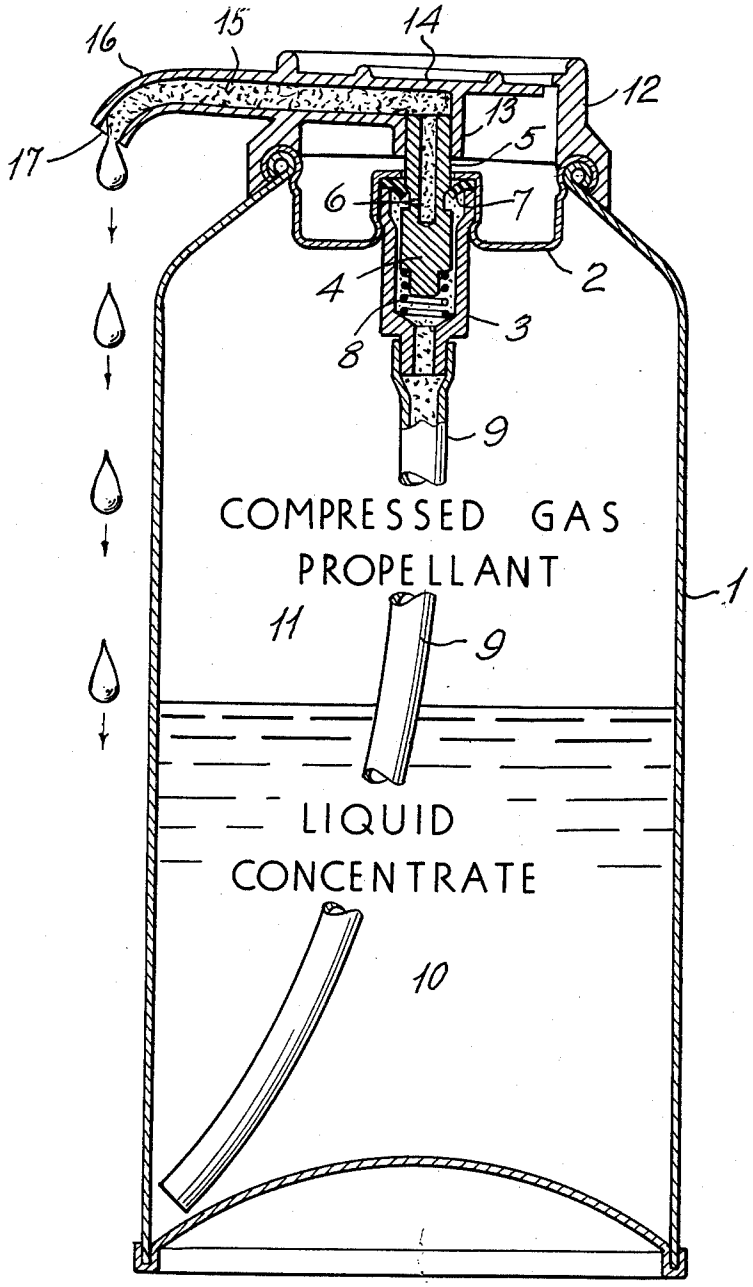
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MEANS FOR DISPENSING LIQUID CONCENTRATE DROP BY DROP

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INVENTOR
ROBERT H. ABPLANALP
BY
Cornelius Zahrt
ATTORNEY

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MEANS FOR DISPENSING LIQUID CONCENTRATE DROP BY DROP

Robert H. Abplanalp, Bronxville, N.Y., assignor of one-half to John J. Baessler, Bronxville, N.Y.

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1 Claim. (Cl. 222—394)

This invention is directed, generally speaking, to the art of dispensing pressure-packed materials consisting of active ingredients packaged within a valved container with a gaseous propellant, which serves to force the active ingredient from the container when the valve is opened. Pressurized packages of this character have heretofore dispersed the active ingredients either in the form of a fine spray or mist or in the form of a liquid stream.

There are a large number of products to which neither of these forms of dispensation is satisfactory and which must be measured out in the form of drops. Vitamins, eyedrops, saccharine, and other medicines are examples of such products. These are commonly retailed in bottles and are measured out by the use of bulbed eye-droppers, glass dip rods and the like.

Other products requiring small quantity dispensing are bitters, "Worcestershire" sauce and the like, commonly packed in spout bottles. When the bottle is inverted and longitudinally shaken, it discharges portions of the contents in successive squirts or jets of indeterminate quantities which, in practice, are generally either too much or too little.

When either of these prior methods of dispensing is employed, the package is opened, thereby permitting the entrance of ambient air and impurities at each dispensing operation. Thus, the sterility of the product is not properly safeguarded and in many cases oxidation, deterioration and spoilage of the products results.

Because of my close association with the aerosol and the broader fields of pressure packaging generally, I conceived that most of the ills and undesirable aspects incident to drop-dispensing as heretofore practiced could be overcome if products to be delivered in small measured amounts could be hermetically sealed in a pressurized container and delivered drop-by-drop, as and when desired, through a normally sealed manually operable dispensing valve associated with such a container.

While this basic inventive concept was spontaneous, the production of practical methods and mechanical means for accomplishing this end were found to involve numerous problems quite diverse from those commonly encountered in the aerosol art where spray and stream dispensing was the rule. That field invariably utilizes systems wherein the rate of discharge through a discharge orifice must insure an uninterrupted flow of a stream, spray or mist which is continuous so long as the valve is held open. Attempts to dispense drop-by-drop by such a system resulted in complete failure.

I found by protracted research, experimentation and tests that, in order to dispense drop-by-drop, the dispensing system must be constituted with due regard to the viscosity and surface tension characteristics of the product, the channel through which the product passed, the discharge orifice at which the drop was formed, the head space in the container, and the pressure and nature

of the propellant which forced the product to the orifice when the valve was opened.

I discovered that, in order to obtain drop-by-drop dispensing, the rate of flow of any particular liquid through the system to the orifice must be insufficient to discharge from the orifice a spray or stream of such liquid.

While this requirement may be met in various ways, I found that excellent results were obtained by making the capacity of the discharge outlet to pass the liquid, greater than the capacity of the system, including the pressure of the propellant, to feed the liquid to said outlet. With this relationship, the rate of flow of liquid through the entire system is slowed at the outlet sufficiently to permit the surface tension of the liquid to there exert itself and accumulate successive portions of such liquid into drop formation. The resulting drops successively respond to the action of gravity and fall free of the orifice in vertically spaced relation. The time interval of this spacing will depend upon the difference in such capacities.

I further found that in order to satisfactorily form drops, as stated, the propellant had to be one which will not form a foam of the material to be dispensed for foaming will preclude the formation of drops and defeat the purposes of this invention. Any appropriate propellant which will discharge the material without foaming may be used, but I prefer to employ one which is substantially insoluble in the active ingredient and chemically inert with respect thereto so as not to change the physical or chemical characteristics of such ingredient or dilute the same. Nitrogen gas is preferred.

An important feature of this invention resides in the fact, of particular importance with medicines, that the product is hermetically sealed in the container except when the valve is opened and at that time the flow from the container seals the latter against the entrance of air and impurities. The product is thus safeguarded against oxidation and contamination and remains good until used.

Another feature of this invention is that it provides a self-contained package, operable to emit drops from a discharge point at a uniform rate, dependent on the manually applied opening of the discharge valve.

This invention makes it possible for the user to easily and accurately dispense liquids by drop-by-drop measurement to the exact quantity prescribed or desired, rather than by hit or miss procedure and without the use of eyedroppers, dip rods, pipettes, squirt bottles, or other extraneous means. The operation is performed without mess or fuss—just "push the button" and count the drops.

Features of the invention, other than those adverted to, will be apparent from the hereinafter detailed description and appended claims, when read in conjunction with the accompanying drawing.

In the accompanying drawing I have illustrated one form of dispenser which may be used in carrying out the method of this invention, but the showing therein made is to be understood as illustrative, only, and not as defining the limits of the invention with respect to either the method or apparatus aspects thereof.

The drawing is a vertical central section of a pressurized drop dispenser embodying one form of system of the present invention.

In said drawing, 1 designates any conventional form of container made of any appropriate material, but hereinafter referred to for convenience as a can. This can has a top closure sealed by a cup 2 on which is mounted any appropriate form of valve which will fulfill the requirements of this invention. For the purpose of illustration I have shown a valve, such as described and claimed in my Patent No. 2,361,814, dated March 17, 1953. That valve comprises a valve body 3 having therein a valve core 4 provided with a stem 5. Said stem,

which is of tubular form, has formed therein a cross axial opening 6 adapted, when the valve is "closed" to be embraced and sealed by a resilient sealing gasket 7. A spring 8 normally moves the valve core into closed position to seal the opening 6. In the drawing the valve is shown in open position.

Attached to the lower end of the valve body is an eduction or dip tube 9 which extends to the bottom of the can. The can contains a liquid concentrate 10 and the head space 11 above said concentrate is filled with a compressed gas propellant.

Mounted on the upper end of the can is a dispensing cap 12 of a character shown in my allowed patent application, Serial No. 619,621, filed October 31, 1956, now Patent No. 2,819,116 and reissued as Reissue Patent No. 24,555. This cap is provided with a hub 13 formed on a tab 14. The hub has a socket which receives the upper end of the valve stem 5 and from this hub extends an outlet passage 15 formed partially within the body of the cap and extending through a spout 16 projecting beyond one side thereof.

The cap shown in the drawing has heretofore been extensively used on dispensers adapted to deliver foam, such, for example, as aerated aerosol shaving creams and the like. I find this type of cap well adapted to carry out the present invention when incorporated in the system of which the drawing is illustrative.

When downward pressure is placed on the tab 14, the valve body is depressed to open the valve as shown in the drawing, so that the compressed gas propellant in the head space 11 may force the liquid concentrate upwardly through the dip tube and through the unsealed opening 6 and thence through the tubular valve stem into and out through the passage 15 to be discharged from the outer end of the passage.

In order that a dispenser of the character shown in the drawing may be useful to dispense liquids in the form of consecutive drops, the system therein illustrated must be so constituted that the rate of flow of the concentrate through the system to the discharge outlet must be less than the capacity of said outlet to pass such material. This rate of flow may be effected in accordance with this invention in various ways, but they all depend upon one fundamental requirement, namely, that there be provided somewhere between the interior of the can and said discharge outlet, a constriction which will slow down the rate of flow to a point where the flow capacity through the system is less than the capacity of the outlet to discharge it. By reference to the drawing it will be noted that the cross section of the passage 15 is materially greater than the cross section of the opening 6 in the valve. Opening 6 therefore can only pass the material through the system at a much slower rate of flow than the capability of the passage 15 to discharge such material through the discharge outlet 17 which is shown as at least equal in cross section to that of the passage 15.

I have referred to the use of a propellant which will not deliver the liquid in the form of foam. In the delivery of foam as heretofore carried out in the aerosol fields, the foam simply backs up in the outlet passage and is discharged therefrom in a continuous ribbon or stream, so long as the valve is open. Such a procedure is of no utility in carrying out the present invention which requires the use of a propellant, such, e.g., as nitrogen gas, which is inert and substantially insoluble in the concentrate and will not tend to dilute the latter. Under these conditions, the liquid, flowing through the valve opening 6 to the passage 15, is materially slowed down during its flow through said passage 15, so that it is delivered to the discharge outlet 17 in free-flowing liquid form to insure such rate of discharge at said outlet as to permit the surface tension of the liquid to there exert itself and accumulate successive portions of said liquid into drop formation as hereinbefore stated.

In carrying out this invention, inert and insoluble propellants, such as nitrogen, argon, neon, crypton, xenon, helium, and radon gases may advantageously be employed, but nitrogen is preferred because it is relatively inexpensive and highly effective in carrying out my purposes.

It should be understood, however, that some other propellants may be employed which are not entirely insoluble or inert, depending primarily upon the uses of the present invention, and more particularly the materials to be dispensed. However, the propellant must be such that it will not cause foaming of the material. When an inert and substantially insoluble propellant is employed, the drop which forms at the discharge outlet 17, is composed entirely of the material and this is important, particularly when medicines are involved, in order that proper measurement of the dosage may be obtained. When some other materials, such as sauces of the character hereinbefore referred to, are dispensed, it would do no harm to use a propellant which is slightly soluble or at least not soluble enough to form a foam. Therefore, while the preferred procedure of the present invention is directed to the dispensing of unadulterated drops, the use of a propellant, which might cause the entrapment of a slight amount of gas within the drop, will not depart from this invention.

As various liquids with which the present invention is operable may widely differ in viscosities, due consideration must be given to the pressure of the propellant. There must be sufficient pressure to feed the concentrate through the system to the discharge outlet 17 and the actual amount of the pressure required will of course depend upon the viscosity of the material and the constriction or type of constriction through which the concentrate is passed. Viscosities ranging from 40 centipoises to 2240 centipoises have been satisfactorily dispensed at the rate of about one drop per second through the employment of pressures ranging from 5 lbs. to 100 lbs. p.s.i., although the invention is not limited to these specific viscosities or pressures.

However, in drop dispensing it is desirable that the spacing of successive drops be substantially constant or at least such that successive drops be readily discernible for optical measuring purposes, from the initial dispensing of such drops from a fully charged container until substantially all of the concentrate has been dispensed. In order to insure such a condition, due regard should be had to the amount of liquid concentrate initially packaged in the can and the amount of head space 11 left in said can. If too little head space is left, the pressure will drop rapidly as the material is dispensed, so that the dispensing of the last part of the contents from the container will require a much longer holding of the valve open, due to pressure drop, than at the beginning of the initial dispensing operation. I have found that substantially equal volumes of liquid concentrate and head space are thoroughly satisfactory in this connection, for while the drops may be more closely spaced from a fully charged can they can be readily counted and that the slowing down of the dropping will not be undesirable to the operator.

Because of the wide range of the viscosity of the liquids which may be dispensed according to this invention, it is not practical or proper to limit this invention to the proportions between head space and concentrate or with respect to particular pressure employed, so long as the law of operation of this invention is adhered to, namely, that the rate of flow of the liquid through the system is less than the capacity of the outlet to discharge such liquid concentrate for it is this factor that permits the surface tension of the liquid to collect successive parts of the flow into drop formation.

In the structure shown in the drawing, the opening 6 in the valve stem constitutes the constriction which controls the rate of flow through the system to the outlet passage 15. In practice, a like result may be accomplished by providing a constriction in some other part

of the system than at the valve. For example, the opening 6 might be made so large as not to serve as a constriction in which case a constriction could be formed in the outlet passage 15 in spaced relation to the outlet 17, or at some other part of the system such as by using a dip tube of such capillary size and of an appropriate length to control such rate of flow. Likewise the rate of flow may be controlled to a large extent by adjustment of the pressure of the propellant, so that by any of these means and others which may be suggested thereby, the law of operation of the present invention may be fulfilled.

I wish it understood, however, that, while I have shown a particular type of valve and a particular valve operating mechanism in the form illustrated in the drawing, the invention is not limited to these structures as other means may be supplied for performing the method of this invention.

In the form of the invention shown in the drawing, the operator can of course control to a certain extent the spacing of the drops by opening the valve to a greater or lesser extent, but in any event full opening of the valve will nevertheless effect such drop-by-drop dispensing for in every case the rate of flow of the material to the outlet passage 15 is such that its capacity is less than the capacity of that passage and its discharge orifice to dispense the concentrate.

The foregoing detailed description sets forth the invention in its preferred practical forms, but the invention is to be understood as fully commensurate with the appended claim.

Having thus fully described the invention, what I claim as new and desire to secure by Letters Patent is:

A drop dispensing package comprising: a normally sealed container partially filled with a free-flowing active ingredient; a valved discharge passage leading from the interior to the exterior of the container and having an outer and of enlarged cross sectional area; and in the head space of said container a propellant under constant pressure sufficiently great to dispense, in the absence of a drop producing constriction in said passage, and uninterrupted flow of active ingredient from the discharge passage when the valve is substantially fully open; said passage having therein a constricted portion to restrict the flow of the active ingredient to the enlarged outer end of the discharge passage sufficiently to permit successive portions of said flow to accumulate in the enlarged outer end of the discharge passage and dispense the active ingredient therefrom in the form of successive drops when the valve is substantially fully open.

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CERTIFICATION OF CORRECTION

Patent No. 2,932,434 April 12, 1960

Robert H. Abplanalp

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 7, for "and", first occurrence, read -- end --; line 11, for "and" read -- an --.

Signed and sealed this 18th day of July 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents