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Morane et al.

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[54] **METHOD FOR FILLING A CONTAINER WITH A FLUID UNDER PRESSURE**

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[51] **Int. Cl.** **B65b 31/04**, B65b 31/10

[58] **Field of Search** 53/36, 239; 92/90; 141/1, 3, 141/9, 20, 100, 103, 104; 222/1, 386.5

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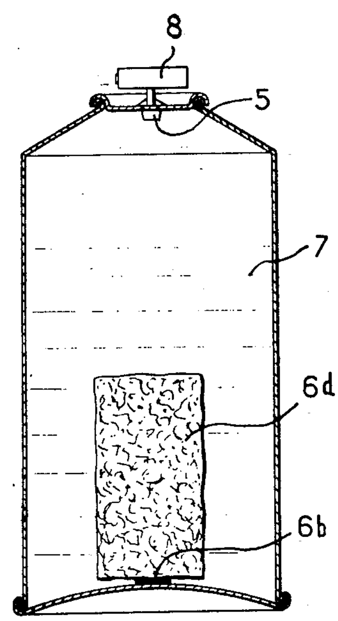
[57] **ABSTRACT**

Method and apparatus for storing and dispensing a fluid under pressure which utilizes a container holding a mass of closed-cell foam material. The fluid to be dispensed is introduced under pressure, thereby compressing the foam material, which expands to expel the fluid when a dispensing valve is opened. The foam material may be impregnated with a propellant gas before the fluid to be dispensed is introduced, and in that case the pressure applied when the liquid to be dispensed is introduced may liquefy the propellant gas trapped in the cells of the foam material.

9 Claims, 8 Drawing Figures



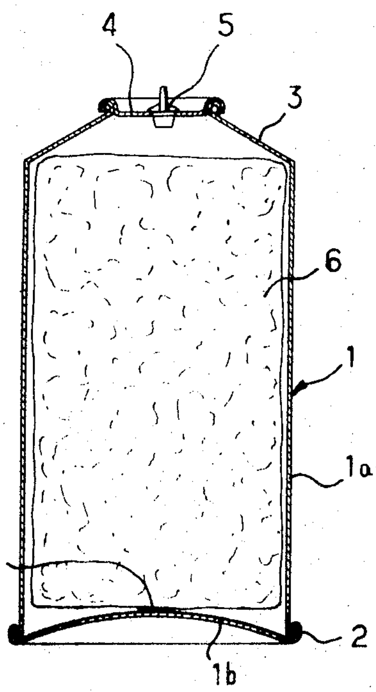


FIG. 1

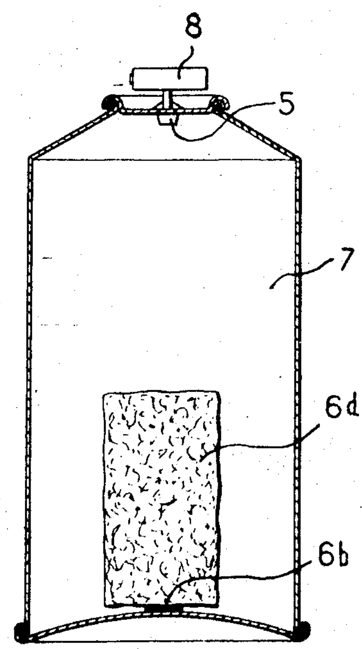


FIG. 2

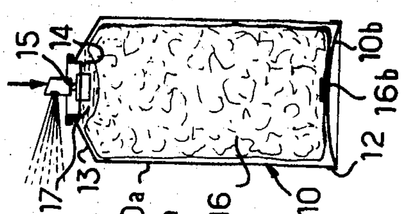


FIG.8

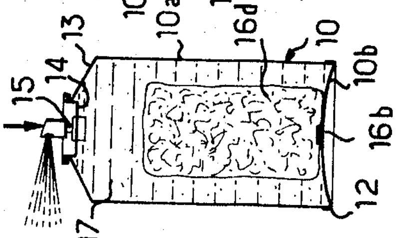


FIG. 7

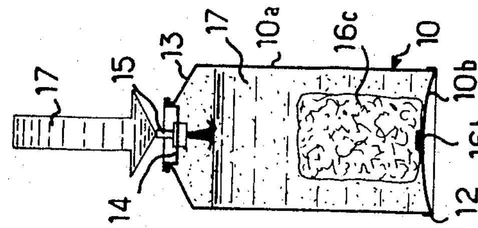


FIG. 6

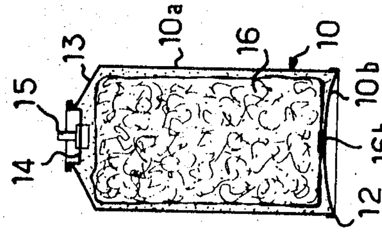


FIG. 5

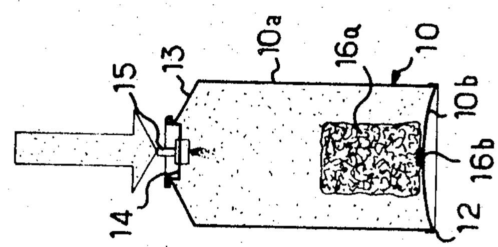


FIG. 4

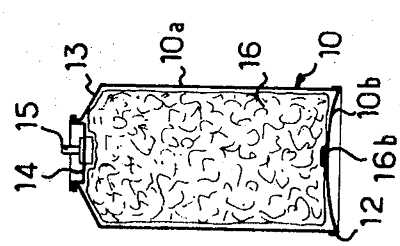


FIG.3

METHOD FOR FILLING A CONTAINER WITH A FLUID UNDER PRESSURE

SUMMARY OF THE INVENTION

In containers for holding pressurized fluids, the product to be dispensed is often placed under pressure at the moment of use by means of a propellant gas. Depending on the particular products to be dispensed and the propellant gas used, it may be disadvantageous to have the propellant gas come in contact with the product to be dispensed. Moreover, it should be noted that the price of the propellant gas used considerably increases the cost of the package and that the use of a propellant gas necessitates that at least certain parts of the container be made impervious to gas under pressure. Seals of this type are relatively difficult to produce.

It has already been suggested that contact between the propellant gas and tie product to be dispensed can be avoided by using containers having a piston with its base resting on the pressurizing gas and the product to be dispensed positioned on top of the piston. This solution substantially complicates the components which must be mounted inside the container and greatly increases the cost of packaging. It has also been proposed to introduce into the container an expansible chamber which is inflated by means of a pressurizing gas and to contract this chamber when introducing the product to be dispensed under pressure into the container outside the expansible chamber. This solution has the serious disadvantage of being very difficult to put into practice because of the difficulty of finding an elastically expansible chamber which is gas tight and inexpensive to manufacture. Moreover, the provision of such a chamber often results in a certain unreliability in the operation of the container.

It is the object of the present invention to provide a new method of packaging under pressure which is capable of dispensing a fluid in a liquid, viscous, or aerosol state without requiring resort to any complicated mechanical arrangement but nevertheless eliminates or substantially reduces the quantity of propellant gas required. It is important to note that, when the propellant gas is completely omitted, there is no need to make the container impervious to gas under pressure.

It is a further object of the present invention to provide a new method of packaging under pressure a fluid which is to be dispensed in a viscous, liquid or aerosol form, which is essentially characterized by the fact that a mass of closed cell compressible material is introduced into the outer jacket of the container while it is open at one end. The open end of the container is then tightly closed. The closed container formed in this manner is provided with at least one valve through which the fluid to be dispensed may be introduced and at least one through which this fluid may be dispensed or one valve may serve both purposes. The fluid to be dispensed is introduced into the container through the said inlet valve.

In a preferred embodiment of the invention the mass of compressible cellular material introduced into the container initially occupies almost the entire inner volume thereof and the cellular material is spaced from the dispensing valve by any suitable means such as a hook or the like. The valve through which the fluid to be dispensed is introduced is also the valve for dispensing this fluid. The container is closed after the cellular material has been introduced thereinto by mounting thereon an end member which supports the introducing and dispensing valve. The original container is a hollow cylinder having a base fixed to its lateral wall. The open end of the cylindrical container may be formed into a conical section at its free end. The valve support may be attached to this conical section.

In a variation of the above process, after the container has been closed and before the fluid to be dispensed is introduced, a certain quantity of a propellant gas capable of diffusing through the cellular material is introduced into the container. This variation of the process according to the invention makes it possible to insure an adequate ejection force, even for the last fraction of the product to be dispensed when it is ejected under pressure from the container. In effect, in the variation of the process in which no propellant is added, the injection of the fluid to be dispensed into the container containing the mass of cellular material results in the compression of the cellular material which contracts inside the outer jacket. This material then tends to return to its original volume to the extend that the product is dispensed, thus serving the purpose otherwise served by a propellant gas. The rate of flow varies considerably in dependence upon how full the container is. In effect, if the force exerted by the cellular material is substantial at the beginning of the distribution, it is much weaker when almost all of the product to be dispensed has been ejected from the container, because at this time the cellular material has almost regained its initial volume. The addition of propellant gas permits this disadvantage to be avoided.

It is accordingly a further object of the present invention to provide a method of packaging under pressure a fluid which is to be dispensed in a viscous, liquid or aerosol form, which method is essentially characterized by the fact that a mass of closed-cell compressible cellular material is introduced into the outer jacket of the container, while it is open at one end. The open end of the container through which the cellular material has been introduced is then closed and the closed container is equipped with at least one valve through which a product to be dispensed may be introduced and a valve through which this product may be dispensed or with one valve which serves both purposes. A propellant gas is then introduced through this valve, preferrably in liquefied form. This propellant gas is capable of diffusing through the cellular material. Preferably after letting the assembly stand for a certain period of time, the fluid to be dispensed from the container is then introduced through the valve.

In this variation of the process according to the invention, the introduction of the propellant gas, preferably in liquid form, compresses the cellular material inside the container, which then occupies a much smaller volume. When the resulting assembly is left to stand, the propellant gas diffuses into the closed cells of the cellular material so that the pressure within and without these cells becomes balanced and the cellular material regains its initial volume and again fills the container. The product to be dispensed may then be injected under a pressure greater than that prevailing inside the outer jacket. This causes further compression of the cellular material and a partial liquefaction of the propellant gas inside the cells of this material.

At the moment of distribution of the product to be dispensed, this product is ejected as a consequence of the pressure exerted by the compressed cellular mass on the product to be dispensed. This pressure is initially equal to the pressure at which the product was introduced into the outer jacket of the container and, at the end of the dispensing period, is near the pressure at which the propellant gas was injected into the outer jacket. But it should be noted that the quantity of propellant gas to be introduced is quite small in proportion to the quantity which must be used if there is no cellular mass. Moreover the cellular mass initially fills the entire volume of the container which is to hold the fluid to be distributed and the propellant gas does not come into contact with the product to be distributed, since it has completely diffused in the gaseous state through the walls of the cellular material and is then enclosed within these cells.

It will thus be seen that, while retaining the advantage resulting from the presence of the compressed cellular material inside the jacket, this variation of the invention provides an adequate ejection pressure at the end of the dispensing process.

Among the compressible cellular materials which may advantageously be used are foams of synthetic materials expanded into closed cells, which materials are inert with respect to the fluid to be dispensed and the propellant gas used, and in particular a polyethylene foam which has been expanded with nitrogen. The outer jacket of the container according to the invention may be made of a thin sheet of metal, which may be covered with a protective varnish. The base of the outer jacket may be attached to the lateral wall thereof by crimping it thereto. The valve support may be attached to the initially open end of the outer jacket in the same way. Suitable propellant gases include all of the conventional propellants and, in particular butane, and the chlorofluorinated hydrocarbons sold under the trademark FREON. It is obvious that the propellant gases used must, as a matter of safety, be compatible with the fluid being dispensed.

It is a further object of the present invention to provide as a new article of manufacture a container for a fluid under pressure which is to be dispensed in a viscous, liquid or aerosol form, which container is essentially characterized by the fact that it comprises an outer jacket provided with a valve for introducing the fluid and a valve for dispensing the fluid (or a single valve serving both purposes), and a mass of closed cell foam material within the jacket, said compressible cellular material being under pressure in said jacket.

In a preferred embodiment of this container a single valve is used both for introducing the fluid and dispensing the fluid. The outer jacket of the container is generally cylindrical in shape, closed at its lower end by a base and at its upper end by a support for the valve. The upper part of the jacket is conical. The valve of the container is provided, after introduction of the fluid to be dispensed into the container, with a pushbutton for controlling its distribution. The volume of the mass of cellular material introduced into the container, when this material is not under pressure, is substantially equal to the inner volume of the outer jacket. The pressure inside the outer jacket after introduction of the fluid to be dispensed is sufficient to reduce the volume of the cellular material by from 40 to 70 percent of its initial volume. The compressible cellular material is closed cell expanded synthetic foam material such as polyethylene, neoprene, or polyurethane expanded with nitrogen.

It is a further object of the present invention to provide as a new article of manufacture a container of the type described above without the fluid to be dispensed.

In a container such as has just been described there is no problem relative to contact between the propellant gas and the product being dispensed. Neither is there any problem resulting from a need to make the jacket gas-tight. The only sealing problems relate to making the jacket sufficiently impervious to hold the fluid to be dispensed. From a technical point of view this materially simplifies its construction.

It should, moreover, be noted that the container according to the invention, when it has been emptied by the user of its fluid contents, may be again recharged by introducing thereinto a suitable fluid charge under pressure. Moreover, the fluid to be dispensed may be in liquid or viscous form. When it is a liquid it may be dispensed in the form of a liquid jet or in aerosol form.

When the variation of the above mentioned process utilizing some propellant gas is put into practice, it is obvious that the container according to the invention must be slightly modified. It is therefore an object of the present invention to provide as a new article of manufacture a container for holding under pressure a fluid which is to be dispensed in viscous, liquid or aerosol form, which is essentially characterized by the fact that it comprises an outer jacket provided with at least one valve for introducing a fluid and a valve for distributing this fluid, or a single valve serving both purposes. Within this jacket is a mass of compressible closed cell cellular material immersed in the fluid to be dispensed. The cells of the cellular material contain a propellant gas. The assembly comprising the fluid and the cellular material is under a pressure inside the outer jacket which is greater than the liquefaction pressure of the said propellant gas.

In a preferred embodiment of the invention the valve used for introducing the fluid is the same as the valve used for dispensing it. The outer jacket has a generally cylindrical shape and is closed at its bottom by a base and at its top by a support for the valve. The upper part of the valve is conical. The valve is provided with a push button controlling the distribution after introduction of the propellant gas into the container after the introduction of the fluid to be dispensed. The volume of the mass of cellular material introduced into the container when the material is not under pressure, is substantially equal to the inner volume of the outer jacket. The pressure which prevails inside the outer jacket after introduction of the fluid to be dispensed is sufficient to reduce the volume of the cellular material holding the propellant gas by about 40 to 70 percent of its initial volume. The compressible foam material is a foam of a synthetic expanded closed cell material such as polyethylene expanded with nitrogen.

It is a further object of the invention to provide as a new article of manufacture a container such as the one described above which is not filled with any fluid to be dispensed, and which is essentially characterized by the fact that it comprises an outer jacket equipped with a valve for introducing and a valve for dispensing fluid, which two valves may be the same one. Inside this jacket is a mass of compressible closed cell foam material which holds a gas under pressure. This gas is capable of diffusing in a gaseous state through the walls of the cells of the foam material and may be liquefied by an increase in the pressure inside the outer jacket.

In a preferred embodiment of the device according to the previous paragraph the mass of compressible cellular material containing a gas under pressure occupies almost the entire volume of the outer jacket. The compressible cellular material is a closed cell foam of a synthetic material such as polyethylene expanded with nitrogen.

It should be further noted that the container according to this variation of the invention when it has been emptied by the user of its fluid contents may be recharged. Moreover, the fluid to be dispensed may be a liquid or viscous product. When it is liquid it may be dispensed as a liquid jet or in the form of an aerosol.

In order that the invention may be better understood two methods of carrying it out will now be described, purely by way of illustration and example, with reference to the accompanying drawings in which:

FIG. 1 is a schematic axial section through a container according to the invention, before the introduction of the fluid to be dispensed into the outer jacket;

FIG. 2 is a schematic axial section through the container of FIG. 1, after the introduction of the fluid to be dispensed under pressure;

FIG. 3 is a schematic axial section through a container according to the invention, after the introduction of a mass of cellular material and after the container has been closed by applying and introducing a dispensing valve thereto;

FIG. 4 represents the container of FIG. 3 after the introduction of a propellant gas under pressure;

FIG. 5 shows the container of FIG. 4 after it has been allowed to stand for a period of time so as to permit the diffusion of the propellant gas;

FIG. 6 shows the container of FIG. 5 after introduction of the product to be dispensed under pressure;

FIG. 7 shows the container of FIG. 6 during the distribution of the product which is to be dispensed; and

FIG. 8 shows the container of FIG. 6 after the product container therein has been dispensed.

Referring now to FIGS. 1 and 2 of the drawing, it will be seen that reference numeral 1 indicates the outer jacket of the container according to the invention. The outer jacket 1 is cylindrical in shape and comprises a lateral wall 1*a* which is connected to a base 1*b* by crimping at 2. The upper part 3 of the outer wall of the jacket 1 has been shaped to a conical form. The free end of the conical part 3 is closed by a support 4 which carries a central valve 5, through which a fluid may be introduced and dispensed. In order to manufacture the container according to the invention, as shown in FIG. 1, the first step is to make the outer jacket by forming the cylindrical lateral wall 1*a* and crimping the base 1*b* thereto. A cylinder 6 of closed cell polyethylene foam material is then inserted into the resulting cylindrical container. The cylinder **6** occupies almost the entire volume of the outer jacket **1** and is attached to the base **1b** by a drop of adhesive material **6b**. The upper part of the outer jacket is then formed into a conical shape and the opening of this cone is closed by a support **4** which carries the valve **5**. This produces the container shown in FIG. **1**.

The fluid **7** is then introduced through the valve **5** under pressure, and compresses the cylinder **6**, which then occupies a cylindrical volume **6a** (FIG. **2**). The volume **6a** is clearly less than the volume **6**. The valve **5** is then equipped with a push button dispenser **8**. When the user wants to employ the container according to the invention, he actuates the valve **5** by means of the push button **8** and thereby dispenses the fluid **7**, which is expelled from the container by the cellular material **6a** which tends to regain its initial volume **6**.

In one particular embodiment, the outer jacket **1** is made of aluminum sheet material which has been varnished and the container, in its final form, has an inner volume of 250 cc. The cylinder **6** initially introduced into the outer jacket has a volume of 240 cc. It is made of a polyethylene foam having closed cells and which has been expanded with nitrogen. Eau de cologne at 60° is introduced through the valve **5** under a pressure of 4.8 kg/cm². The cylinder **6** is thus compressed to occupy a volume of 100 cc. The container then holds 150 cc of cologne at 60°. By pressing on the pushbutton **8** the user may dispense an aerosol spray of eau de cologne. Almost the entire 150 cc of eau de cologne may be distributed in this way.

Referring now to FIGS. **3–8** of the drawing, it will be seen that reference numeral **10** indicates the outer jacket of the container according to the invention. The jacket **10** has the general shape of a cylinder, the lateral wall **10a** of which is connected to a base **10b** by crimping at **12**. The upper part **13** of the outer jacket **10** has been formed into a conical shape. The end of the conical part **13** is closed by a support **14** crimped to the free edge thereof. The support **14** carries in its central part a valve **15** through which a fluid may be introduced and dispensed.

In order to manufacture the container according to FIG. **3**, the outer jacket is first made up so as to provide the lateral wall **10a** crimped to the base **10b**, to which a cylinder **16** of closed cell polyethylene foam has first been attached. The cylinder **16** occupies almost the entire volume of the outer jacket **10** and is attached to the base **10b** by a drop of adhesive **16b**.

The upper part of the outer jacket must then be formed into the conical part **13**. The support **14** with its valve **15** is then crimped to the open end of this conical part to produce the container shown in FIG. **3**.

A propellant gas such as a chlorofluorinated hydrocarbon or butane is then introduced through the valve **15** at a liquefying pressure of 20° C. The cylinder **16** is compressed and then occupies the volume indicated by **16a** on FIG. **4**.

The propellant gas is then permitted to diffuse through the polyethylene of the cylinder **16** for 48 hours. At the end of this time the cylinder **16** has regained its initial volume due to diffusion of the propellant gas into its cells. This stage is shown in FIG. **5**. The product **17** which is to be dispensed is then introduced through the valve **15** under a pressure greater than the pressure at which the propellant gas was introduced. The cylinder **16** is again compressed and then occupies a volume indicated by **16c** on FIG. **6**. The container is then ready to dispense the product.

FIG. **7** shows the volume **16d** of cylinder **16** at one point during distribution of the product **17**, when the user operates valve **15**. The product **17** is evacuated in response to the pressure exerted thereon by the cylinder **16** as it expands from the volume **16a** to the volume **16d**. At the end of the distribution, the cylinder **16** has regained its initial volume, that is to say it occupies the entire inner volume of the outer jacket **10**. This stage of the distribution is shown in FIG. **8**. However, the last portion of the fluid **17** to be dispensed is ejected under a pressure corresponding to the pressure developed inside the cells of the foam constituting the cylinder **16** by the propellant gas initially introduced into said cells. It will thus be seen that at the end of the distribution, a satisfactory flow from the container may still be obtained.

Three examples of this second embodiment which have just been described, and which are illustrated in FIGS. **3** to **8**, will now be given:

EXAMPLE 1

A cylindrical jacket is used which has an inner diameter of 52 mm and an inner volume of 305 cm³. Inside this container is a cylinder of closed cell polyethylene foam which completely fills the cylindrical jacket.

Before being inserted in to the container, the cylinder of foam material has an outer diameter of 56 mm. After the container has been closed by applying a valve support comprising a valve for introducing and dispensing fluid, 4.4 g of a chlorofluorinated hydrocarbon is introduced into the container. This hydrocarbon is commercially sold as "FREON 12" and is introduced under a pressure of 4.8 kg/cm². The container is then left to stand for 2 days. Two hundred and ten g of Bourboule water is then introduced through the valve of the container under a pressure of 6 kg/cm². At the end of this introduction the cylinder of foam material is compressed by about 70 percent. The flow curve in grams per second is shown by the following results:

Average flow—0.655 grams per second
Maximum flow — 1 gram per second
Minimum flow — 0.25 grams per second

To measure the flow, the water was sprayed for a period of 10 seconds every 30 seconds until the container was completely empty. This shows that the minimum rate of flow at the end of the distribution period was entirely satisfactory.

EXAMPLE 2

The same container as used in Example 1 was employed with the same cylinder of foam material inside it. The rates of flow were measured in the same manner. 1.5 g of butane under a pressure of 3.2 kg/cm² was introduced into the container. This container was left to stand for 2 days. One hundred fifty g of Bourboule water was then introduced under a pressure of 5.6 kg/cm². The compression of the cylinder after this water had been introduced was about 55 percent. The flow rate curve in grams per second is shown by the following results:

Average rate of flow — 0.332 g/s
Maximum flow — 1 g/s
Minimum flow — 0.2 g/s

EXAMPLE 3

The same container as in Example 1 was used with the same cylinder of foam material inside it. The measurements were carried out by ejecting the product for a period of 5 seconds every 30 seconds.

4.5 g of a chlorofluorinated hydrocarbon sold under the trademark FREON 12 was introduced into the container under a pressure of 4.8 kg/cm². The container was left to stand for 2 days. About 100 g of a shaving cream having the following composition per 100 g was then introduced into the container under a pressure of 5 kg/cm².

"Double-pressure" stearin	25.0 g.
Hot ash lye at 50° baume'	1.3 g.
Triethyanolamine	0.3 g.
Glycerin	2.5 g.
Light vaseline oil	7.0 g.
Titanium oxide	0.3 g.
Perfume	0.2 g.
Water	63.4 g.

After the introduction of this cream the compression of the foam cylinder was about 35 percent. The flow curve in g/s is shown by the following results:

Average flow	0.123 g./s.

Maximum flow	0.35 g./s.
Minimum flow	0.10 g./s.

It should be noted that the produce being dispensed from the container according to the present example is in the form of a non-foaming shaving cream.

It will of course be appreciated that the embodiments which have just been described have been given purely by way of example and may be modified as to detail without thereby departing from the basic principles of the invention. In particular, the process and container according to the invention may be used for packaging products used in many technical fields and, among others, in cosmetics, food products, pharmacological products, paints and varnishes, household cleaning products and insecticides. The cellular product may be kept in position within the container by adhesively securing it to a wall, by hooking it to a wall or by means of special holding members. When no propellant gas is introduced into the container the cellular material may be compressed when introduced into the container even before the introduction of the fluid to be dispensed, so as to obtain at the end of the distribution a residual pressure assuring adequate evacuation of the last drops of fluid to be dispensed.

What is claimed is:

1. Method of packaging a fluid under pressure which comprises the steps of introducing a mass of closed-cell compressible cellular material into a container having an opening therein, closing said opening, providing said container with a dispensing valve, introducing into said container, under pressure, a propellant gas capable of diffusing into the cells of said cellular material, and introducing a fluid to be dispensed into said container while said fluid is under pressure, thereby compressing said foam material.

2. Method as claimed in claim 1 according to which said fluid is introduced through said dispensing valve.

3. Method as claimed in claim 1 in which said valve is mounted in a closure which is used to close said opening.

4. Method as claimed in claim 1 in which said container has a cylindrical wall and comprising the step of forming one end of said wall into a conical portion having a free edge defining said opening.

5. Method as claimed in claim 1 in which said cellular material is selected from among those inert to the fluid to be dispensed.

6. Method as claimed in claim 1 in which said cellular material is selected from the group of synthetic expanded foams consisting of polyethylene, neoprene and polyurethane foams.

7. Method as claimed in claim 1 in which said gas is permitted to diffuse into said cellular material for several hours before said fluid to be dispensed is introduced into said container.

8. Method as claimed in claim 7 in which said cellular material is a polyethylene foam material inert with respect to both said propellant gas and the fluid to be dispensed.

9. Method as claimed in claim 7 in which said propellant is selected from the group consisting of butane and chlorofluorinated hydrocarbons.

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