April 13, 1965 G. M. RIEDL ETAL 3,178,075

PRESSURIZED CONTAINER

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FIG. 3

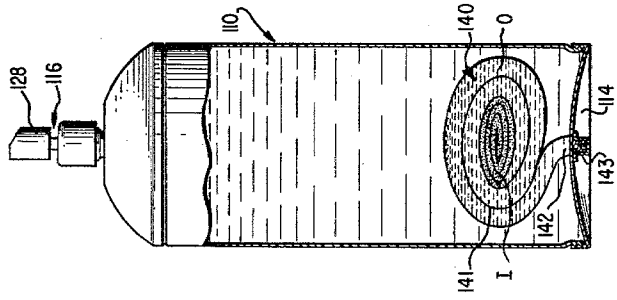

FIG. 2

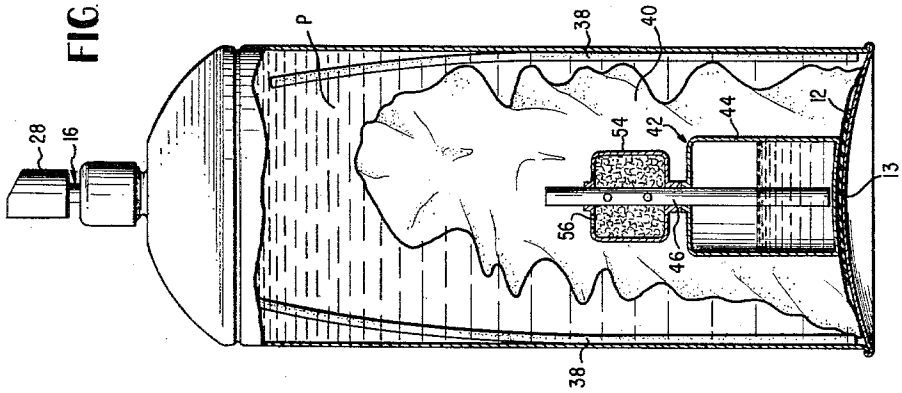

FIG. 1

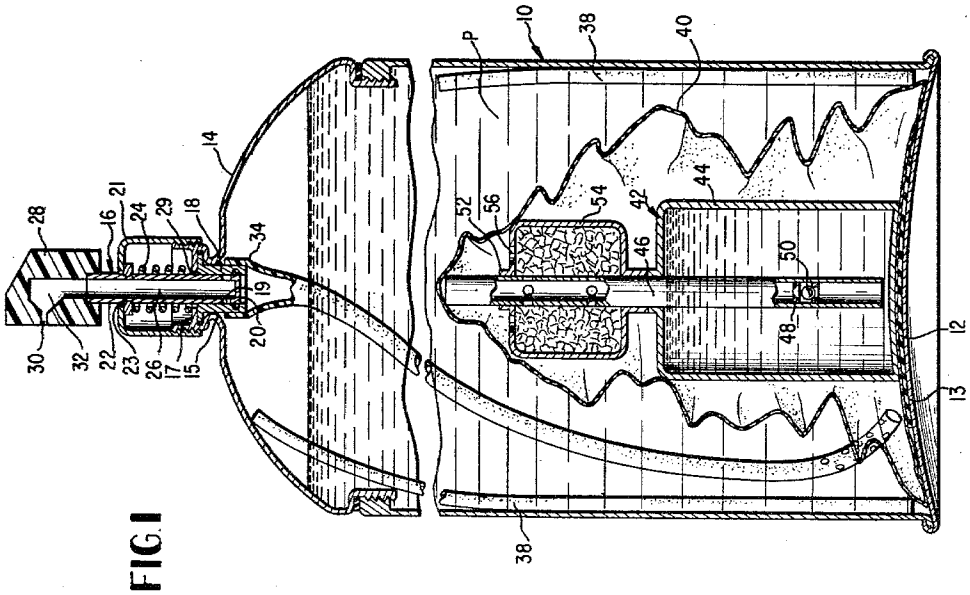

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FIG.4

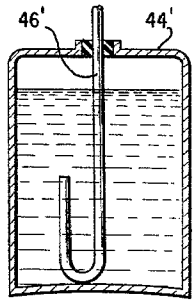


FIG.5

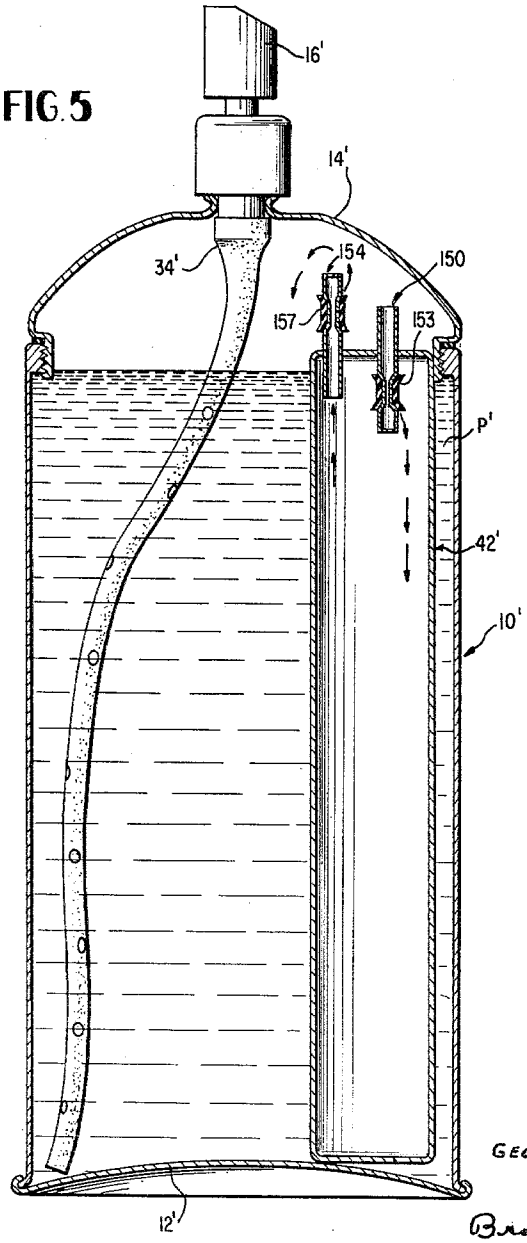
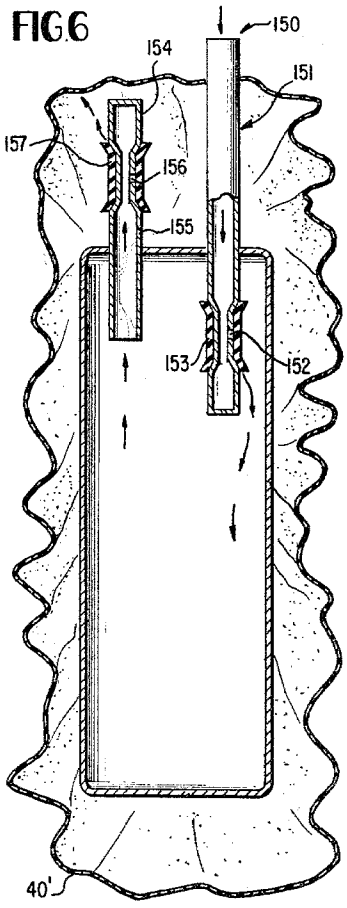


FIG.6



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PRESSURIZED CONTAINER

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10 Claims. (Cl. 222—386.5)

The present invention relates to fluid dispensing means and deals more particularly with apparatus for dispensing flowable material from a container by means of gaseous pressure.

It is conventional practice to package under pressure a wide variety of fluid materials which may vary in consistency from free flowing liquids to creams and viscous pastes. Materials contemplated include dental cream, cologne water, syrups, shaving cream, mayonnaise, whipped cream, and paste. Usually the package is pressurized by adding to the material a propellant, which may be a liquefied or compressed gas, to provide the necessary force to expel the material or product from the package or container. However, these pressurized or aerosol containers have certain disadvantages. For example, such containers are charged with a gas under a pressure of about 40 to 60 lbs.-gauge pressure. As the contents thereof are used by the opening of the valve associated with such containers, there results a gradual diminution of the gaseous pressure. As a result, when the user thereof comes to dispensing the last of the contents of the container, there is insufficient gaseous pressure to expel the contents satisfactorily even after vigorous shaking of the container. If this is compensated for by placing the contents under greater initial gaseous pressure, there is the possibility that the pressurized container may explode.

Accordingly, it is a principal object of the present invention to provide a pressurized container or can for dispensing a paste-like or liquid material of such construction as to deliver the material under relatively constant pressure regardless of the amount of material left in the container.

A further object of the invention is to provide a pressurized container for dispensing pasty and liquid materials which container will expel even the residual contents thereof without the necessity of shaking the container on the part of the user.

A further object of the invention is to provide a pressurized container for dispensing pasty and liquid materials which container will expel even the residual contents thereof due to the in situ generation of gas by chemical or mechanical means within the container concomitantly with the expulsion of the materials therefrom.

A further object of the invention is to provide a pressurized container for dispensing flowable materials, whether solids such as powders, or liquids of varying viscosity, of such construction that the propellent force for expelling the material from the container remains substantially contsant so as to insure the delivery of all of the material from the container.

A further object of this invention is to provide a low cost pressurized container for dispensing fluid materials of varying viscosity in which the more expensive type of fluorocarbon propellent is replaced by carbon dioxide or any other inexpensive gas.

A further object of this invention is to provide a pressurized container for dispensing fluid materials of varying viscosity by a self-inflating flexible bag which effects the complete expulsion of the materials from the container.

A further object of this invention is to provide a pressurized container for dispensing flowable materials which container will eliminate the problem of incompatibility between products and propellants when in contact with the valve and the container or with each other.

Other objects and advantages will be apparent from the description which follows.

According to one embodiment the present invention contemplates using a plastic bag within a portion of a conventional pressurized or aerosol container having a valve. The flowable material under gaseous pressure is located in a portion of the container around the bag. Positioned within the bag is a carbon dioxide generator which forms carbon dioxide as the material is expelled from the container by opening the valve. Due to this in situ generation of gas every time the valve is opened, there is always sufficient gas pressure present to expel the entire contents of the container.

The precise nature of the present invention will become evident from the following specification and the accompanying drawings in which:

FIG. 1 is a vertical sectional view of a pressurized container constructed according to the present invention and showing the container in condition for operation;

FIG. 2 is a view partly in section and partly in perspective of the container of FIG. 1 except slightly reduced in size showing the change in the contour of the plastic bag after the valve has been opened so as to effect a discharge of the material therefrom;

FIG. 3 is a schematic vertical sectional view of a modified construction;

FIG. 4 is a vertical sectional view of another modified construction;

FIG. 5 is a vertical sectional view of a further modified construction; and

FIG. 6 is a vertical sectional view of a still further modified construction.

The illustrative embodiment of FIG. 1 comprises a cylindrical container 10 having a cap 14 and a bottom 12. Cap 14 has a threaded neck 15 with inwardly projecting flanges 17 and a centrally disposed valve seat 18. A cover 21 having a central opening 23 therethrough threadedly engages neck 15. Mounted within a bore 20 defined by opening 23, flanges 17 and valve seat 18 is a valve 16 resiliently mounted by means of a spring 24 which cooperates with flange 29. Valve 16 has a stem 22 with openings 19 in the lower end thereof. The stem 22 projects upwardly through the bore 20 of the valve seat 18 and is secured to a knob or actuator 28. This knob has a lateral duct 30 and a central duct 32. The lateral duct 30 extends from the outside of the knob 28 to the central duct 32 which is in alignment with the bore 20. Connected to the valve seat 18 of the cap 14 is a perforated dip tube 34 that extends into that part of the container which contains the flowable product P to be dispensed. The bore 20 is in communication with tube 34 by means of openings 19 when knob 28 is depressed. The dip tube can be of variaible length and also perforated. Positioned along the side of the container are one or more siphon or conductor tubes 38 which can be of varying lengths and which prevent the product from being sealed off due to the receptacle or bag 40 expanding as will be explained hereinafter.

It will be noted that the bag 40 envelops a gas generator 42 fixedly mounted on an insulating plastic layer 13 positioned on the bottom 12 of container 10. The gas generator comprises a lower chamber 44 containing a liquid acid material such as an aqueous solution of citric acid. Passing vertically upward through chamber 44 is an open tube 46 having a valve 48 and valve seat 50 at its lower end and opening 52 in its upper end. Mounted on container 44 is a smaller receptacle 54 which contains a salt, such as sodium bicarbonate, capable of liberating carbon dioxide when brought in contact with an acid. An annular opening 56 is provided in receptacle 54.

To prepare the container 10 for market, the gas gen-

erator unit **42** with its enveloping bag **40**, which is usually a plastic material like polyethylene, is mounted on the bottom of container **10**. The product, for example, cologne, to be dispensed is then loaded into the container **10** under a pressure of 40–80 p.s.i. gauge of nitrogen or carbon dioxide. This pressure will in turn not only collapse bag **40** but cause the air therein to be compressed. In addition, one or more siphon tubes **38** are positioned along the wall of the container **10**. The cap **14** and its associated valve **16** are then sealed into the top of the container. To dispense the material, the user depresses the knob **28** opening the valve **16**. Due to the liquid cologne being under gaseous pressure, depressing the knob **28** causes the contents to be propelled from the container through tube **34**, openings **19**, bore **20**, central duct **32** and lateral duct **30**. Simultaneously, due to the ejection of some of the product, the pressure within bag **40** will be greater than the pressure on the outside thereof such that there will be a pressure difference on container **44** so that the acid will rise in tube **46**, pass through openings **52**, and contact the sodium bicarbonate in receptacle **54** thereby liberating carbon dioxide which will expand bag **40** and force the product out through valve **16** whenever knob **28** is depressed or in the open position. FIG. 2 illustrates the position the bag **40** will take after the pressure container has been in use.

The role of the perforated siphon tube **38** now becomes apparent. Since it is possible that the bag **40** may seal off some of the product as the bag expands during use of the pressure container, the presence of one or more siphon tubes provides communication between areas which may become sealed off due to the expanding bag **40**. As more and more of the product is dispensed from the container **10**, the bag will continue to expand so as to fill completely the container and effect a complete expulsion of the product therefrom due to the continuing in situ generation and liberation of carbon dioxide.

The amount of citric acid and sodium bicarbonate which will be necessary can readily be calculated from the following equation:

$$C_6H_8O_7 + 3NaHCO_3 \xrightarrow{H_2O} C_6H_5Na_3O_7 + 3H_2O + 3CO_2$$

Thus, approximately 1.9 grams of sodium bicarbonate when reacted with 1.5 grams of anhydrous citric acid will generate about 1 gram of carbon dioxide or about 550 cc. at 70° C. under one atmosphere pressure. According, the amount of citric acid and sodium bicarbonate to be employed will depend on the size and pressure of the container.

The use of a valve **50** in the tube **46** is in the event the container is tipped upside down. In that case, the valve **50** will be held in valve seat **48** and the acid will be prevented from contacting the bicarbonate and thereby prevent an excess liberation of carbon dioxide.

The plastic layer **13** can be dispensed with if there is no problem with respect to storing the containers at low temperatures where freezing of the water solution of acid might occur. Under such circumstances, the container **44** could be attached, as by soldering, directly to the bottom **12**. Similarly, valve **50** can be eliminated from tube **46** if there is no likelihood of the container being inverted.

It will also be evident to those skilled in the art that the gas generator and its enveloping receptacle and bag can be constructed in the manner shown in FIG. 3 wherein a dispenser **110** with a valve **116** and a knob **128** similar to that shown in FIG. 1 is employed. The dispenser **110** is first filled with the product P', such as mayonnaise, except for sufficient space to crimp on a bottom **114** which has attached thereto a coiled plastic bag **140** having an inner zone I of coils **141** lined with a substance S, such as $NaHCO_3$, capable of liberating CO_2 when in contact with an acid. The bag terminates in a tube **142** with a valve **143** therein mounted in the bottom **114**. The outer zone O of coils **141** of the bag is then charged under a pressure of about 50 p.s.i. gauge with an aqueous solution of preferably a weak acid. It is to be understood that the plastic bag can be disposed in the form of a number of contacting angular folds instead of rolled up in the coils as shown in FIG. 3.

When knob or actuator **128** is depressed, the product is forced out by the expansion of bag **140** which is under an internal pressure of about 50 p.s.i. gauge. However, as the bag **140** expands, it will also unfold permitting the acid solution to contact the substance P' so as to give off additional CO_2 and thereby maintain the pressure relatively constant although the volume of the bag increases in size as the bag unfolds.

In FIG. 4 there is shown a modification in which the tube **46** with its valve **48** and valve seat **50** are replaced by a curved capillary tube **46'** with its opening reaching the center of chamber **44'** corresponding to chamber **44** of FIG. 1. Such a construction will also prevent the flow of a liquid from the chamber **44'** in the event the pressurized container is inverted.

The examples shown in FIGS. 1 through 4 above can be described as pressurized containers of the present invention wherein the gaseous pressure within the containers is maintained substantially undiminished by means of a chemical gas generator. However, it is to be understood the gas can be generated in situ by a so-called mechanical gas generator. As representative of this modification, reference is made to FIG. 5 wherein **10'** is a container similar to FIG. 1 having a bottom **12'**, cap **14'**, valve **16'**, dip tube **34'**, and product P' corresponding to similar elements of container **10** of FIG. 1. However, the corresponding gas reservoir or generator **42'** is of the mechanical type. This container has two one-way valves, an inlet valve **150** and an outlet valve **154**. The inlet valve **150** consists of a short length of tubing **151** with a small hole **152** on the side thereof covered by a band of rubber **153**. Similarly, the outlet valve **154** consists of a short length of tubing **155** with a small hole **156** on the side thereof covered by a band of rubber **157**.

The present pressurized container **10'** is prepared for the market by positioning the mechanical gas generator **42'** therein. The product is poured in to the level shown in FIG. 5, the air is purged and the valve is crimped on. Then a gas, such as nitrogen or carbon dioxide, is forced through the valve **16'** under a pressure of about 100 p.s.i.g. The gas will then bubble up through the liquid P' to reach the inlet valve **151**. It will then flow into the gas generator or reservoir **42'**, which is of an adequate size, through the inlet valve **151** until the pressure in the generator rises to about 100 p.s.i.g. The operation of the inlet valve **151** is such that the flow of gas therethrough and subsequently through hole **152** pushes the band of rubber **153** away and allows the gas to enter the generator. However, this flow of gas cannot reverse itself since this would press the rubber band **153** towards the tubing in the present instance where the tubing **151** is within the generator **42'**. The operation of outlet valve **154** is somewhat similar in that the pressure of the gas from the reservoir **42'** plus the decrease in external pressure as the product P' is expelled from the container **10'** will cause the rubber band **157** to expand and permit flow of the gas out through hole **156**. Thus when the valve **16'** is actuated, the product P' will be forced from the container **10'** so that the gaseous pressure on the product P' which is outside the generator **42'** will be reduced. This lowering of pressure will create a pressure unbalance such that a fresh supply of gas will flow from the generator **42'** through outlet valve **154**.

In FIG. 6 there ise shown a further modification in which the generator **42'** of FIG. 5 is positioned within a bag **40'** such that the outflow gas from valve **154**, described above, will push against flexible bag **40'** which in turn will exert a pressure against surrounding product P' and cause its expulsion through valve **16'** of container

10' much in the same manner as shown in FIGS. 1 and 2 above. In the FIG. 6 modification, it will be noted that the inlet valve 150 is of sufficient length so as to project from the bag 40'.

From the foregoing description it will be apparent that there has been devised an inexpensive yet efficient pressurized container in which the relatively cheap carbon dioxide is used as the propellant to effect a complete expulsion of the product from the container by chemical means.

Moreover it is evident that the container need not be pressurized under high pressures so as to make certain there will be adequate pressure available for the expulsion of the last of the product. With the present invention, there is a continuous and relatively constant gas pressure developed due to the fact that as the product is used, more carbon dioxide is liberated to maintain the original gas pressure due to the interaction of the acid with the bicarbonate.

In addition, the pressurized can of the present invention is admirably suited to the dispensing of whipped cream and related products which cannot be under too great a gaseous pressure, otherwise the desired fluffiness of the product, as it is expelled from the container, is not obtained.

It will also be evident to those skilled in the art that there has been devised a pressurizing unit consisting of a flexible bag 40 and a gas generator 42 within said bag which can be inserted in a conventional pressurized can which contains a material, such as mayonnaise, under gaseous pressure. By incorporating the pressurizing unit of the present invention, one is assured of a cotninuous liberation of carbon dioxide during the use of the container whereby the last remaining portion of material is expelled from the can.

Various modifications will be apparent to those skilled in the art. For example, other acids, solid or liquid, and other chemicals can be employed if desired. Similarly, the source of the gas be a solid or liquid. With foodstuffs, the relatively harmless organic acids, such as citric and tartaric acid, can be effectively used. Where foodstuffs are not involved, some of the stronger inorganic acids such as sulfuric and hydrochloric will be found suitable. In addition, it will be evident to those skilled in the art that other valve or actuator means can be employed to release the product from the container (see U.S. Patent No. 2,671,578).

Although only the bag is indicated as made of a flexible plastic like polyethylene and rubber, for certain purposes the entire container might be made of plastic instead of metal. In general, the bag can be made of any convenient impervious flexible material including metallic foils, plastics, and specially treated fabrics. In addition, one or more siphon tubes can be used with the FIG. 3 or FIG. 6 modification.

While the generator is shown positioned within an expandable bag (FIG. 1), it will be evident to those skilled in the art that the product could be placed in a collapsible bag connected to the valve 16 by means of tube 34 (see U.S. Patent No. 2,671,578) and the generator positioned outside thereof within the container 10. Moreover, two or more units can be positioned within a single container so that two or more products could be expelled from the same container 10 through a common valve or separate valves (see U.S. Patent No. 2,947,449).

While the illustrative embodiments of the invention have been described hereinbefore with particularity, it will be understood that various other modifications will be apparent to and can readily be made by those skilled in the art without departing from the scope and spirit of the invention. Accordingly, it is not intended that the scope of the claims appended hereto be limited to the description set forth herein but rather than the claims be construed as encompassing all the features and patentable novelty which reside in the present invention including all features which would be treated as equivalents thereof by those skilled in the art to which the invention pertains.

What we claim is:

1. Apparatus for dispensing flowable materials of varying viscosity comprising a container having a bottom and a cap with an opening therein, a manually operable valve positioned in said opening, a manually movable knob secured to said valve for moving the valve to an open position, said knob having a discharge duct therein, a tube connected to said duct and extending down into said container, a portion of said container adapted for holding the flowable materials which are under gaseous pressure, a chemical gas generator positioned in a second portion of said container and means associated with said generator responsive to a decrease in external pressure on said generator whereby gas is chemically liberated from said generator when the valve is in an open position to effect a substantially constant continuing pressure against the materials so as to facilitate the expulsion thereof.

2. Apparatus for dispensing flowable materials of varying viscosity comprising a container having a bottom and a cap with an opening therein, a manually operable valve positioned in said opening, a manually movable actuator secured to said valve for moving the valve to an open position, said actuator having a discharge duct therein, a tube connected to said duct and extending down into said container, a portion of said container adapted for holding the flowable materials which are under pressure, a gas generator positioned in a second portion of said container, and a flexible bag enveloping said generator such that when the valve is in open position, the generator begins to produce a gas gradually and regularly so as to maintain the pressure within the bag undiminished regardless of its expansion and in turn effects a further pressure against the materials so as to facilitate the expulsion thereof.

3. Apparatus for dispensing flowable materials of varying viscosity, comprising a container having a bottom and a cap with an opening therein, a manually operable valve positioned in said opening, a manually movable actuator secured to said valve for moving the valve to an open position, said actuator having a discharge duct therein, a tube connected to said duct and extending down into said container, a portion of said container adapted for holding the flowable materials which are under pressure, a gas generator located in a second portion of said container, at least one siphon tube connecting said portions, and a flexible bag enveloping said generator such that when the valve is in open position, the generator begins to produce a gas gradually and regularly as to maintain the pressure within the bag undiminished regardless of its expansion and in turn effects a further pressure against the materials so as to facilitate the expulsion thereof.

4. Apparatus for dispensing flowable materials of varying viscosity comprising a container having a bottom and an opening at a cap end thereof, a manually operable valve positioned in said opening, a manually movable actuator secured to said valve for moving the valve to an open position, said actuator having a discharge duct therein, a tube connected to said duct and extending down into said container, a pressurized portion of said container adapted for holding the flowable materials to be expelled, a gas generator positioned in a second portion of said container, said generator having a chamber containing a first chemical and a receptacle containing a second chemical which upon reacting with the first chemical is a source of gas, a means connecting said chamber and receptacle, and a flexible bag enveloping said generator such that when the valve is in open position the first chemical, due to a pressure unbalance, is caused to flow into said receptacle so as to contact the second chemical therein and liberate a gas which successively replenishes the pressure within the bag and in turn maintains gaseous pressure against the materials so as to facilitate the expulsion thereof.

5. In a pressurized container the improvement consisting of a pressurizing unit comprising a gas generator positioned within a bag which is subjected to an external above atmospheric gaseous pressure, said generator having a chamber containing a first liquid chemical and a receptacle containing a second chemical which upon reacting with the first chemical is a source of gas, a tube connecting said chamber and receptacle, and said liquid chemical flowing into said receptacle when the external pressure on the bag diminishes whereby the chemicals contact one another and liberate a gas which causes the bag to expand.

6. A pressurizing unit for containers consisting of a flexible plastic bag under external pressure and a gas generator positioned within the bag, said generator having (1) a chamber containing a liquid chemical and (2) a receptacle containing a second chemical which upon reacting with the first chemical is a source of gas, a tube connecting said chamber and receptacle, such that the liquid flows into said receptacle when the external gaseous pressure on the bag diminishes so as to contact the second chemical therein and liberate a gas whereby the plastic bag expands.

7. The improvement of claim 5 wherein the means connecting said chamber and receptacle contains a check means to prevent the liquid chemical from contacting the second chemical in the event the container is inverted.

8. The apparatus of claim 4 wherein there is an insulating layer overlying the bottom of the container.

9. Apparatus for dispensing flowable materials of varying viscosity comprising a container having a bottom and a cap with an opening therein, a manually operable valve positioned in said opening, a manually movable knob secured to said valve for moving the valve to an open position, said knob having a discharge duct therein, a portion of said container adapted for holding the flowable materials which are under gaseous pressure, a chemical gas generator positioned in a second portion of said container and means associated with said generator responsive to a decrease in external pressure on said generator whereby gas is chemically liberated from said generator when the valve is in an open position to effect a substantially constant continuing pressure against the materials so as to facilitate the expulsion thereof.

10. The apparatus of claim 1 wherein the chemical gas generator is a coiled bag under above atmospheric gaseous internal pressure and containing chemical reagents capable of reacting with each other to liberate a gas in response to the decrease in external pressure whereby the bag is caused to unfold and thereby exert the substantially constant continuing pressure against the materials so as to facilitate the expulsion thereof from the container.

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