(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 312 080**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **88117098.9**

(51) Int. Cl.[4]: **B01F 3/04 , B67D 1/00**

(22) Date of filing: **14.10.88**

(30) Priority: **15.10.87 US 108684**

(43) Date of publication of application:
19.04.89 Bulletin 89/16

(84) Designated Contracting States:
AT CH DE FR GB IT LI LU SE

(71) Applicant: **The Coca-Cola Company**
310 North Avenue
Atlanta Georgia 30313(US)

(72) Inventor: **Plester, George**
Rheinstrasse 79
D-4300 Essen 18(DE)

(74) Representative: **Abitz, Walter, Dr.-Ing. et al**
Abitz, Morf, Gritschneder P.O. Box 86 01 09
D-8000 München 86(DE)

(54) Portable, automatic water carbonator, requiring no electrical components.

(57) A portable carbonator includes a built-in CO_2 supply system which operates on disposable gas generating cartridges. The system requires no electrical power and is self-sufficient and automatic. CO_2 gas is generated by a chemical reaction between reagents which carbonates and/or propells the water. Whenever carbonated water is drawn, the reagents react and generate more CO_2 so as to maintain a constant pressure of the carbonated water.

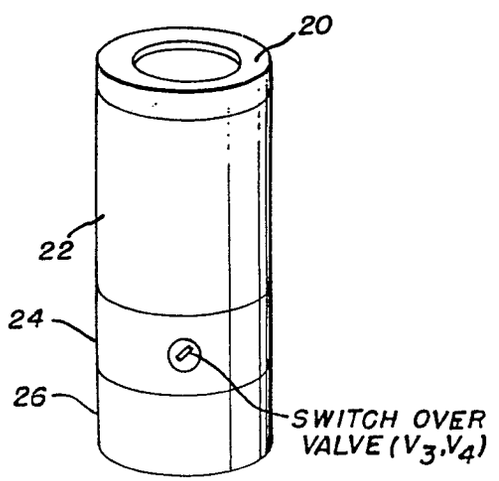


FIG. 1A

EP 0 312 080 A1

PORTABLE, AUTOMATIC WATER CARBONATOR, REQUIRING NO ELECTRICAL COMPONENTS

BACKGROUND OF THE INVENTION

This application is related to applicant's copending EP application filed on even date herewith and entitled "Supply of Controlled, Medium Pressure CO_2-Gas In Simple, Convenient Disposable Packaging". (Applicant's Ref: 95-776P).

The present invention relates to a carbonator assembly which requires no electrical components and includes a CO_2 gas generator module which generates the gas by a chemical reaction.

The water carbonator, in combination with the conventional CO_2-cylinder, comprises a system, which is an essential part of those beverage dispensers which use syrup and water to produce a finished carbonated beverage. Conventional carbonator systems require complex controls firstly to ensure the correct degree of carbonation and secondly to provide a constant water pressure while dispensing. The latter is essential for providing good control of the water-syrup dispensing ratio and a constant carbonation level while water is being drawn. Furthermore the conventional CO_2 supply comprises heavy, high pressure CO_2 cylinders, which are necessarily returnable, refillable packages, are inconvenient in use, and require pressure controls and safety devices.

In home-dispensing, a non-pressurized or low-pressure CO_2 package is important, since it simplifies distribution through normal retail channels and provides greater convenience for the non-professional user. In addition, a convenient design of carbonator for home-dispensing is one which is portable, can be filled at the user's sink, and be replaced into the dispenser after filling. Home dispensers are essentially simple devices, with few controls, and in the future some may be fitted into refrigerators, eliminating the need for separate cooling. This in turn implies the need for simple mechanical controls of the carbonation process. However, both the actual carbonation and the generation of gas for dispensing purposes should occur automatically, with minimum user manipulation. Otherwise, the advantages of simplicity and cost-effectiveness are counter-balanced by the lack of essential convenience.

SUMMARY OF THE INVENTION

Accordingly, it is a primary object of the present invention to provide a non-electric carbonator assembly, which carbonates water and propells the same to a station in a dispenser where it is mixed with concentrate, by the energy provided by CO_2 gas emitted by a chemical reaction between a plurality of reagents.

It is another object of the present invention to provide a carbonator assembly which delivers carbonated water at a substantially constant pressure.

The present invention achieves these objects of the present invention by use of a substance, such as sodium bicarbonate, which in contact with an acid, such as citric or phosphoric acid, releases carbon dioxide. The two components can be mixed as powders, so that carbon dioxide is generated when water is added. Alternatively, one or both components can be dissolved in water and thereafter gas generation occurs when the two solutions are mixed together. Details of a suitable CO_2 gas generator are also fully disclosed in the aforementioned copending application of applicant.

Chemical generation of CO_2 gas is generally known. Also known are devices, which use this form of gas-generation to carbonate water to a predetermined degree. These are mostly inconvenient, because they often involve the user in an unacceptable degree of manipulation. Also they are not useable in place of the conventional carbonator/CO_2 cylinder system found in beverage dispensers, since they have no means of maintaining a constant pressure within the carbonator once water is being drawn to feed the dispenser.

The system described herewith enables the design of a portable carbonator, complete with a built-in CO_2-supply system, which operates on disposable gas generating cartridges. The system requires no electrical connections and is self-sufficient, and automatic. It demands a minimum amount of manipulation by the user and requires him simply to fill the carbonator, insert the cartridge and replace the cartridge cover and carbonator lid. Nonetheless, once the carbonator is closed, it proceeds to carbonate the water to the correct level, and whenever water is drawn, it reacts by generating more CO_2 so as to maintain a constant pressure.

Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

Figure 1 is an exploded view of a first embodiment of a carbonator assembly of the present invention;

Figure 1A is a perspective view of the assembly of Figure 1 in its assembled state;

Figure 1B is a sectional view along line X-Y of Figure 1;

Figure 1C is a sectional view along line P-Q of Figure 1;

Figure 1D is a partial vertical section of the region of the Figure 1 assembly containing valves V_3, V_4;

Figure 1E is a sectional view along line A-A of Figure 1D;

Figures 2A to 2C illustrate additional embodiments of the present invention;

Figures 3A and 3B illustrate the structure of a gas generating capsule for use in the carbonator assembly of the present invention;

Figure 4 is a sectional view of another embodiment of a carbonator assembly with the components arranged horizontally; and

Figures 5A and 5B illustrate how the carbonator assembly of Figure 4 could be mounted in the door of a home refrigerator.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Basic Principles

The basic principles are illustrated, by way of example, by Figure 1 and Figures 1A to 1E.

The carbonator consists of a lid 20, a main body 22, an intermediate section 24(which houses the pressure-regulating "memory" and the internal channels) and a base 26 into which the CO_2-generating cartridge is inserted. These three sections are shown apart in an "exploded" view in the flow-diagram in Figure 1 to simplify the description. The CO_2-generating cartridge 28, in the particular example shown, comprises two separate parts. Each of these two parts consists of pellets of a mixture of sodium bicarbonate and citric acid (or another suitable solid acid) in a perforated outer package. An air-gap is present between the two parts and one is mounted above the other. In the lower part, reagent R_c has the correct proportions for securing the necessary level of water carbonation. In the upper part reagent R_p, is proportioned so as to provide adequate gas quantities for propulsion and displacing the entire contents of the carbonator to the dispensing point, while maintaining the required pressure.

The main body consists of a large chamber W, which contains the carbonated water and two small chambers A and B, which contain reagent water. All three chambers are filled simultaneously, when the correct water level is reached in the carbonator. The lid 20 simply srews down and seals onto the top of the main vessel and seals the chambers A and B separating them from each other and from W, once the lid is secured.

Furthermore, the lid presses down on spring rods 30, (Figure 1B) which run down inside the walls of the main body and open valves V_1 and V_2 as soon as the lid is fully closed. The three-way valve V_3 is normally open to Vent 3 (leading to the top of chamber 24) this position being ensured by spring pressure. When the lid is replaced, a third vertical rod 30, also running down inside the walls of the main body fits into a ratchet (Figure 1D) and prevents the spring from returning the valve V_3, once the valve is set in another position. The user can thus change the position of valve V_3 during operation and it springs back to its normal position only when the lid is removed.

The base section 26 can be unscrewed from the central section 22, so that the cartridge 28 comprising reagents R_c and R_p can be inserted. The user inserts the cartridge 28 before closing the lid 20 of the main chamber W.

The system described can be constructed of moulded plastic parts, with in-built channels for the various flows shown and the three valve-actuating rods. The three valves V_2, V_3, V_4 consist of simple plug-cocks and are inserted in prepared borings in the side of the central casting which also contains chamber C.

The system operates as follows. As soon as the lid is replaced, valve V_1 opens and the water in chamber A discharges into chamber D flooding the lower part R_c of the reagent cartridge 28, Simultaneously, the water in chamber B flows into chamber C. The reagent R_c gradually releases CO_2 through the diffuser 32 to effect the required carbonation level in the water in chamber W. The head-pressure in chamber C at the end of the carbonation cycle is equal to that in chamber D and the whole system now reaches pressure equilibrium.

The carbonator can be placed into the dispenser either while carbonating or at the end of the carbonation cycle. A simple, self-sealing push-in

connector at the base fits onto the dispenser. Once dispensing can begin, the user simply switches valve V_3 to the dispensing position. From that moment, whenever water is drawn out of the carbonator and the pressure in the carbonator drops, the pressure in chamber D also drops and water enters chamber D from chamber C, since this chamber is now at a higher pressure. The water floods the cartridge R_p and generates CO_2 until the pressure in chambers W and D have attained equilibrium with the reference pressure in chamber C. When pressure equilibrium has been reached, the water is pushed back into chamber W and the reaction stops. The process repeats itself whenever the pressure in W drops below the reference pressure in C. This reference pressure acts as a pressure "memory" and the pressure "memory" is set by the system itself after carbonation is complete.

These basic principles can be applied in a variety of different modes. Figures 2A, 2B and 2C show other examples.

In Figure 2A, water flows from chamber W to the carbonating chamber D_c. A ball-float 34 prevents the chamber from overfilling. The resultant reaction carbonates the water in chamber W. In addition, CO_2 flows into the pressure-reference chamber C and, as carbonation is complete and propellant CO_2 is needed, the user switches the control valve 36. Water from chamber C now enters the second reaction chamber D_p and generates CO_2 until the pressure in W and D_p is in equilibrium with the pressure in C. The water is now expelled back to C and the reaction stops. The process repeats itself every time the pressure in W drops.

In Figure 2B, water flows from chamber W into reaction chamber D and also into pressure reference chamber C, which forms an outer ring around D. Ball-floats 34 prevent overfilling in chambers D and C. Carbonation takes place and W, C and D reach pressure control valve 36 and water flows from chamber C into D, generating pressure C. The water then flows back into C and the reaction stops. The process repeats itself every time the pressure in W drops.

In Figure 2C, water flows from W into C and D simultaneously and ball-floats 34 prevent over-filling. After carbonation the user switches the control valve 36 and water flows into the reagent chamber D through an orifice and directly impinges on the propellant reagent R_p. As soon as the pressure in D has reached equilibrium with C, the water flow stops, and the reaction stops. The water level in chamber D gradually rises until all reagent R_p is exhausted.

Horizontal Carbonator

All the above devices can easily be fitted into a refrigerator, since they require no electrical connections and are self-sufficient, compact units. However, in certain cases, a horizontal tank may be easier to accommodate in the door of a refrigerator. Figures 3A, 3B and 4 illustrate such a system, using the principles already described.

Firstly in Figures 3A and 3B, a suitable gas-generating cartridge 40 is shown. The cartridge 40 consists of a moulded plastic shell 42. The top-section is filled with bicarbonate pellets 44, the middle section with pellets containing a mixture of bicarbonate and powdered acid 46 and the lower section contains a liquid acid 48. The top and bottom sections are connected by a tube 50, which is sealed with foil 52 at the bottom and filter paper 54 at the top. The top and bottom of cartridge 40 are closed by sealing foil 56.

Figure 4 shows a sectional view of the carbonator tank. Lid (1) is removed and the tank filled with water up to a pre-determined mark. The reagent water tank (14) is filled at the same time, as soon as the water reaches the required level. When lid (1) is replaced the top of the reagent water tank is sealed. Simultaneously, valve 4 is opened by the pressure which lid (1) exerts on a spring valve actuator. However, the water in the reagent tank cannot as yet flow out, since it is restrained by a second valve (5). Lid (2) is removed and the gas generating cartridge 40 inserted. The cartridge 40 does not reach its lowest position, being restrained by an o-ring (6). When lid (2) is replaced, the cartridge is punctured on the top foil 56 and forced to its lowest position. In its lowest position, the cartridge 40 seals its base (9) against o-ring (7) and its top section (10) against a seal (8). A spring bellows (13) enters the base of the cartridge displacing the acid into the top section. The spike (11) in the center of the bellows opens the channel to the top section through foil 52.

When lid (2) is fully closed, valve (5) opens automatically and water from the reagent water chamber flows into the carbonating reagent section (12) of the cartridge. CO_2 gas is released and flows to sparge tubes 60, carbonating the water to the level pre-determined by the quantity of chemicals.

The spring bellows (13) has forced acid in contact with bicarbonate and this also generates CO_2, pressurizing the head-space of the tank. As soon as the head-space pressure has reached equilibrium with the spring pressure in the bellows, the spring contracts, the acid returns to the lower chamber and the reaction stops. Thereafter, the process repeats itself, whenever water is drawn out of the carbonator and the head-pressure drops.

Figures 5A and 5B show a typical installation of a horizontal carbonator tank in a refrigerator. The

tank can now be connected to a dispensing point within or outside the refrigerator.

The above principles can also be applied to a vertical carbonator. They also illustrate how a liquid acid may also be used, in place of a solid acid, and how an external fixed pressure reference may be applied in place of the self-generated internal reference as described in Figures 1 and 2. The external pressure reference can be by spring pressure (as above), or by an air-cushion or by a membrane or by a piston or by some other similar pressure-exerting device.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

Claims

1. A carbonator assembly comprising:

a) carbonator means for containing water to be carbonated by the mixing of CO_2 gas therein;

b) gas generating means including reagents for generating CO_2 gas when the reagents chemically react, said gas generating means being in fluid communication with the water in said carbonator means;

c) pressure memory means in fluid communication with both said carbonator means and said gas generating means;

d) valve means for accommodating the flow of carbonated water from said carbonator means when OPEN and preventing the flow therefrom when CLOSED; and

e) control means responsive to the relative internal pressures between the carbonator means, the gas generator means and the pressure memory means for initiating or precluding a chemical reaction of said reagents to initiate or stop the generation of CO_2 gas.

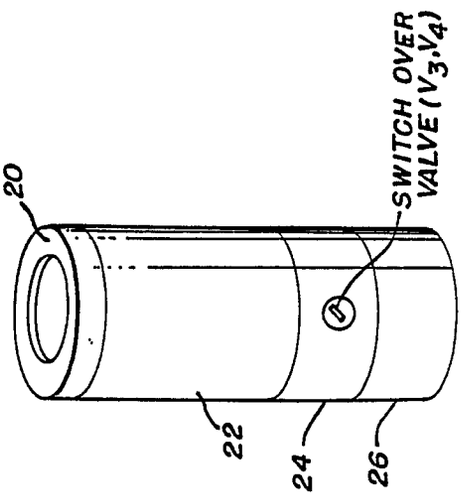


FIG. 1A

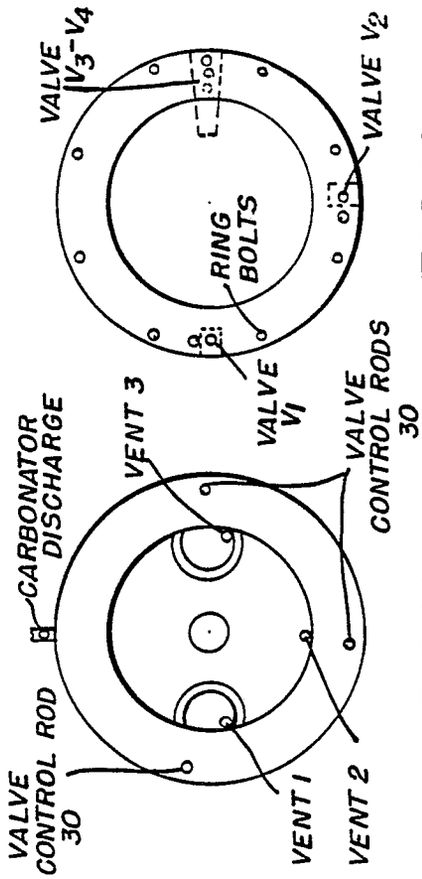


FIG. 1B

FIG. 1C

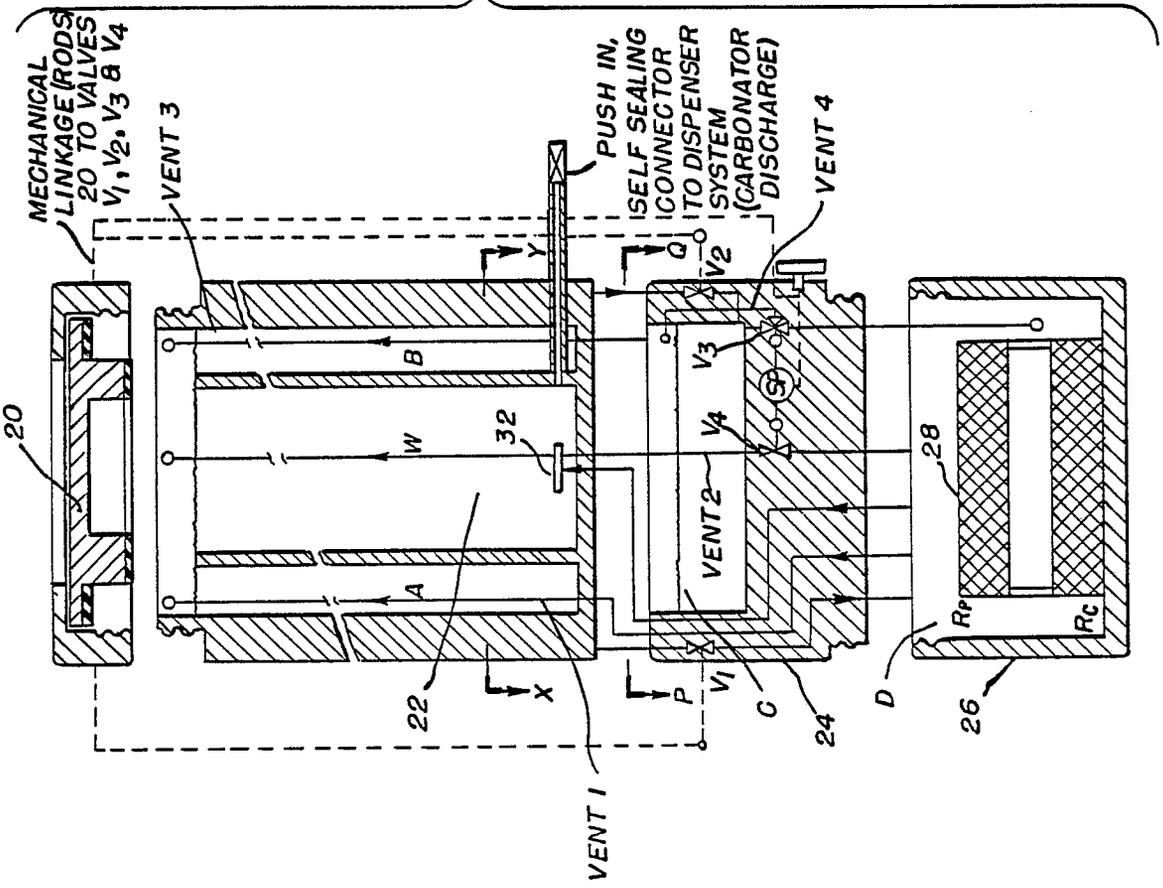


FIG. 1

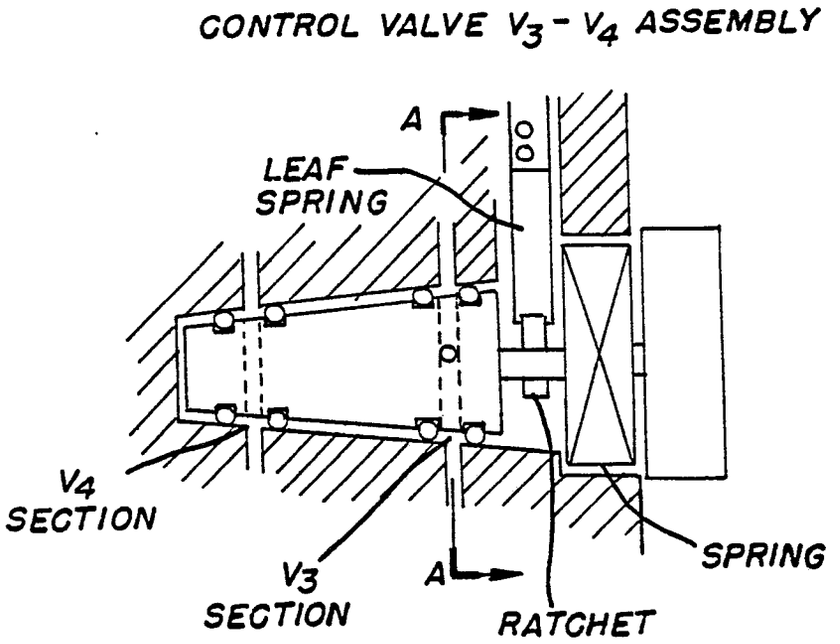

CONTROL VALVE V_3 - V_4 ASSEMBLY
A
LEAF SPRING
V_4 SECTION
V_3 SECTION
A
SPRING
RATCHET

FIG. 1D

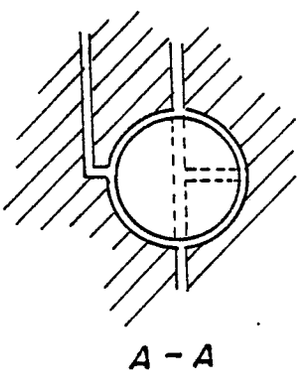

A - A

FIG. 1E

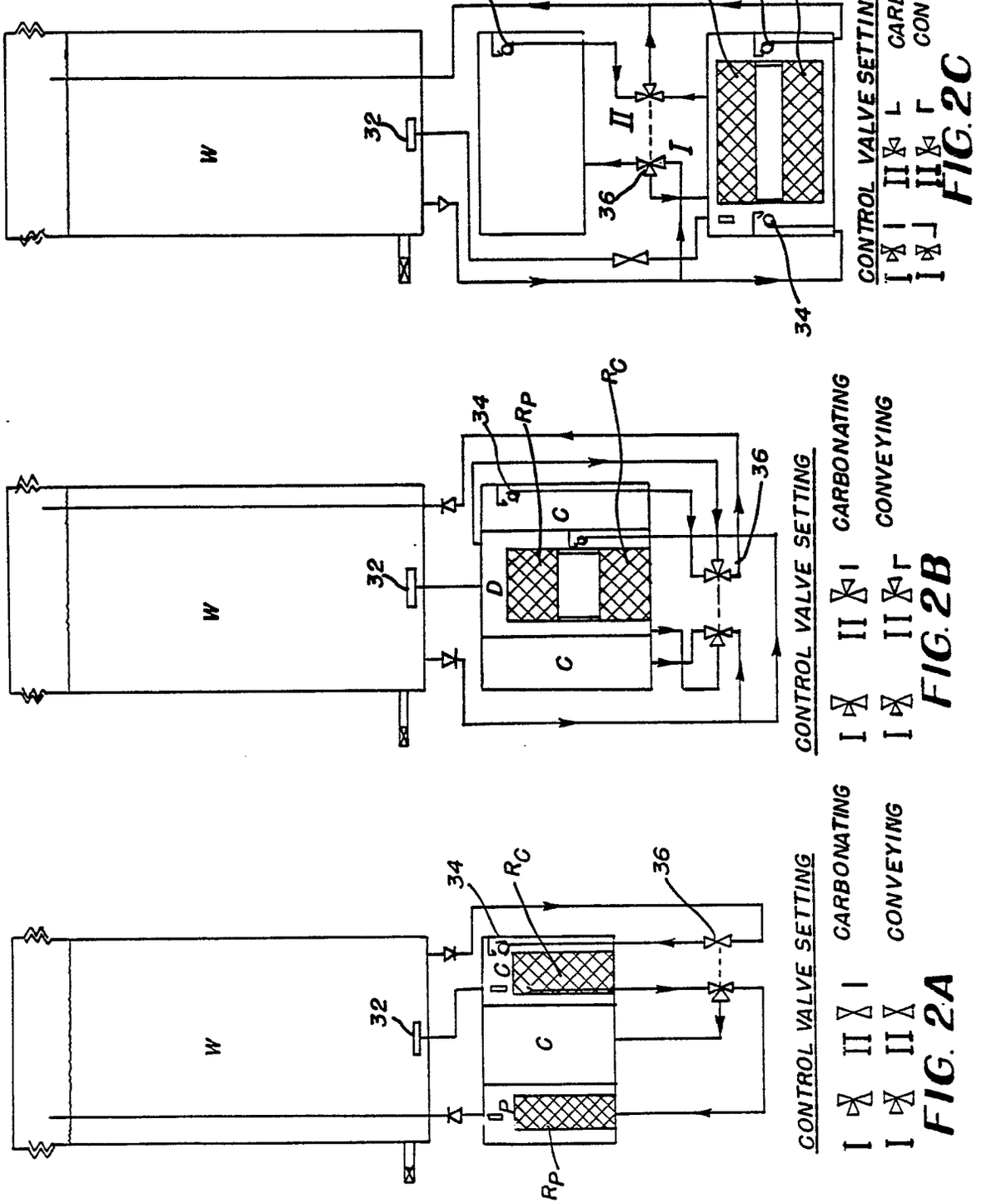


FIG. 2A

FIG. 2B

FIG. 2C

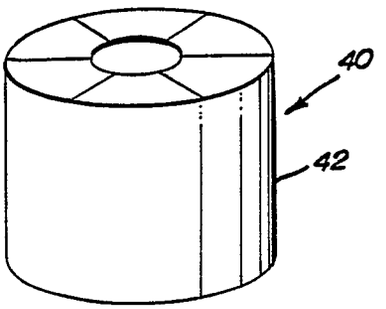


FIG. 3A

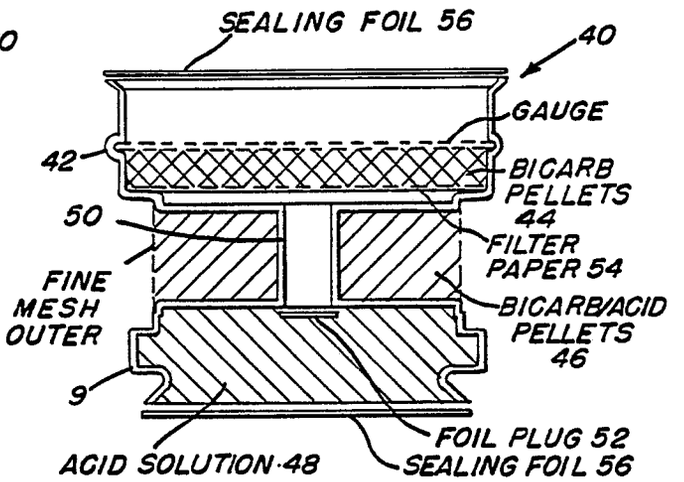
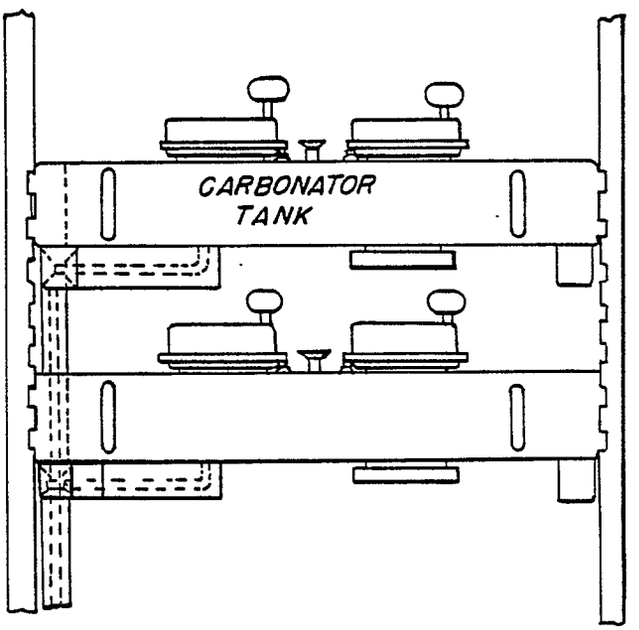


FIG. 3B

CARBON TANK INSTALLATION IN REFRIGERATOR



VIEW OF INSIDE OF REFRIGERATOR DOOR

FIG. 5A

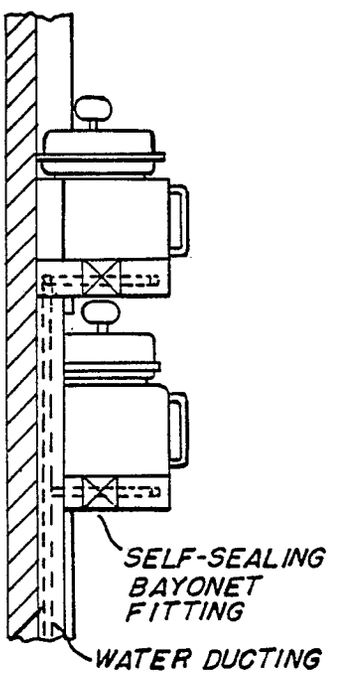


FIG. 5B

CARBONATOR TANK(SECTIONAL VIEW)
GAS GENERATING SYSTEM

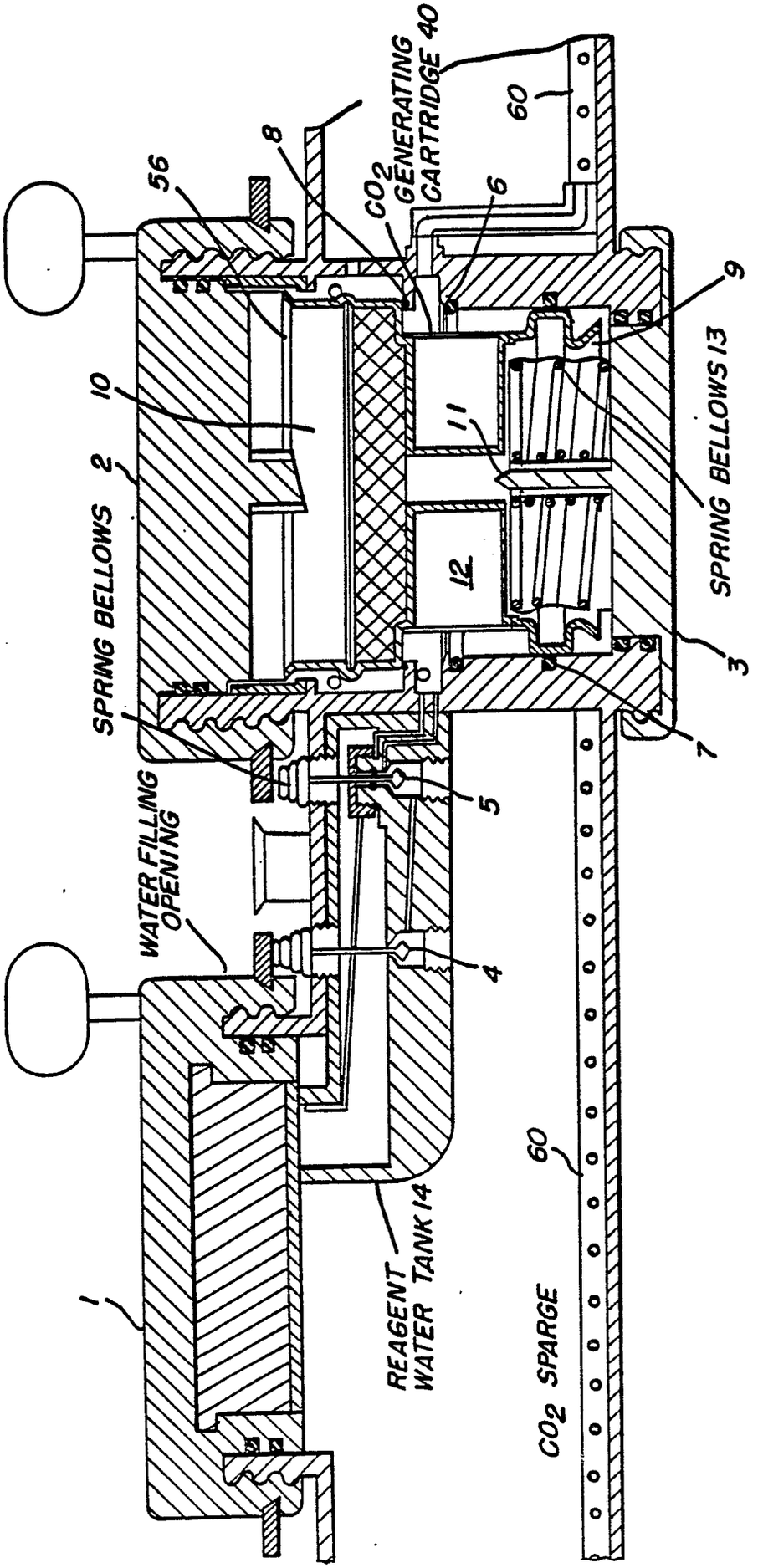


FIG. 4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 88 11 7098

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	DE-C- 45 734 (G.F. GRAF) * whole document *	1	B 01 F 3/04 B 67 D 1/00
A	DE-C- 7 114 (O. ZWIETUSCH)	1	
A	GB-A-2 139 910 (THORN EMI) * claims 1,2 *	1	
A	EP-A-0 168 990 (THORN EMI) * claim 1 *	1	
A	US-A-4 304 736 (J.R. MCMILLIN et al.) * claim 1 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 01 F 3/00
B 67 D 1/00
C 01 B 31/20

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	11-01-1989	KESTEN W.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)