the carbonation inlet port 7.

[0039] It is well known that according to the Bernoulli theorem of compressible fluids that the decreasing of the internal diameter of a port causes the increasing of the velocity of the fluid flowing through it.

However it has been experienced that below a certain diameter dimension, the frictional resistance generated by the internal wall, surfaces of the port are so high as to reduce the velocity of the flow and as described above such a velocity is substantially constant despite of pressure of the fluid (at least for a given range of pressure). This is called choked flow

[0040] Clearly there is a lower limit of the diameter dimension below which the fluid is prevented to pass through the port at all, only an extremely high working pressure would force the fluid to flow.

[0041] As regards the first configuration of the present invention, wherein the carbon dioxide supply line 4 fluidly intercepts or joints into the liquid beverage supply line 2 via the carbonation inlet port 7 and the mixing device is fed with the liquid/gas mixture emerging from the junction point, a series of tests has been performed leading to the graph shown in fig. 5 where the Y-axis depicts the CO₂ concentration of the dispensed liquid beverage in gram per liter and X-axis depicts the CO₂ working pressure value in bar (the experimental point of the graph are obtained for a working water pressure of 2 bar).

It is clear that with a conventional carbonation inlet port (2-6 mm) effective carbonation (in order to produce complete sparkling beverage) can be achieved only if the CO₂ working pressure value is around 1.7-2 bar, outside such a range the CO₂ concentration rapidly drops below 5 g/l.

On the other hand by utilizing a carbonation inlet port having an internal diameter of around 0.4 mm, the CO₂ concentration remains above 5 g/l for a CO₂ working pressure of 2 to 3.7 bar and above 5,5 g/l for a CO₂ working pressure of 2,3 to 3.2 bar

Further by utilizing a carbonation inlet port having an internal diameter of around 0,3 mm, the CO₂ concentration remains above 5 g/l for a CO₂ working pressure of 3 to 6 bar.

It can be fully appreciated that the present invention enables the CO₂ working pressure to vary within a broad range without adversely affecting the final CO₂ concentration of the dispensed beverage and hence no adjustment of the CO₂ working pressure value is required.

[0042] In addition, according to a preferred embodiment of the present invention the carbon dioxide supply line 4 and the liquid beverage supply line 2 are reciprocally arranged so that the gas flow, entering into the liquid beverage supply line 2 through the carbonation inlet port 7, has at least a vectorial component of the velocity vector oriented in the opposite direction of the liquid flow in order to enhance the turbulence and thereby the liquid/gas contact surface.

In particular, at the carbonation inlet port 7 the carbon dioxide supply line 4 and the liquid beverage supply line 2 form an angle V of 90° to 180° and preferably of about 135°.

[0043] The liquid/gas mixture emerging upstream from the carbonation inlet port 7 is then supplied to the mixing device 6 via a suitable fitting 15.

A carbonated beverage supply line 17 fluidly connects the mixing device 6 to the dispenser point 8.

The dispenser point 8 includes an outlet valve 18 for dispensing the carbonated beverage. Operation of the outlet valve 18 causes the simultaneous opening of the electro-valve 13.

Optionally a compensator can be provided in correspondence to the dispenser point 8 so that the carbonated beverage can be issued with a pleasant jet.

[0044] As regards the second configuration of the present invention, wherein the carbon dioxide supply line 4 is fluidly connected directly to the mixing device 6 through the carbonation inlet port 7, which is adapted to introduce carbon dioxide directly into the mixing device, a series of tests has been performed leading to the graph shown in fig. 6 where the Y-axis depicts the CO₂ concentration of the dispensed beverage in gram per liter and further the flow rate of the dispensed liquid in liter per minute, the X-axis depicts the CO₂ working pressure value in bar (the experimental point of the graph are obtained for a working water pressure of 2 bar).

[0045] By utilizing a conventional carbonation inlet port (2-6 mm) the CO₂ concentration remains above 5.5 g/l for a CO₂ working pressure of 3.7 to 4.7 bar. However as it is shown in the lower portion of the graph, the flow rate of the dispensed liquid rapidly decreases when the CO₂ working pressure exceeds 4 bar and above 4.7 bar the flow rate is extremely low.

By utilizing a carbonation inlet port having an internal diameter of around 0.4 mm, the CO₂ concentration remains above 5.5 g/l for a CO₂ working pressure of 4.2 to 7, whereas the flow rate starts to slightly decrease when the CO₂ working pressure is above 5.5 and up to 7 bar CO₂ working pressure the flow rate is still sufficiently high for the beverage dispenser to operate in an effective manner.

[0046] It can be fully appreciated again that the present

invention enables the CO₂ working pressure to vary within a broad range without adversely affecting the final CO₂ concentration of the dispensed beverage and hence no adjustment of the CO₂ working pressure value is required.

[0047] The mixing device 6 can comprise any turbulating structures adapted to produce the largest possible CO₂/liquid contact surface in order to facilitate the absorption of CO₂.

In case of the first configuration according to the present invention the turbulating structures are adapted to mix the flow of carbonated liquid beverage and free CO₂ to enhance further combination thereof.

In a preferred embodiment the mixing device 6 comprises a rotor having a plurality of blades and adapted to rotate inside a chamber.

According to the first or to the second configuration of the present invention, the liquid /gas mixture or the flat liquid beverage flow entering into the chamber cause the rotor to be driven into rotation in order to carry out carbonation.

In a further preferred embodiment the mixing device comprises a positive displacement pump and in particular a diaphragm pump or a gear pump which has been found to be adapted to effectively carry out the carbonation process.

It can be easily appreciated that in case of the last described embodiment, operation of the outlet valve 17 causes the simultaneous opening of the electro-valve 13 and operating of the positive displacement pump.

[0048] It has to be stressed that according to the present invention, the liquid beverage working pressure, downstream the water pressure reducer 9, can also be higher than 3 bar, in some country, in fact, the intake pressure available from the municipal water supply mains is around 4-5 bar and also near 6 bar.

The extreme values of the CO₂ working pressure range are determined by the fact that below 2 bar, extremely low or no liquid/gas mixing at all occurs, whereas above 7 bar the liquid beverage is prevented to reach the liquid/gas section 15 and thereby the carbonation inlet port 7.

[0049] According to the present invention, the water working pressure value can be higher or lower than the CO₂ working pressure value in correspondence to the carbonation inlet port 7 depending on the nozzle dimensions, the hydraulic characteristic of the fluid circuit and of the in-line carbonator.

[0050] Optionally, the beverage dispenser according to the present invention can be in the form of a post-mix dispenser adapted to mix syrup or concentrate to the flat or carbonated water to produce beverage of different flavour wherein the mixing is carried out at the time of dispensing. For this purpose, the beverage dispenser comprises a plurality of reservoirs containing syrups or concentrates to be mixed with water. The concentrate reservoirs can be fluidly connected to the liquid beverage supply line 2 or to the carbonated beverage supply line

17 in order to introduce the concentrate into the flat water, i.e. upstream the liquid/gas section 15, or into the carbonated water, i.e. downstream the liquid/gas section 15.

[0051] The beverage dispenser according to the present invention can be used in any beverage dispensing apparatus and preferably in home appliances, in particular refrigerators, built-in units, beverage centre as well as in free standing devices.

[0052] The beverage dispenser according to the present invention provides a carbonation system utilizing few, simple and low cost components, which do not need particular requirements about adjustment, operation and maintenance.

Conclusively, it can therefore be stated that the carbonation system provided in the beverage dispenser according to the present invention is fully effective in solving the drawbacks connected with prior-art systems in a simple manner.

Claims

1. A beverage dispenser comprising
 - a liquid beverage supply line (2) fluidly connected to a water source (3),
 - a gas supply line (4) fluidly connected to a pressurized gas source (5),
 - at least one mixing device (6) for mixing the gas with the liquid beverage,
 - at least one inlet port (7) fluidly connecting the gas supply line (4) to the liquid beverage supply line (2) or to the mixing device (6) for introducing the gas into the liquid beverage,
 - a dispenser point (8) for dispensing the liquid beverage mixed with gas, **characterized in that** the flow cross-section dimension of said inlet port (7) is such that fluid resistance is generated for reducing the velocity of the gas flow entering into the liquid beverage supply line (2) or into the mixing device (6) to a predetermined value.
2. A beverage dispenser according to claim 1, wherein said inlet port (7) has a flow cross-section diameter of about 0.1 to about 0.9 mm.
3. A beverage dispenser according to claim 1 or 2, wherein said inlet port (7) has a flow cross-section diameter of about 0.3 to about 0.5 mm.
4. A beverage dispenser according to claim 3, wherein said mixing device (6) is adapted to be fed with the liquid/gas mixture emerging from a junction point where the gas supply line (4) joints into or fluidly intercepts the liquid beverage supply line (2) via the inlet port 7.
5. A beverage dispenser according to claim 4, wherein the gas supply line (4) and the liquid beverage supply line (2) are reciprocally arranged so that the gas flow, entering into the liquid beverage supply line (2) through the inlet port (7), has at least a vectorial component of the velocity vector oriented in the opposite direction of the liquid beverage flow in order to enhance the turbulence and thereby the liquid/gas contact surface,
6. A beverage dispenser according to claim 5, wherein at the inlet port (7) the gas supply line (4) and the liquid beverage supply line (2) form an angle V of 90° to 180° and preferably of about 135° .
7. A beverage dispenser according to claim 3, wherein said mixing device (6) is fluidly connected to the liquid beverage supply line (2) via a liquid beverage connection and to the gas supply line (4) via the inlet port (7), which is adapted to introduce gas directly into the mixing device (6).
8. A beverage dispenser according to any of the preceding claims, wherein said mixing device (6) comprises a rotor having a plurality of blades and adapted to be driven into rotation inside a chamber by the liquid beverage flow or by the liquid/gas mixture entering into the chamber.
9. A beverage dispenser according to any of the preceding claims, wherein said mixing device (6) comprises a positive displacement pump and in particular a diaphragm pump or a gear pump.
10. A beverage dispenser according to any of the preceding claims, wherein the working pressure value of the liquid beverage into which the gas is to be introduced is of 1.5 to 7 bar.
11. A beverage dispenser according to any of the preceding claims, wherein the working pressure value of the gas to be supplied to the inlet port (7) is of 2 to 7 bar.
12. A beverage dispenser according to any of the preceding claims, wherein said liquid beverage supply line (2) is connected to the municipal water supply mains or alternatively the water source (3) is a pressurized tank.
13. A beverage dispenser according to any of the preceding claims, wherein a cooling unit (10) is provided to cool down the liquid beverage in which the gas is to be introduced or the liquid beverage mixed with gas to be dispensed,
14. A beverage dispenser according to any of the preceding claims, wherein the gas supply line (4) comprises an electro-valve (13) adapted to fluidly con-

nect, selectively, the gas pressurized source (5) to the inlet port (7), said the electro-valve (13) is adapted to control and adjust the amount of gas to be supplied to the inlet port (7) so that the gas content of the liquid beverage to be dispensed can be varied according to a level to be selected by a user. 5

15. A beverage dispenser according to any of the preceding claims, comprising a post-mix dispenser adapted to introduce syrup or concentrate into the flat water upstream the mixing device (6), or into the water mixed with gas downstream the mixing device (6). 10
16. A beverage dispenser according to any of the preceding claims, wherein said gas is carbon dioxide gas. 15
17. A refrigerator comprising a beverage dispenser according to any of the preceding claims. 20

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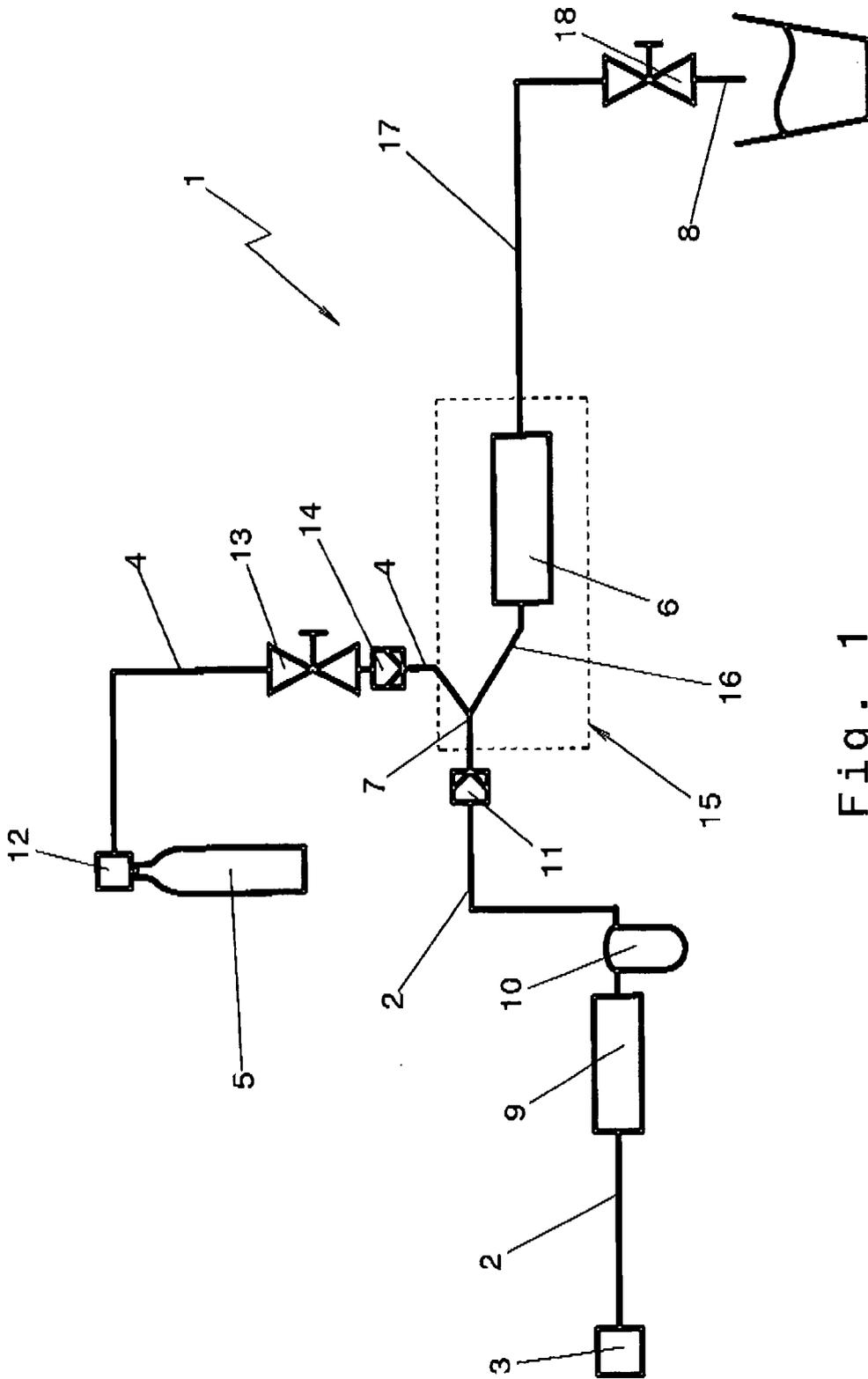


Fig. 1

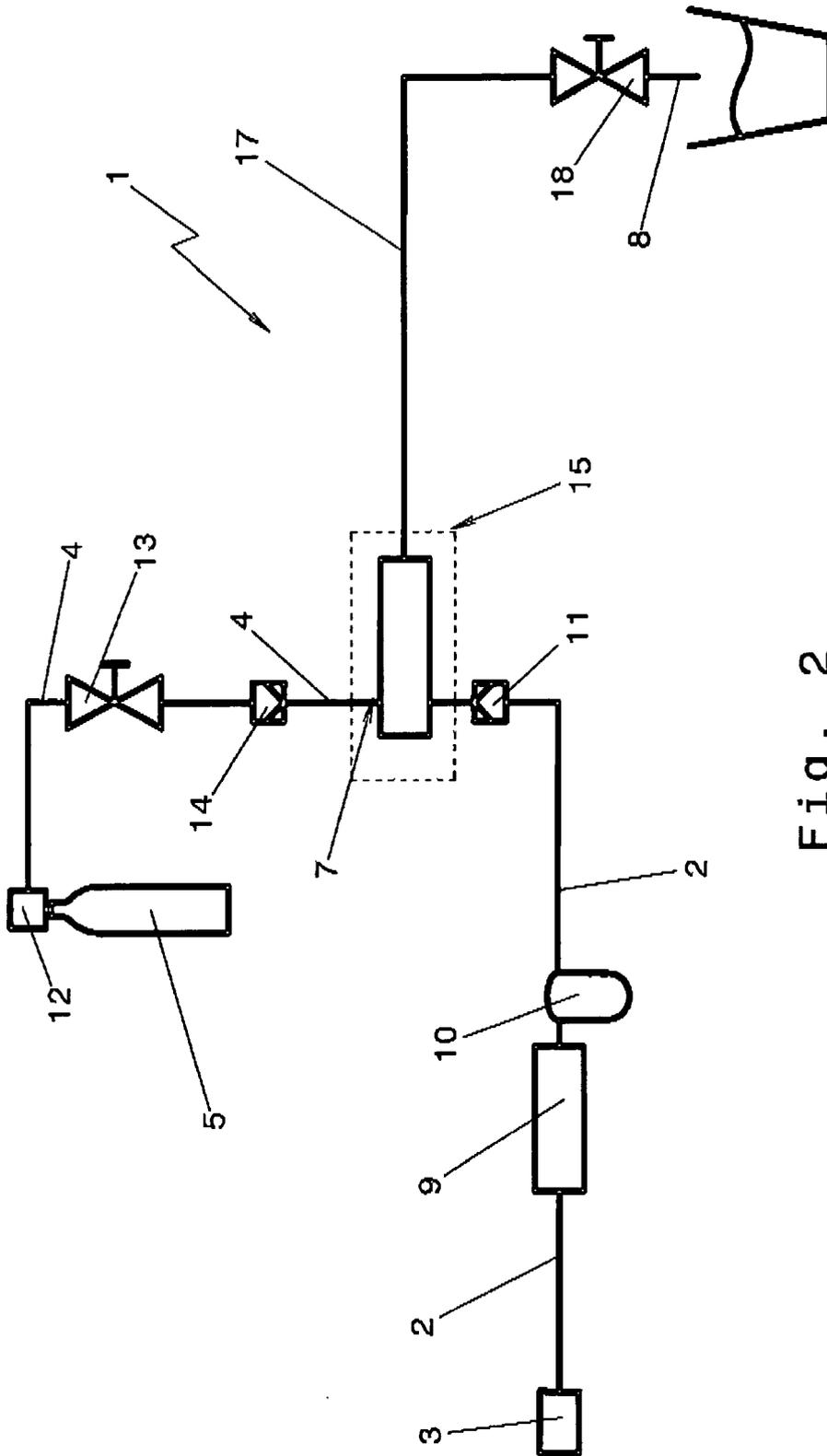


Fig. 2

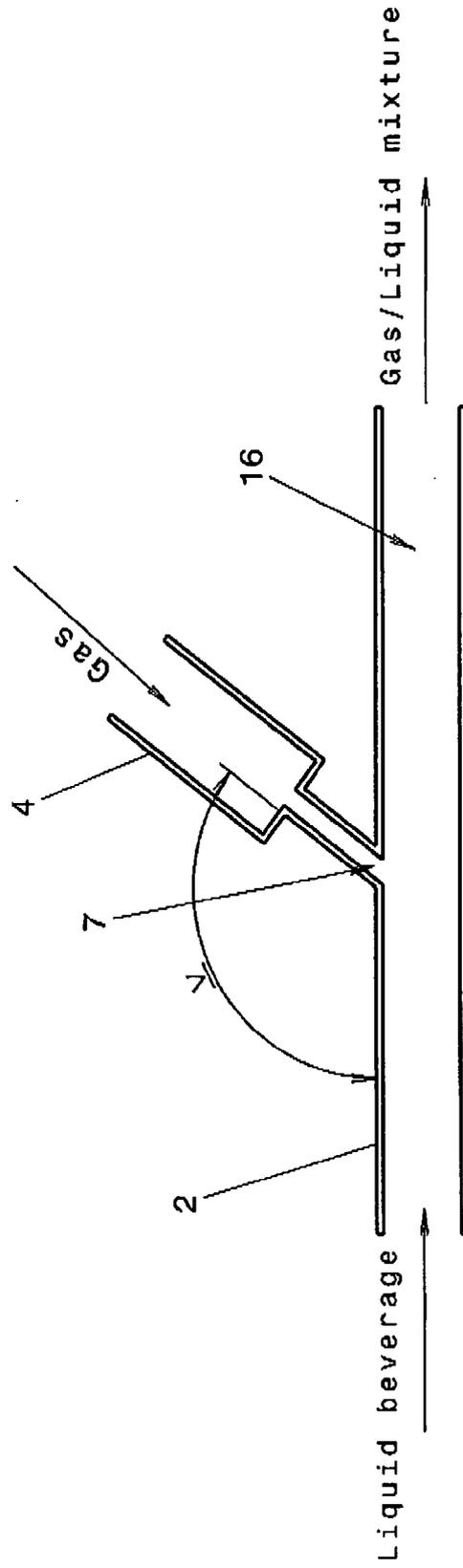


Fig. 3

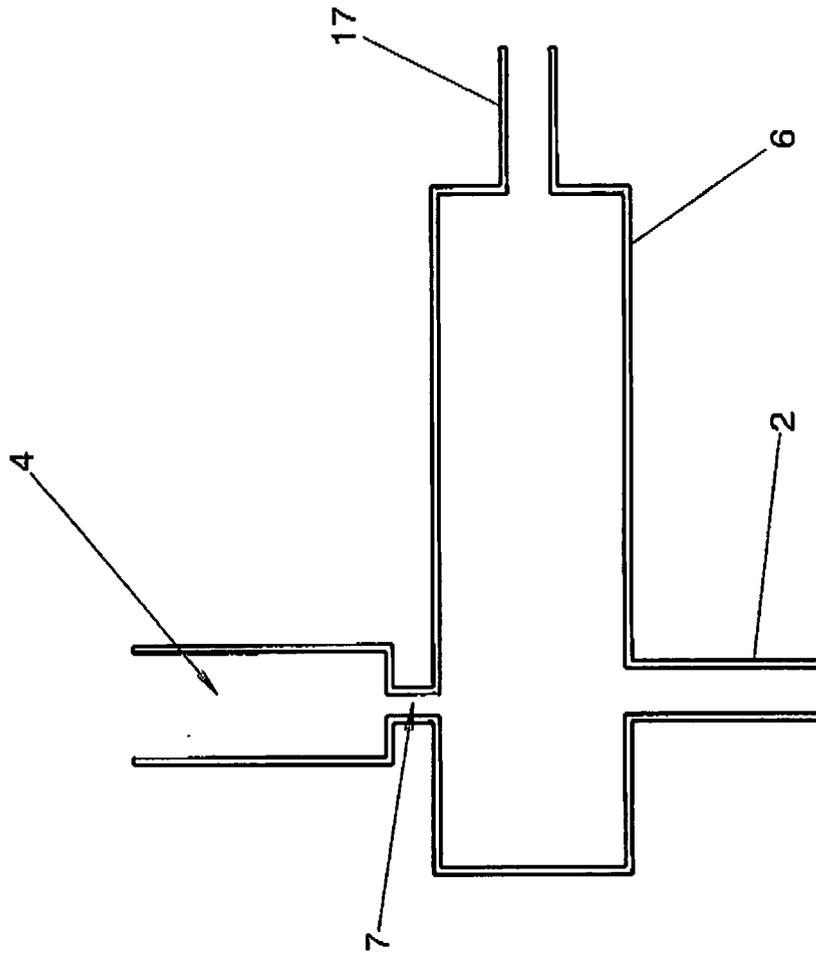


Fig. 4

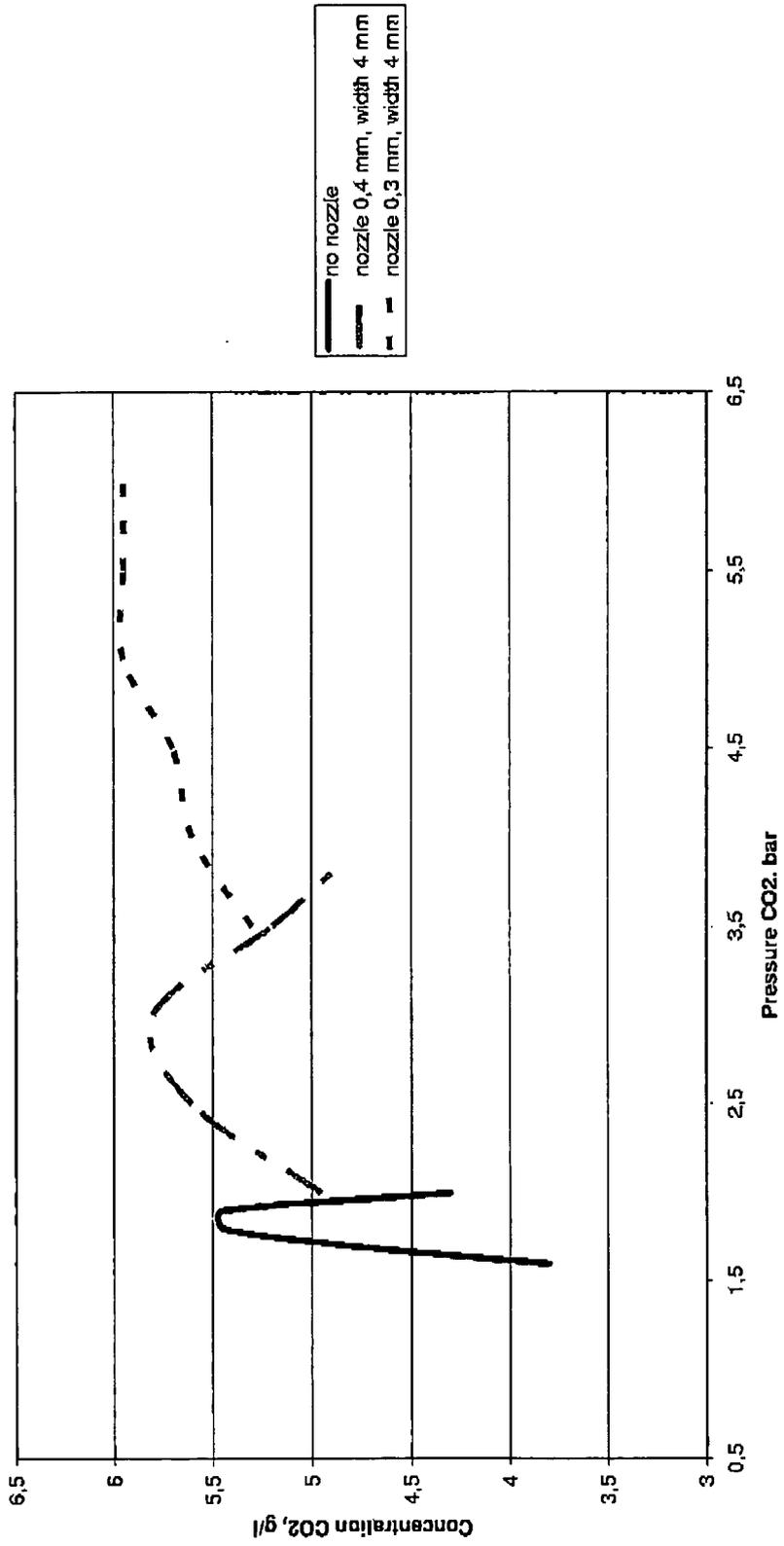


Fig. 5

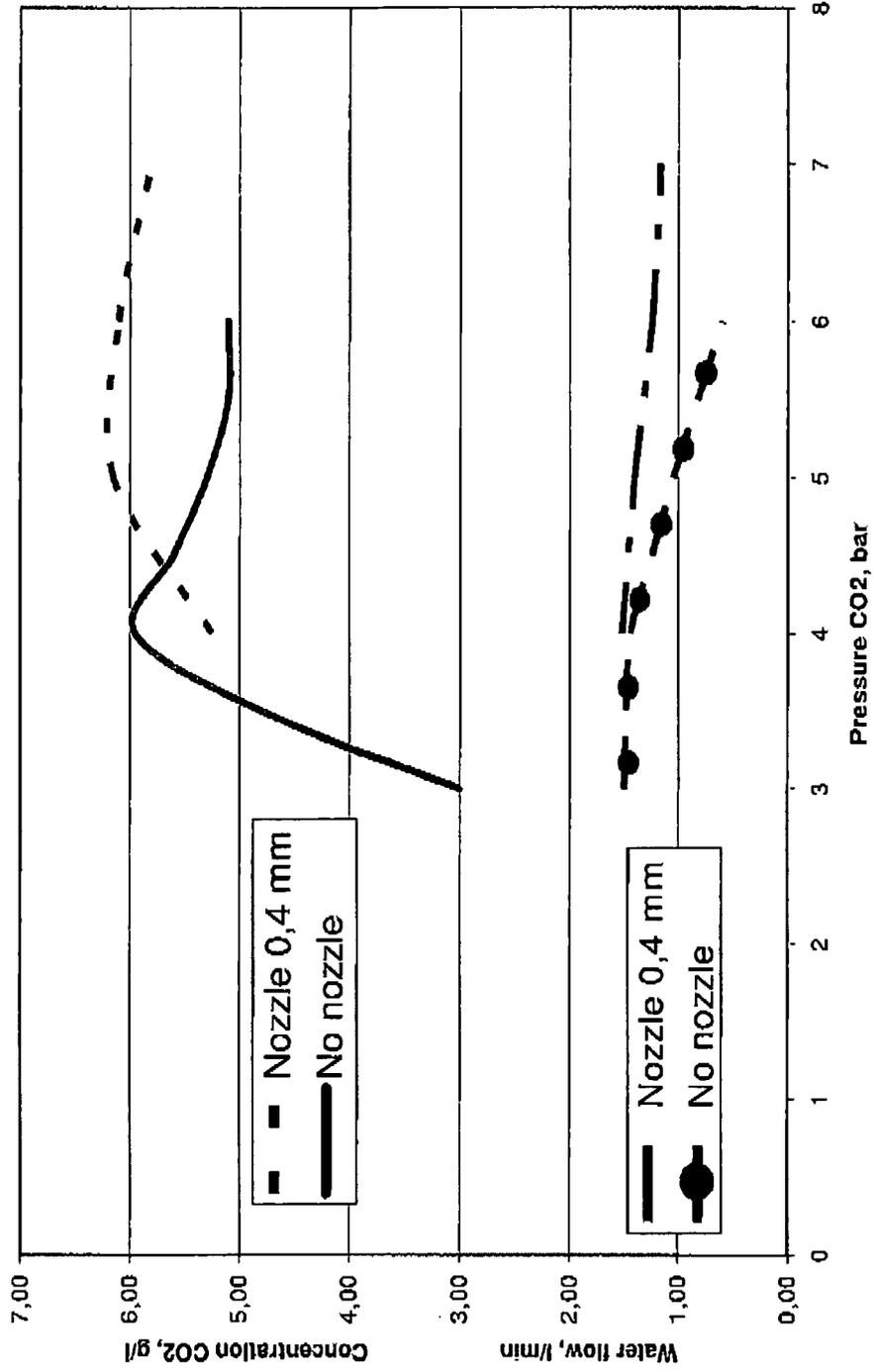


Fig. 6



DOCUMENTS CONSIDERED TO BE RELEVANT				
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)	
X	US 4 915 261 A (STRENGER MARSHALL C [US]) 10 April 1990 (1990-04-10)	1-16	INV. B01F3/04 B01F5/04 A23L2/54 B67D1/00 F25D23/12	
Y	* column 9, lines 1-32 * * column 10, line 38 - column 11, line 61 * * abstract; figures 1,14,19,20 *	17		
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Y	* page 1, lines 10-16 * * page 3, line 125 - page 4, line 71 * * figures 1-5 *	17		
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A	US 6 986 506 B2 (CHAPMAN TEDDIE C [US] ET AL) 17 January 2006 (2006-01-17)	1-17		B01F A23L B67D F25D
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Y	EP 1 614 986 A (DAEWOO ELECTRONICS CORP [KR]) 11 January 2006 (2006-01-11)	17		
	* paragraphs [0012], [0013] * * abstract; figure 4 *			
The present search report has been drawn up for all claims				
Place of search		Date of completion of the search	Examiner	
Munich		10 March 2008	Brunold, Axel	
CATEGORY OF CITED DOCUMENTS				
X : particularly relevant if taken alone		T : theory or principle underlying the invention		
Y : particularly relevant if combined with another document of the same category		E : earlier patent document, but published on, or after the filing date		
A : technological background		D : document cited in the application		
O : non-written disclosure		L : document cited for other reasons		
P : intermediate document		& : member of the same patent family, corresponding document		

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EPO FORM 1503 03.82 (FOAC01)



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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