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PRESSURE-FEED DEVICE.

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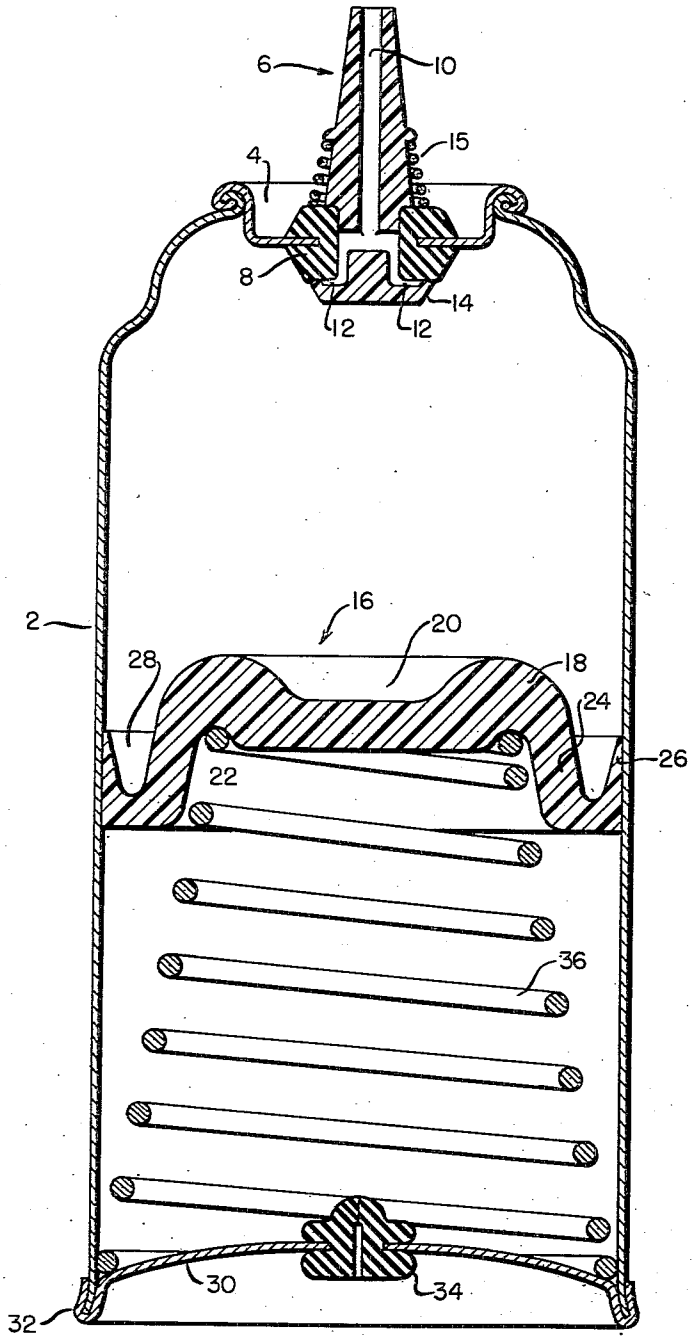

INVENTORS
JOSEPH KAYE
JAMES B. RESWICK
BY Kenway Jenney Witter & Hildreth
ATTORNEYS

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PRESSURE-FEED DEVICE

Joseph Kaye, Brookline, and James B. Reswick, Wellesley, Mass., assignors of twenty-five percent to Alf K. Berle, Dedham, Mass.

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The present invention relates to pressure-feed devices and more particularly to devices for propelling or dispensing a material by means of an enclosed source of gas or vapor under pressure.

An example of a device of this character is the familiar dispensing container adapted to dispense shaving cream, paint or other material when a valve is manually opened. The propelling source comprises a gas or vapor contained under pressure within the dispenser and usually mixed with the material to be dispensed.

This usual form of dispenser has many disadvantages, particularly in the possibility of loss of pressure fluid through the valve with consequent wastage of the contents. Furthermore this type of container has been found not to work satisfactorily with thick or viscous materials, of which toothpaste is an example, since the high pressures necessary for expulsion of the paste result in diffusion of the gas through the paste or channeling of the gas around the paste with consequent loss of pressure and wastage of the contents.

The present invention has for its object the construction of a pressure-operated propelling or dispensing apparatus in which materials of substantially any viscosity can be handled and without loss of pressure or appreciable wastage of contents.

With this object in view the present invention comprises as its principal feature the combination of a container having a semi-flexible piston with the material to be dispensed on one side and the pressure-source material on the other, in combination with a spring acting on the piston in such a manner that the material to be dispensed is maintained under an excess pressure over the pressure-source material. The construction of the device will presently be described in detail.

The accompanying drawing is a sectional elevation of a device embodying the principles of the present invention.

The illustrated embodiment of the invention comprises a dispensing container constructed for the dispensing of a thick viscous material such as, for example, toothpaste, although it may be applied to other materials and to other types of apparatus. As shown in the drawing, the device comprises a cylindrical can **2** of more or less conventional form having a cap **4** with a manually operable dispensing valve **6** of any suitable type. For purposes of completeness the valve **6** is described as a tube mounted in a rubber eyelet or grommet **8** in the cap **4** and having a central passage **10** communicating with a number of radial grooves **12** formed in the upper side of a head portion **14** of the valve. A helical spring **15** holds the valve outwardly. Material contained within the can under pressure will be dispensed through the passages **12** and **10** whenever the tube is pushed inwardly or rocked to one side.

According to the present invention the can **2** is provided with a piston **16** of semi-flexible material, such as polyethylene. The piston has a central portion **18** with a depression **20** which is of a size to surround the head

14 of the tube **10** as the contents of the can are exhausted. The underside of the piston is provided with a circular groove **22** to accommodate the upper end of a compression spring as will hereinafter be described. The piston is provided with a downwardly extending side wall **24** which terminates in an upwardly extending lip **26** adapted to fit smoothly within the can. The lip **26** is thin and flexible at its upper end and therefore presents toward the upper part of the can an annular hollow space **28** which, as will presently be described, serves as a means for tightly sealing the lip **26** against the side wall of the can.

The bottom of the can is closed by a bottom head **30** which is sealed into the can by a conventional sealing lip **32**. A filling grommet **34** of flexible rubberlike material is provided at the center of the head **30**, to permit introduction of the pressure-source material.

A coiled compression spring **36**, of general helical form but tapering upwardly, bears at its lower end against the head **30** and at its upper end is received within the annular groove **22** heretofore described.

The can is filled with the material to be dispensed, say toothpaste. The filling operation may be conveniently accomplished in a completely assembled can by forcing the paste in through the valve **6**; a needle may be inserted in the grommet to relieve the air under the piston. Alternatively the can may be filled through the bottom before the cap **4** and bottom head **30** are applied; then the entire assembly is completed and sealed. Whatever method of filling the paste is used, the pressure material is then inserted through the filling grommet **34** by means of a filling needle. The material comprises Freon preferably, which has a high vapor pressure at room temperature conditions. If necessary, the Freon may be chilled; in any event it is sufficient to introduce it under a pressure greater than its vapor pressure at the filling temperature. After filling, a quantity of the pressure material exists in liquid form in the bottom of the can and its vapor overlies the liquid. The quantity of pressure-source material is such that some liquid will remain in the can at normal temperatures when the can is completely empty of the paste, thus insuring that a substantially constant vapor pressure is available throughout the useful life of the device.

The drawing shows the position of the piston **16** at a time when a part of the contents has been dispensed. The piston may be considered to divide the can into an "upper" and a "lower" chamber, the former for the contents to be dispensed and the latter for the pressure-source material. If it were not for the spring **36**, the pressure in the upper chamber would be the same as that in the lower chamber, namely, the vapor pressure of the Freon. Under such conditions the piston would be in balance and there would be a tendency for Freon to leak past the lip **26** into the upper chamber. This leakage would tend to occur whenever the valve **6** was operated since the friction of the piston against the wall of the can would inhibit its movement and the relief of pressure at the top due to the opening of the valve would cause the Freon vapor to find a path around the lip **26**. However, because of the presence of the spring **36**, the hydrostatic pressure on the top of the piston is greater than the vapor pressure on the bottom. This is due to the fact that the total force exerted on the bottom is the sum of the spring force and the force due to the pressure of the Freon vapor. The only force acting on the upper face of the piston is that due to the hydrostatic pressure of the paste. Since the total forces on top and bottom must be equal for equilibrium, this means that the hydrostatic pressure on the top is necessarily greater than the vapor pressure on the bottom. Hence there is no possibility for the vapor to flow upwardly around the piston lip. Any tendency for

flow between chambers is in the opposite direction. However, when a viscous material, such as toothpaste, is contained in the upper chamber its flow is resisted by the viscosity of the material itself. Furthermore, the sealing space **28** which is filled with the contents under pressure causes expansion of the lip **26** into tight contact with the walls of the can and prevents any downflow; and this action occurs even in the case of relatively non-viscous materials in the upper chamber of the can.

The spring is of such strength that it is capable of applying a definite force to the piston even when the piston is at the upper limit of its movement. The condition by which the excess of pressure is exerted on the piston in a downward direction exists throughout the entire useful life of the container. When the valve **6** is opened the contents are dispensed by reason of the pressure differential between the upper chamber and the atmosphere, and the piston travels upwardly. Under conditions of piston movement, the forces acting on the piston are not, strictly speaking, in equilibrium, since the total force acting on the bottom of the piston must exceed the force acting on the top by an amount necessary to overcome friction between the piston and the container, and also by an amount necessary to accelerate the piston (which latter, however, may usually be considered negligible, because of the slow rate of motion). In any event, the spring will be sufficiently strong to insure that the excess of hydrostatic pressure is always in a downward direction, whether under static or dynamic conditions.

It will be understood that the descriptive designations "upper" and "lower," and similar terms used herein, refer to the drawing, and not to the orientation of the dispenser itself, since the device may be used in any position, and the pressure conditions are independent of position.

Although the invention has been described as adapted for the dispensing of materials from a container for domestic use, as, for example, for toothpaste and similar materials, it may be understood that it is equally applicable to apparatus for propelling and dispensing liquids and pastes of any character regardless of the shape or size of the container or the viscosity characteristics of the material being propelled.

Having thus described the invention, we claim:

1. A pressure feed dispensing device comprising a container having a cylindrical portion, a piston received in the cylindrical portion of the container to divide said portion into a contents chamber and a pressure chamber, a valve for dispensing of material from the contents chamber, the pressure chamber being sealed against the atmosphere and containing a pressure-source material permanently producing in the pressure chamber a superatmospheric pressure by presence of vapor therein, the pressure-source material acting at all times to apply to the piston a force in a direction toward the valve, and resilient means in one of the chambers acting on the piston to urge it toward the valve, whereby the hydrostatic pressure of the material in the contents chamber is greater than the pressure of the vapor in the pressure chamber.

2. A dispensing container as defined in claim 1 in which the piston is formed with a flexible sealing lip against the container and an annular hollow space facing into the contents chamber to seal the lip against the container.

3. A pressure feed dispensing device comprising a container having a cylindrical portion, a piston received in the cylindrical portion of the container to divide said portion into a contents chamber and a pressure chamber, a valve for dispensing of material from the contents chamber, the pressure chamber being sealed against the atmosphere and containing a supply of liquid permanently producing a superatmospheric vapor pressure which acts at all times to apply to the piston a force in a direction toward the valve, and resilient means in one of the chambers acting on the piston to urge it toward the valve, whereby the hydrostatic pressure of the material in the contents chamber is greater than the vapor pressure in the pressure chamber.

4. A pressure feed dispensing device comprising a container having a cylindrical portion, a piston received in the cylindrical portion of the container to divide said portion into a contents chamber and a pressure chamber, a valve for dispensing of material from the contents chamber, the pressure chamber being sealed against the atmosphere and containing a pressure-source material permanently producing in the pressure chamber a superatmospheric pressure by presence of vapor therein, the pressure-source material acting at all times to apply to the piston a force in a direction toward the valve, and a spring in the pressure chamber under compression at all times to apply to the piston a force in a direction toward the valve, whereby the hydrostatic pressure of the material in the contents chamber is greater than the pressure of the vapor in the pressure chamber.

5. A dispensing container as defined in claim 4 in which the piston is formed with a flexible sealing lip against the container and an annular hollow space facing into the contents chamber to seal the lip against the container.

6. A pressure feed dispensing device comprising a container having a cylindrical portion, a piston received in the cylindrical portion of the container to divide said portion into a contents chamber and a pressure chamber, a valve for dispensing of material from the contents chamber, the pressure chamber being sealed against the atmosphere and containing a supply of liquid permanently producing a superatmospheric vapor pressure which acts at all times to apply to the piston a force in a direction toward the valve, and a spring in the pressure chamber under compression at all times to apply to the piston a force in a direction toward the valve, whereby the hydrostatic pressure of the material in the contents chamber is greater than the vapor pressure in the pressure chamber.

7. A dispensing container as defined in claim 6 in which the piston is formed with a flexible sealing lip against the container and an annular hollow space facing into the contents chamber to seal the lip against the container.

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