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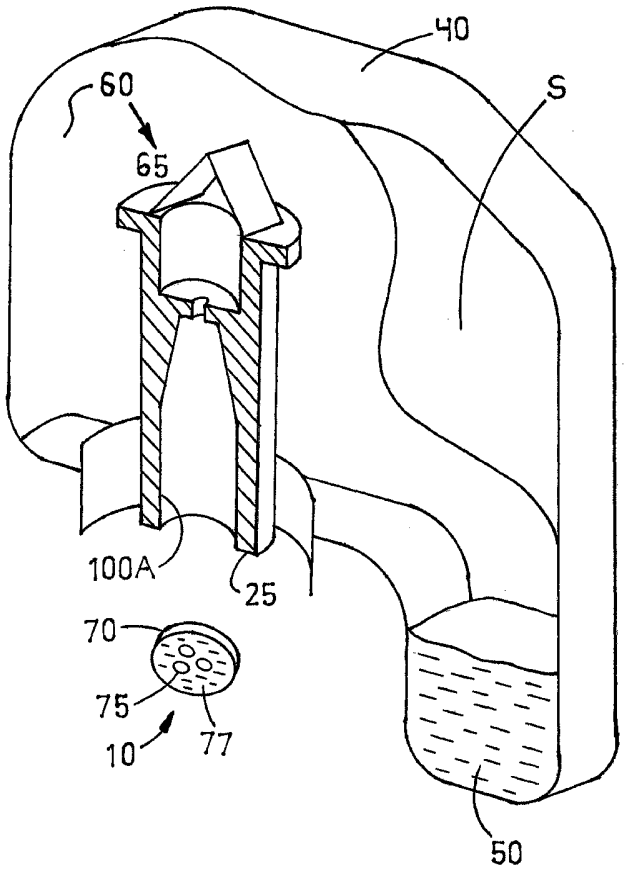
(54) Title: PBOB SYSTEM (PLURAL BODY ON DEMAND)



(57) Abstract: The present disclosure includes several pioneering discoveries. Including, a complete dose (10) of gas (60) formed essentially by motive gas (65). Dose (10) having the form of a plurality of bubbles (75). Also, a pbod ejected from any selected initial velocity. Also, a succession of identical bubbles formed essentially by a motive gas. Pbod systems transport a dose of liquid and a dose of gas to a target via pbod (70). Pbod systems may provide a solution to many various problems in many various technologies.

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TITLE OF THE INVENTION

pbod system (plural body on demand)

TECHNICAL FIELD OF THE INVENTION

The present pioneering discovery resides in pbod systems. A pbod consists essentially of: a dose of liquid having the form of one ball; and a dose of gas having the form of a plurality of balls (bubbles); and the ball of liquid encloses the balls of gas; and the pbod is assembled on demand.

Portions of the present description are previously disclosed in COFFELT,JR. U.S. patent application No. 10/827,901 filed 19 April 2004 (19.04.04).

Pbod systems are capable of providing a solution to numerous problems. Obviously, there are many pertinent problems in many various technologies, which are incorporated herein by reference. The pbod may be used in any of these pertinent arts. The following are examples of these pertinent arts and problems.

The art of forming pendant drops is well known. And further, there are many arts, which utilize the pendant drop, or droplet. For example, fuel injection, surgery, chemical / biological arts, or eye drops, including many others. And within these arts, a typical range of quantities is in the microliter range. For example, an over-the-counter pendant eye drop is between 15 to 30 microliters. It is also well known, an optimal quantity of liquid for opthalmic medicament applications is in the 5 to 7 microliter range. For example, TIMOLOL (Bausch & Lomb, Rochester, NY,U.S.). And in light

of the high cost of opthalmic medicament, a 3 microliter dose is most likely highly desireable. The prior art clearly shows the art of forming one pendant drop on demand is not capable of reliably attaining these small microliter quantities.

It is also well known, an additional problem has existed for many years in the prior eye drop systems. Specifically, the requirement of tilting the head back to instill an eye drop. One method, which attempts to solve this problem is dispensing the medicament in a spray (plurality of droplets). However, these jet systems are clearly subject to inaccuracies , recalibration, and failures due to the presence of complex moving parts and substantial frictional forces.

Additional prior methods attempt to solve this problem (tilted head). For example, in Basilice, et al U.S. patent No. 5,848,999 Dispensing eye drops is disclosed. The methods of Basilice attempt to solve this problem by utilizing an apparatus designed to dispense the eye drop on the lower eye-lid. However, this method includes an abnormal displacement of the lower eye-lid. Therefore, the systems of Basilice are clearly not optimal.

Examples of complex dispensing apparatus include, Cohen et al U.S. patent No. RE 38,007 discloses a microdispensing opthalmic pump. The systems of Cohen inescapably dispense a plurality of droplets. The systems in Cohen are required to contain several complex moving parts. Where this complex prior system includes springs, balls, moving pistons, and check valves. Therefore, the systems of Cohen are subject to failure, error, repair, or recalibration due to the inescapable inherent frictional forces present in the system.

Further example of complex prior systems include Ershow et al U.S. patent No. 5,756050 discloses a device for dispensing microdoses (microdrops / drops). For example, BIOMEK.RTM.1000 (BECKMAN) Automated Laboratory Workstation for dispensing cell lines and bacteria.

Further attempts to solve these pertinent problems are disclosed in Coffelt,Jr. U.S. patent No. 6,206,297 gasdrop and apparatus for manufacturing gasdrop. The accuracy of dosages in the gasdrop, in the microliter range, is unknown.

Excessive fuel emissions is also a well known problem.

The emissions of combustion engines clearly must be reduced to a minimum. And it is obvious, if the same quantity of power can be produced from less fuel, the emissions will most likely be less.

Pbod systems is a pioneering technology. This technology is disclosed in Coffelt,Jr. International Publication No. WO 02/43845, published under the Patent Cooperation Treaty 06 June 2002, Dual microliter dosage system. In WO 02/43845, the terms "dosdrop" and "microdose" refer to the article of manufacture in the present specification. And in the corresponding U.S. patent application No. 10/296.487, filed 22 NOV 2002, the term "dosdrop" is changed to "pbod" or "hbod". This name change does not alter the structure disclosed in WO 02/43845. This change merely changes the name associated with the structure.

To make clear, the presently disclosed novel pbod systems manufacture the structure disclosed in WO 02/43845. For example, a "pbod" is a "dosdrop"; and a "pbod" is a "microdose" where each of these terms refer to the same structure. And the objective of these changes in name is to attain the most suitable name for this pioneering article of manufacture.

The term "pbod" refers to "plural body on demand". A pbod consists essentially of: a dose of liquid having the form of one first ball; and a dose of gas having the form of a plurality of balls (bubbles); and the ball of liquid encloses the balls of gas; and the pbod is assembled on demand. And the pbod is ejected from the system on demand.

The prior pbod systems in WO 02/43845 utilize distinct discrete complex metering apparatus, first, to inject a dose of liquid into the flow channel; and second, insert a syringe needle into the dose of liquid; and third, inject a dose of gas into the liquid via the needle. The dose of gas is formed by inserting the needle into the liquid; and displacing the plunger of the syringe.

Subsequently, a motive gas ejects this dose of liquid and dose of gas having the form of one pbod. Where this motive gas may form a portion of the dose of gas. However. the prior art motive gas does NOT form the complete dose of gas. The prior art does not contemplate any method or

or apparatus to attain the results of the present invention.

Problems in these prior art pbod systems include the requirement of complex metering apparatus. Which inherently creates a relatively high probability for error and reduced reliability. It is well known, systems with moving parts are subject to error and failure due to frictional forces. And therefore, these complex pbod systems are subject to recalibration or repair. Further, the cost of manufacturing these prior pbod systems is relatively excessive.

Additional problems in the prior pbod systems include the problems associated with dispensing small microliter bubbles into a liquid. For example, experiments show, under normal conditions of the systems in WO 02/43845, the probability of ejecting a limited plurality of 0.07 microliter bubbles on demand from a syringe needle is very near zero. Therefore, this problem imposes quantitive limitations on the prior art pbod systems.

Additional problems in this prior art pbod system include, the system is not optimal to be used in a doctor-patient enviornment. And further, this prior art pbod system is not optimal for a person to self-instill a pbod to the eye. For example, a pbod dispensed on the eye for dryness relief.

INDUSRTIAL APPLICABILITY

In light of all of the above-mentioned problems in the prior art pbod systems, and the numerous well known problems and failed attempts in all pertinent technologies, there is clearly a need for a simple inexpensive system, which will reliably dispense optimal doses of liquid on demand to a target. For example, it is well known, there are numerous attempts over a period of many years, which have failed to dispense small microliter doses in a unitary body. For example, the pendant drop.

Therefore, the present pioneering discovery will be greatly appreciated for providing simple, reliable pbod systems, which transport a unitary body of liquid and gas to a target. Where optimal accurate doses of liquid and gas are attainable. Further, provide a pbod system which is capable of allowing the doses to vary over a range of

quantities IF desired. Further, provide a pbod system capable of being adapted to be used, for example, in a doctor-patient or self-instill enviornment; and possibly chemical / biological enviornment, for example, pipette systems; fuel injection enviornment, including many other technologies, which rely on this type of fluid and/or gas transportation. The present pioneering discovery will be greatly appreciated for providing reliable pbod systems, which may provide a solution to problems in many various technologies.

SUMMARY OF THE INVENTION

The present pioneering discovery resides in pbod svstems. A pbod consists essentially of: a dose of liquid having the form of one first ball; and a dose of gas having the form of a plurality of balls (bubbles); and the ball of liquid encloses the balls of gas; and these components of the pbod are assembled on demand. For example, first, the ball of liquid is disjointed from the gas; and second, the ball of liquid encloses the gas.

A novel pbod system resides in a pbod system where a complete dose of gas is formed essentially by a motive gas. Where this motive gas is the sole source of this complete dose of gas. And this dose of gas is subsequently the complete dose of gas in one pbod.

The present disclosure includes a second discovery. Where this second discovery is summarized as a pbod capable of being dispensed from any indiscriminate selected initial velocity. For example, a pbod having an initial velocity, which is either vertical, horizontal, or any other selected orientation.

The present disclosure includes a third discovery. This third discovery is summarized as a succession of identical bubbles formed essentially by a motive gas. Where the spacing of these bubbles appears to be nearly identical. Further, the diameter of these identical bubbles is inversely proportional to the flow speed. For example, a greater flow speed forms smaller bubbles. (i.e. 0.003cm or 0.03cm dia.)

The present disclosure includes a fourth discovery. This fourth discovery is summarized as a pbod system, which utilizes inherent residual liquid in a discharge tube.

This system ejects a pbod from the discharge tube; and a dose of liquid inherently remains in the discharge tube; and this residual liquid inherently forms a plurality of transverse walls; and this residual liquid is used in conjunction with an additional dose of liquid to form a subsequent pbod. For example, a 3 ul dose of liquid is added to 1 ul residual liquid to form a 3 ul pbod.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The present invention is further described by reference to the appended drawings taken in conjunction with the following description wherein identical or corresponding parts are identified by the same reference character throughout the several views of the drawing where:

FIG. 1 is a right side perspective sectional view of a pbod dispenser, including: a flexible bottle (40); a dispensing tip (100A); a liquid (50); gas (60); and a pbod (70).

FIG. 2 is a right side sectional view of pbod dispensing tip (100A); and bottle (40).

FIG. 3 is a top view of pbod dispensing tip (100A).

FIG. 4 is a right side view of structure (22).

FIG. 5 is a right side sectional view of pbod dispensing tip (100A); and the axis of tube (27) is horizontal.

FIG. 6 is a right side sectional view of pbod dispensing tip (100A); and tip (100A) contains a dose (77) of liquid (50).

FIG. 7 is a right side sectional view of pbod dispensing tip (100A); and tip (100A) contains the dose (77); and dose (77) encloses a dose (10) of gas (60); and dose (10) having the form of a plurality of balls (bubbles).

FIG. 8 is a front sectional view of a prototype R22; and a succession of identical bubbles (204).

FIG. 9 is a front view of a prototype R11; and a pbod (70).

NOTE: the diameter of pbod dispensing tip (100A) is exagerated in FIG. 1 and FIG. 2 to show detail.

NOTE: FIG. 1 does not show resin (5) for clarity; and FIG. 1 does not show resin (1) for clarity.

NOTE: FIG. 2 does not show portions of cap (45) for clarity; and does not show portions of cap (41) for clarity.

NOTE: FIG. 5 does not show portions of tube (43) for clarity; and a single line is utilized to represent tube (43).

DETAILED DESCRIPTION OF THE INVENTION

The present pioneering discovery resides in pbod systems. Including, a pbod system where a complete dose of gas is formed essentially by a motive gas. Where this dose of gas is the complete dose of gas in one pbod.

The pbod is referred to as a "microdose" in the International Application published under the Patent Cooperation Treaty under No. WO 02/43845, 06 June 2002 (06.06.02), Dual Microliter Dosage System.

The structure of the microdose in WO 02/43845 is the same structure disclosed in the present specification. Where this structure is presently identified by the term "pbod". The name is changed to attain the most suitable name for this pioneering article of manufacture.

A pbod consists essentially of: a dose of liquid having the form of one first ball; and a dose of gas having the form of a plurality of balls (bubbles); and the ball of liquid encloses the balls of gas; and these components of the pbod are assembled on demand. For example, first, the liquid is disjointed from the gas, and second, the ball of liquid encloses the balls of gas. The pbod is subsequently ejected from the system.

Each dose, liquid, gas, motive gas, and additional pertinent parameters must be capable to assemble a pbod on demand. If a pbod is formed, it can be concluded, all pertinent parameters are capable to form one pbod.

A pbod exists in two states. First, a non-discrete pbod attached to a surface. Second, a discrete pbod.

Objectives of the present invention include, provide a pbod system where a complete dose of gas is formed essentially by a motive gas. Further, provide a pbod system, which is simple, relatively inexpensive, and substantially more reliable over the prior art. Further, provide a pbod system capable of attaining optimal dosages. i.e. opthalmic, fuel-injection, including many others. Further, provide a pbod system, which is not subject to substantial frictional forces, recalibration, or mechanical failure due to frictional forces. i.e. moving pistons.

A second discovery includes a pbod capable of being

dispensed from from any indiscriminate selected initial velocity. For example, a pbod having an initial velocity, which is either vertical, horizontal, or any other selected orientation.

A third discovery includes a succession of identical bubbles formed essentially by a motive gas. Where the spacing of these bubbles appears to be nearly identical. Further, the diameter of these identical bubbles is inversely proportional to the flow speed. For example, a greater flow speed forms smaller bubbles. For example, a flow speed of [x] forms bubbles of 0.03 cm diameter; and a flow speed of [y] forms bubbles of 0.003 cm diameter; where [y] is greater than [x].

A fourth discovery includes a pbod system. which utilizes inherent residual liquid in a discharge tube. First, this pbod system ejects a pbod from the discharge tube; and second, a dose of liquid inherently remains in the discharge tube; and third, this residual liquid inherently forms a plurality of transverse walls; and this residual liquid is used in conjunction with an additional dose of liquid to form a subsequent pbod. For example, a 3 ul dose of liquid is added to 1 ul residual liquid to form a 3 ul pbod.

Meaning of TERMS: The present specification contains well known structures having axis of symmetry. Where these structures have a longitudinal axis of symmetry, and a transverse axis of symmetry.

For example, in a cylindrical shaped tube, the transverse axis of symmetry coincides with a diameter of the tube. And the longitudinal axis of symmetry is a line perpendicular to the diameter and intersecting the mid-point of the diameter.

The following embodiments are described with reference to the longitudinal axis of symmetry. For example, in FIG. 2 the longitudinal axis of symmetry of tube (27) is vertical.

The term "axis" as used hereinafter means: " the longitudinal axis of symmetry".

The term "transverse" as used hereinafter means: " a direction perpendicular to the longitudinal axis of symmetry". For example, in FIG. 2, a transverse direction is disposed in a horizontal plane relative to the axis of tube (27).

Units of MEASURE: milligrams = mg ; microliters = ul ; centimeters = cm ; millimeters = mm ; milliliters = ml ; grams = g ; cubic centimeters = cc

The present invention is hereinafter described with reference to the appended drawings where identical or corresponding parts are identified by the same reference character throughout the several views of the drawing.

The following is a description of general embodiments. And more specific embodiments of the appended figures are provided by the following prototypes.

FIG. 1 is a right side perspective sectional view of a pbod dispensing tip (100A). Dispensing tip (100A) is symmetrical, therefore, the left side perspective sectional view is a mirror image of FIG. 1.

The lower end of tip (100A) is a cylindrical shaped tube (27). Tube (27) having a flat annular outlet (25).

A conical shaped tube (28) is rigidly attached to the upper end of tube (27). The upper end of tube (28) is monolithic with a transverse disc shaped wall. This disc shaped wall having a centrally located opening (35). For example, tube (28), the disc shaped wall, and opening (35) can be a standard VISINE dispensing tip. i.e. over-the-counter eye drops.

FIG. 2 shows tube (27) is attached to tube (28) by an annular epoxy resin (4). Resin (4) forms a leak-tight seal at this point of attachment.

FIG. 1 shows the inner diameter surface of tube (27) and the inner diameter surface of tube (28) forms a continuous flow channel. The axis of tube (27) is co-axial with the axis of tube (28).

There are clearly standard methods to form tube (27) and tube (28) as a unitary body. Therefore, the lower end of tip (100A) does not show the joints and resin (4) in FIG. 1.

A cylindrical shaped tube (29) is rigidly attahced to the upper end of tube (28). This attachment is formed by annular epoxy resin (4). An annular leak-tight seal is formed at this point of attahment. Tube (29) is co-axial with tube (28).

The lower end of tube (29) is co-planar with the upper end of tube (28).

A cylindrical shaped tube (11) is rigidly attached to the upper end of tube (29). The upper flat annular surface of tube (11) is co-planar with the upper flat annular surface of tube (29). Tube (11) is attached to tube (29) by annular epoxy resin (2). The boundaries of resin (2) are limited to the lower flat annular surface of tube (11). The boundaries of resin (2) are also limited to the outer surface of tube (29).

FIG. 2 shows a structure (22) is rigidly attached to the upper end of tube (29). This attachment is formed by epoxy resin (1). Resin (1) is located at two places, one at the lower left side of structure (22), and one at the lower right side of structure (22) (FIG. 2). The boundaries of resin (1) are limited to the outer surface of structure (22). The boundaries of resin (1) are also limited to the width of structure (22) indicated by the dimension "N". The boundaries of resin (1) are also limited to the upper flat surface of tube (11), and the upper flat surface of tube (29).

Structure (22) is formed of two flat rectangular converging walls. FIG. 2 and FIG. 4 show structure (22) having an inverted V shape.

FIG. 3 is a top view of dispensing tip (100A). FIG. 3 does not show resin (1) for clarity. FIG. 3 shows structure (22) is centrally located on tube (11). And the width of structure (22) is indicated by dimension "N".

FIG. 4 is a right side view of structure (22). The height of structure (22) is indicated by dimension "V". And the distance between the lower end of the walls is indicated by dimension "Y".

A tube (43) is rigidly attached to the lower portion of tube (27), as shown in FIG. 2. This attachment is formed by an annular epoxy resin (5). Resin (5) provides a leak-tight seal. Outlet (25) is located near the mid-point of the axial length of tube (43). Tube (43) is co-axial with tube (27).

Tube (43) is rigidly attached to a bottle (40) as shown in FIG. 2. This attachment is formed by an annular epoxy

resin (6). Resin (6) forms a leak-tight seal.

The lower end of tube (43) includes a removeable cap (45), and a removeable seal (44). There are clearly many standard methods to form a cap and seal. For example, the cap and tip on a standard VISINE bottle (eye drop bottle). Bottle (40) also includes a removeable cap (41), and a removeable seal (42).

FIG. 2 shows bottle (40) contains an appropriate quantity of liquid (50). Where the appropriate quantity of liquid (50) can be determined according to the objectives set forth in the following experiments.

FIG. 1 depicts a general embodiment of a pbod dispenser. For example, a pbod dispenser used to self-instill a pbod on the eye.

FIG. 1 shows point S is on the left side vertical wall of bottle (40). And point T is on the right side vertical wall of bottle (40). Where these points S and point T are the typical points used to dispense a 30ul pendant drop from a standard VISINE eye drop bottle.

Prototype R29 is similar to FIG. 1. Prototype R29 utilizes a VISINE bottle (40). Where points S and point T are on the vertical side walls of the VISINE bottle (40); and the axis of tube (27) is vertical.

TO make clear: for prototype R29: the applied collapsing force (at points S and T) is horizontal; and the axis of tube (27) is vertical.

For prototype R29: dispensing tip (100A) is located near the neck of the VISINE bottle. Where an objective of this location is to avoid damage to the dispensing tip (100A) during collapsing of the bottle walls.

FIG. 1 shows an appropriate quantity of liquid (50) located in the lower portion of bottle (40). Where the appropriate quantity of liquid (50) can be determined according to the objectives set forth in the following experiments. For example, bottle (40) is rotated such that structure (22) is immersed in liquid (50); and bottle (40) is rotated such that structure (22) is surrounded by gas (60).

FIG. 1 shows a complete pbod dispensing apparatus. FIG. 1 shows a dynamic state. The pbod dispensing apparatus

has ejected a pbod (70). Pbod (70) consists essentially of: a dose (77) of liquid (50) having the form of one first ball; and a dose (10) of gas (60) having the form of a plurality of bubbles (75); and dose (77) encloses dose (10); and dose (77) and dose (10) are assembled on demand.

This pbod dispensing apparatus shown in FIG. 1 forms a motive gas (65). Where this motive gas (65) is the sole source of the dose (10). Dose (10) is formed essentially by motive gas (65). For example, a syringe needle does not exist in this novel pbod system.

Pbod (70) contains three bubbles (75). Where this quantity of three bubbles (75) is within the capabilities of the present specification. And these three bubbles (75) form the complete dose (10). For example, dose (10) is 1 ul of gas (60); therefore, the first bubble (75) contains 0.3 ul of gas (60); and the second bubble (75) contains 0.3 ul of gas (60); and the third bubble (75) contains 0.3 ul of gas (60); and each of these three bubbles (75) is formed by motive gas (65). The motive gas (65) forms the three bubbles (75). And these three bubbles (75) form the complete dose (10) of pbod (70).

Methods to form pbod (70) are provided in the following experiments.

FIG. 8 shows a front sectional view of a prototype R22. Prototype R22 is formed of a VISINE bottle (200); and a VISINE dispensing tip (201); and a tube (202).

VISINE tip (201) is located at the typical location on the bottle, which dispenses a 30 ul pendant drop. The VISINE tip (201)is not altered. The VISINE bottle (200) is not altered.

The upper end of tube (202) is cut to fit into the inner diameter of tip (201). Where these cuts form an inverted conical shape at the upper end of tube (202). Tube (202) is fitted to tip (201) such that a leak-tight seal is formed.

Prototype R22 is utilized to form a succession of identical bubbles (204). FIG. 8 shows succession (204) is formed of eight bubbles; and each of these bubbles have identical diameters. For example, for a bubble diameter of

0.007 cm, the variance of the diameter is estimated to be within approximately plus or minus 0.002 cm.

FIG. 8 shows a dynamic state. And also shows a selected quantity of liquid (207) disposed in prototype R22. The upper end of liquid (207) is indicated by the arcuate line at point (211). The concise steps, which form the configuration shown in FIG. 8 are set forth in the following experiment E. FIG. 8 does not show the inherent phenomenon, which causes the succession of identical bubbles (204) to be formed.

FIG. 8 shows the succession of identical bubbles (204) is located near the axis of tube (202). And liquid (207) encloses bubbles (204).

Prototype R22 is described further in the followig table.

FIG. 9 shows a front view of a prototype R11. One of the objectives of prototype R11 is to show a very reliable pbod system. For example, prototype R11 dispenses more than three hundred consecutive pbods; and each pbod contains 7 ul of liquid; and there is no overspray for any trial. Where prototype R11 utilizes inherent residual liquid located in the discharge tube.

FIG. 9 shows the upper end of prototype R11 is a flexible VISINE bottle (300). Where this VISINE bottle does not contain a dispensing tip. The upper end of a tube (301) is rigidly attached to the lower end of the neck of the VISINE bottle (300). Tube (301) is co-axial with the neck of the VISINE bottle. This attachment is formed by an annular epoxy resin (311). Resin (311) forms an annular leak-tight seal.

The upper end of a tube (302) is inserted approximately 0.5 cm into the lower end of tube (301). The lower end of tube (301) is indicated by reference numeral (310).

Prototype R11 is utilized to dispense a pbod (70). The scale of FIG. 9 is not suitable to show the interior structure of pbod (70); and therefore, a dot is utilized to show pbod (70).

Prototype R11 is described further in the following table. A concise method of utilizing prototype R11 is provided in the following Experiment Q.

The following prototypes are particular embodiments of the appended figures of the drawing. Where the present description of these figures, and the following description in the prototype table define the structure of the prototype. Each prototype table contains a list of the pertinent figures of the drawing. For example, in prototype table PROTOTYPE R29, FIG. 2, FIG. 3, and FIG. 4 define the configuration of prototype R29, and the present description of these figures define the configuration of prototype R29, and the corresponding parts of prototype R29 are further defined in the prototype table PROTOTYPE R29, and prototype R29 is similar to FIG. 1.

All prototypes presented herein are made by the present Inventor. All prototypes are made by hand. Also, only one prototype of each model No. exists. For example, only one prototype R29 exists.

All cuts in all prototypes are made with a STANLEY knife (pencil style handle) with blade model No. 11-411 UPC No. 076174114119.

The cuts are made according to the following steps:
First, placing one sheet of paper (20 lb) on a rigid solid horizontal wooden table;
second, placing the part on the sheet of paper;
third, placing the cutting edge of the blade on the surface of the part; and the cutting edge of the blade resides approximately horizontal; and the cutting edge of the blade remains approximately horizontal throughout the entire cut;
fourth, slowly increasing the force on the handle in one vertical direction until cutting begins; and maintaining an approximate constant speed throughout the entire cut; and maintaining only one vertical direction of cutting throughout the entire cut.

NOTE: each entire surface is cut with only one continuous motion. For example, while cutting a 0.5 cm diameter tube, the blade traverses a vertical distance of 0.5 cm in one continuous motion.

The parts of prototype R29 are assembled according to the following steps, including:
First, cutting all parts to the desired dimension;
second, inserting a smooth solid copper wire into the outlet

end of tube (27), such that the end of the wire extends approximately 0.8 cm beyond the upper end of tube (27); and the OD of the wire matches the ID of tube (27) to a slip-fit (i.e. the OD of the wire is approximately 0.02 cm less than the ID of tube (27);

third, placing tube (28) on the upper end of tube (27) such that the wire maintains tube (28) co-axial with tube (27);

fourth, applying the lower portion of annular resin (4) as shown in FIG. 2, and allow to dry for 5 hours;

fifth, placing tube (29) on tube (28) as shown in FIG. 2; and applying annular resin (4) and allow to dry for 5 hours;

sixth, placing tube (11) on the upper end of tube (29) as shown in FIG. 2; and applying resin (2) as shown in FIG. 2;

seventh, placing structure (22) on the upper end of tube (29) and applying resin (1) as shown in FIG. 2;

eighth, while holding only tube (27), removing the copper wire from tube (27) (objective is to not break seal of resin (4));

ninth, attaching tube (27) to tube (43) with resin (5) as shown in FIG. 2, and allow to dry for 5 hours;

tenth, attaching tube (43) to bottle (40) as shown in FIG. 2; and allow to dry for 8 hours; and the axis of tube (27) is perpendicular and co-planar with the axis of the neck of the VISINE bottle (40); and dispensing tip (100A) is located near the neck of the VISINE bottle (40).

The parts of prototype R29 are placed by hand at the desired location; and the epoxy resin is applied; and the location of the part is adjusted as necessary using a narrow steel rod and magnifying glass (approximately 3 times power). The dimensions of the prototype are checked after drying.

For prototype R29: structure (22) is formed from one flat sheet of PVC; and first, cut to the desired width; and second, bend to two flat parallel walls; and third, cut to the desired height; and fourth, seperate the two walls to the desired dimension Y.

The present figures of the drawing depict the configuration of the present prototypes. These figures are an approrimate scaled version of the actual prototype. Therefore, IF necessary, these figures of the drawing can be

utilized to determine the location of a part. Also, parts of the prototypes may be not shown for clarity.

Obviously, the appended figures of the drawing do not show the inherent results of the above-described method of forming the present prototypes. For example, resultant surface roughness of a cut surface, edge sharpness of a cut surface, or very small gaps between surfaces (i.e. approximately 0.002 cm, or approximately 0.01 cm). All inherent features, which result from the method of making the present prototypes described herein (made by hand) form a part of the present disclosure.

PROTOTYPE R29

Prototype R29 is previously described and shown in FIG. 2, FIG. 3, FIG. 4, and similar to FIG. 1; and further described as follows:

PART No.	DESCRIPTION
(22)	converging rectangular flat walls; inverted V shape; transparent PVC; dimension N = 0.13 cm ; dimension V = 0.23 cm ; dimension Y = 0.10 cm ; 0.025 cm thick; from the bubble wrap packaging from JB WELD (JB WELD COMPANY) UPC: 043425826558
(11)	tube; and each end is flat; material: TEFLON; 0.317 cm OD; 0.165 cm ID; 0.13 cm axial length; (SPECTRUM CHROMATOGRAPHY)
(29)	tube; and each end is flat; material: TEFLON; 0.158 cm OD; 0.078 cm ID; 0.69 cm axial length; (SPECTRUM CHROMATOGRAPHY)
(28)	dispensing tip from VISINE; 0.16 cm upper end OD; 0.08 cm lower end ID; 0.35 cm axial length; opening (35) is 0.02 cm diameter; from lot No. 0103611 / expire OCT 2005; material is unknown / similar to polyethelene (PFIZER, INC.); 0.04 cm upper end ID UPC: 074300008035
(27)	tube; and each end is flat; material: TEFLON; 0.158 cm OD; 0.078 cm ID; 0.64 cm axial length; (SPECTRUM CHROMATOGRAPHY)
(1)(2)(4)(5)(6)	JB WELD (JB WELD COMPANY) UPC: 043425826558 NOTE: resin (1) is 0.1 cm wide; 0.13 length; 0.08 cm height; and is located at two places; and the 0.13 cm length of resin (1) coincides with the dimension N of structure (22).

(40)	VISINE bottle; 15 ml (PFIZER, INC.)
(41)	VISINE cap; from 15 ml VISINE bottle(PFIZER,INC)
(43)	neck of VISINE bottle; 15 ml; approximately 0.9 cm ID; 1.3 cm axial length; tube shape
(42)	VISINE dispensing tip (PFIZER, INC.)
(44)	annular seal; from portion of VISINE dispensing tip; 1.0 cm OD; 0.9 cm ID; and 0.2 cm length (PFIZER, INC.)
(45)	VISINE cap; from 15 ml VISINE bottle(PFIZER,INC)

PROTOTYPE R22

Prototype R22 is previously described and shown in FIG. 8; and further described as follows:

PART No.	DESCRIPTION
(200)	VISINE bottle; empty; 30 ml (PFIZER, INC.)
(201)	VISINE dispensing tip (PFIZER, INC.)
(202)	tube; and each end is flat; 0.317 cm OD; 0.078 cm ID; 6.5 cm length; polyethelene; translucent; the upper end of tube (202) is cut to accomodate the lower end ID of tip (201) such that a leak-tight seal is formed

PROTOTYPE R11

Prototype R11 is previously described and shown is FIG. 9; and further described as follows:

PART No.	DESCRIPTION
(300)	VISINE bottle only(no tip); 30 ml (PFIZER,INC)
(302)	tube; and each end is flat; 0.18 cm OD; 0.08 cm ID; 3.0 cm length; the upper end OD of tube (302) is cut such that tube (302) can be inserted into tube (301); and such that a leak-tight seal is formed; polyethelene
(301)	tube; and each end is flat; 0.28 cm OD; 0.13 cm ID; 2.0 cm length; polyethelene
(311)	JB WELD (JB WELD COMPANY) UPC: 043425826558

The following table is a list of the experiments, the prototype utilized in the experiment, and a summary of an objective of the experiment:

SUMMARY OF EXPERIMENTS

EXPERIMENT X:	prototype R29 ;	measure diameter of liquid on test paper.
EXPERIMENT U:	prototype R29 ;	other person executes Experiment X
EXPERIMENT M:	prototype R29 ;	measure mass of pbod
EXPERIMENT Q:	prototype R11 ;	form pbod utilizing residual liquid; and observe diameter of discrete pbod i.e. FIG. 9
EXPERIMENT E:	prototype R22 ;	form succession of identical bubbles
EXPERIMENT V:	prototype R29 ;	eject a pbod having a vertical initial velocity i.e. a direction opposite to a gravity vector
EXPERIMENT H:	prototype R29 ;	eject a pbod having a horizontal initial velocity
EXPERIMENT L:	prototype R29 ;	eject a pbod having a 45 degree initial velocity; and a 135 degree initial velocity

Experiment X is executed according to the following steps [Xa.] to [Xg.] as follows:

[Xa.] Holding bottle (40) in one hand at points S and point T with the thumb and forefinger such that structure (22) is immersed in liquid (50) (i.e. FIG. 1 rotated 90 degrees); and also such that outlet (25) is clearly observable;

[Xb.] observing bottle (40) to confirm structure (22) is immersed in liquid (50);

[Xc.] slowly collapsing bottle (40) at points S and point T with the thumb and forefinger approximately 0.5 cm such that liquid (50) is visible at outlet (25); and the end of liquid (50) is located at or near the outlet (25) as shown in FIG. 5 (i.e. 0.05 cm is near the outlet; and 0.07 cm beyond the outlet is near the outlet); an objective of this step includes to confirm that tip (100A) contains liquid (50);

[Xd.] slowly removing the collapsing force at points S and point T; and simultaneously maintain enough compressive force

to hold the bottle; and simultaneously rotating bottle (40) to a dispensing position shown in FIG. 6 and FIG. 1 such that gas (60) surrounds structure (22); it requires about 1 to 2 seconds to remove the collapsing force; and do not remove the collapsing force rapidly (i.e. within 30 ms is rapidly);

[Xe.] waiting approximately 1 to 2 seconds; and do not wait more than approximately 5 seconds to execute step [Xf.];

[Xf.] collapsing bottle (40) at points S and point T with the thumb and forefinger at approximately 0.5 cm per second, or approximately 0.4 cm per second (i.e. 0.5 cm / 1 second, or 0.4 cm / 1 second); and dispensing a pbod on the test paper; NOTE: outlet (25) is disposed approximately 9 cm above the test paper for all trials in Experiment X;

[Xg.] placing bottle (40) at a typical rest position for the VISINE bottle (i.e. the axis of tube (27) is horizontal); and measuring the outer diameter of the liquid on the test paper; and recording data. End of EXPERIMENT X.

EXPERIMENT V is executed according to the following steps [Va.] to [Vc.] as follows:

[Va.] Holding bottle (40) at points S and point T, and rotating bottle (40) such that structure (22) is immersed in liquid (50) (i.e. FIG. 1 rotated 90 degrees);

[Vb.] rotating bottle (40) to an inverted position of FIG. 1 (i.e. the initial velocity of the pbod is in the opposite direction of a gravity vector);

[Vc.] collapsing bottle (40) at points S and point T with the thumb and forefinger at approximately 0.5 cm per second, or approximately 0.4 cm per second; and observing results; and recording results. End of EXPERIMENT V.

EXPERIMENT H is executed according to the following steps [Ha.] to [Hc.] as follows:

[Ha.] Holding bottle (40) at points S and point T, and rotating bottle (40) such that structure (22) is immersed in liquid (50) (i.e. FIG. 1 rotated 90 degrees);

[Hb.] rotating bottle (40) such that the axis of tube (27) is horizontal and structure (22) is surrounded by gas (60);

[Hc.] collapsing bottle (40) at points S and point T with the thumb and forefinger at approximately 0.5 cm per second, or

approximately 0.4 cm per second; and observing results; and recording data. End of EXPERIMENT H.

EXPERIMENT L is executed according to the following steps [La.] to [Lc.] as follows:

[La.] Holding bottle (40) at points S and point T such that the axis of tube (27) is vertical and liquid (50) is disposed at the lower portion of bottle (40) as shown in FIG. 1; and subsequently rotating bottle (40) such that structure (22) is immersed in liquid (50) (i.e. FIG. 1 rotated 90 degrees);

[Lb.] rotating bottle (40) to 45 degrees from the position of FIG. 1 (i.e. the initial velocity of the pbod is 45 degrees from a gravity vector);

[Lc.] collapsing bottle (40) at points S and point T with the thumb and forefinger at approximately 0.5 cm per second, or approximately 0.4 cm per second; and observing results; and recording data. End of EXPERIMENT L.

EXPERIMENT U is executed according to the following steps [Ua.] to [Ud.] as follows:

[Ua.] Notifying another person the following steps are an experiment;

[Ub.] the present Inventor giving verbal and visual instructions to this other person; where these instructions are to execute Experiment X according to the steps [Xa.] to [Xg.] set forth herein;

[Uc.] Inventor observing this other person execute steps [Xa.] to step [Xg.];

[Ud.] Inventor observing, recording, and measuring the results of the trial. End of EXPERIMENT U.

EXPERIMENT E is executed according to the following steps [Ea.] to [Ef.] as follows:

[Ea.] Removing tip (201) from bottle (200) (do not remove tube (202) from tip (201));

[Eb.] injecting approximately 20 to 60 ul of liquid (207) in dispensing tip (201) such that the upper surface (211) is approximately 0.2 cm above opening (35);

[Ec.] replacing tip (201) on bottle (200);

[Ed.] rotating bottle (200) such that the axis of tube (202) is generally vertical as shown in FIG. 8;

[Ee.] collapsing bottle (200) at points S and point T at an

approximate constant speed of 0.1 cm per second, or 0.4 cm per second (collapse with thumb and forefinger);

[Ef.] observing the upper end of tube (202). End of EXPERIMENT E.

EXPERIMENT Q is executed according to the following steps [Qa.] to [Qe.] as follows:

[Qa.] Removing tube (302) from tube (301);

[Qb.] injecting 6.7 ul of liquid into the lower end (310) of tube (301) using metered syringe (1 cc / 29 guage needle);

[Qc.] replacing tube (302) into tube (301); and tube (302) extends approximately 0.5 cm into tube (301); and maintain an appropriate compressive force at points S and point T such that the dose of liquid remains in a static state (no motion); and the dose of liquid is located at the lower end of tube (301);

[Qd.] rotating bottle (300) such that the axis of tube (302) is generally vertical as shown in FIG. 9;

[Qe.] collapsing bottle (300) at points S and point T with the thumb and forefinger at approximate constant speed of approximately 0.1 cm per second to approximately 0.3 cm per second, and a total distance of approximately 0.5 cm; and observing the discrete pbod (i.e. pbod (70) in FIG. 9).

NOTE: The residual liquid in tube (302) is not removed; and the residual liquid in tube (301) is not removed. Tube (301) and tube (302) contain residual liquid at the end of step [Qe.].

NOTE: An additional step [Qf.] is added for trials Nos. 12 to 39. This step [Qf.] is as follows:

[Qf.] removing tube (302) from tube (301); and placing tube (302) on a horizontal surface; and measuring the location and width of the residual liquid in tube (302).

End of EXPERIMENT Q.

EXPERIMENT M is executed according to the following steps [Ma.] to [Mc.] as follows:

[Ma.] Placing one sheet of test paper on scale;

[Mb.] closing all sides of breeze break; and set zero function;

[Mc.] dispensing pbod onto test paper according to steps in Experiment X; and recording electronic display of the mass.

End of EXPERIMENT M.

TABLE X R29 L Experiment X

Liquid (50) = REFRESH LIQUIGEL(lot No. 30469) prototype R29
(ALLERGAN, INC.) (expire: Mar 06)

TRIAL	O	D(in)	TRIAL	O	D(in)	TRIAL	O	D(in)
19 July 2004 (19.07.04)								
1		0.170—7:07am	41		0.180	81		0.180
2		0.180 air	42		0.160	82		0.150
3		0.170 27.5 C	43		0.160	83		0.150
4		0.170	44		0.160	84		0.160
5		0.170	45		0.170	85		0.160
6		0.170	46		0.150	8:11am-86		0.180
7		0.160	47		0.180	87		0.180
8		0.170-7:13am	48		0.170	88		0.170
9	1x	0.170	49		0.150	89		0.180
10		0.170	50		0.170	90		0.170
11		0.150	51		0.180	91		0.160
12		0.170	52	1x	0.150	92		0.180
13		0.170	53		0.150	93		0.170
14		0.160	54		0.180	94		0.170
15		0.180	55		0.170	95		0.160
16		0.170-7:19am	56		0.170	96		0.150
17		0.180	57		0.180	97		0.170
18		0.180	58		0.170	air	98	0.170
19		0.180	59		0.150	28.0 C	99	0.170
20		0.180	60		0.180	8:22am-100		0.180
21		0.180	61		0.160	19 July 101		0.190
22		0.190	62		0.160	2004	102	0.180
23		0.170	63		0.160	103		0.180
24		0.170	64		0.170	104		0.180
25		0.160	65		0.170	105		0.170
26		0.180	66		0.170	106		0.180
27		0.170	67		0.170	107		0.180
28		0.160	68	1x	0.160	108	1x	0.170
29		0.160	69		0.170	109		0.180
30		0.180	70		0.160	110		0.180
31		0.170	71		0.160-7:59am	111		0.180
32		0.170	72		0.180	112		0.170
33		0.170	73		0.170	113		0.180
34		0.160	74		0.170	114		0.170
35		0.170	75		0.170	115		0.180
36		0.180	76		0.150	116		0.170
37		0.160	77		0.170	117		0.170
38		0.160	78		0.170-8:05am	118		0.180
39		0.160	79		0.170	119	2x	0.180
40		0.170	80	2x	0.180	120		0.170

NOTE: Approximately 5 trials per 100 trials do not appear to have any bubbles; the bubbles may be small and not observable, or the bubbles burst prior to observing on test paper. All pbods in these trials for this Experiment X contain approximately 3 to 5 bubbles having a diameter of approximately 0.02 cm diameter, except as noted above.

TABLE X R29 L (cont.) Experiment X

Liquid (50) = REFRESH LIQUIGEL(lot No. 30469) prototype R29
(ALLERGAN, INC.) (expire: Mar 06)

TRIAL	O	D(in)	TRIAL	O	D(in)	TRIAL	O	D(in)
19 July 2004(19.07.04)								
121		0.170	161		0.180	11:00pm-201		0.170
122		0.170	162		0.170	202		0.180
123		0.170	163		0.190	11:02pm-203		0.170
124		0.170	164		0.170	6:51am-204		0.180
125		0.170	165		0.160	21 July 205		0.170
126		0.160	166		0.160	2004 206		0.170
127		0.160	167		0.180	207		0.180
128		0.150	168		0.170	208		0.170
129		0.170	169		0.170	209		0.180
130		0.180-5:10pm	170		0.180-5:39pm	210		0.180
131		0.170 air	171		0.190	211		0.180
132		0.160 29.0 C	172		0.160	212		0.180
133		0.160	173		0.180	213		0.180
134		0.170	174		0.160	214		0.180
135		0.180	175		0.150	215	1x	0.150
136		0.180	176		0.180	216		0.180
137		0.180	177		0.180	217		0.170
138		0.170	178		0.180	218		0.180
139		0.180	179		0.180	219		0.190
140		0.170	180		0.180	220		0.180
141		0.180	181		0.170	221		0.180
142	1x	0.160	182		0.160	222		0.180
143		0.190	183		0.170	223		0.180
144		0.180	184		0.170	224		0.180
145	1x	0.180	185		0.170	225		0.180
146	1x	0.180	186		0.170	226		0.180
147		0.180	187		0.160	227		0.180
148		0.180	188		0.170	228		0.180
149		0.180	189		0.170	229		0.180
150		0.180-5:24pm	190		0.170	7:10am-230		0.180
151		0.170	191		0.180	7:20am-231		0.190
152		0.170	192		0.180	air 232		0.170
153		0.190	193		0.160	27.5 C 233		0.170
154		0.160	194		0.160	234		0.160
155		0.170	195		0.160	235		0.170
156		0.170	196		0.160	236		0.180
157		0.170	197		0.160	237		0.170
158		0.180	198		0.140	238		0.170
159		0.180	199		0.160	239		0.180
160		0.170-5:32pm	200		0.170-6:02pm	240		0.180

NOTE: prototype R29 is not used between 21 July 2004, 10:30pm to 24 July 2004, 8:40am; and cap (45) and seal (44) is on neck (43) during this period of rest ; TOTAL hours at rest between trial 600 to trial 601: 58 hours.

TABLE X R29 L (cont.) Experiment X

Liquid (50) = REFRESH LIQUIGEL(lot No. 30469) prototype R29
(ALLERGAN, INC.) (expire: Mar 06)

TRIAL	O	D(in)	TRIAL	O	D(in)	TRIAL	O	D(in)
21 July 2004(21.07.04)								
241		0.180	281		0.180	321		0.180
242		0.180-7:28am	282		0.180	322		0.180
243		0.160	283		0.170-9:56am	323		0.180
244		0.170	284		0.180	324		0.160
245		0.180	285		0.160	325		0.170
246		0.180	286		0.170	326		0.160
247		0.180	287		0.170	327		0.160
248		0.180	288	2x	0.170	328		0.180
249		0.160	289	2x	0.160	329		0.170
250		0.160-7:33am	290		0.180-10:02am	330		0.180
251		0.170-9:28am	291		0.190	331	1x	0.180
252		0.180 air	292		0.180	332		0.180
253	1x	0.170 27.8 C	293		0.180 4:58pm-	333		0.180
254		0.150	294		0.180	334		0.180
255		0.180	295		0.180	335		0.170
256		0.170	296		0.180	336		0.180
257		0.170	297		0.170	337		0.150
258		0.180	298	1x	0.170	338		0.180
259		0.170	299		0.190	339		0.160
260		0.170	300		0.180-10:10am	340	1x	0.160
261		0.170	301		0.190-4:35pm	341		0.150
262		0.170-9:36am	302		0.180	342		0.180
263		0.190-9:39am	303		0.180	343		0.170
264	1x	0.180	304		0.190	344		0.170
265		0.160	305		0.160	345	1x	0.170
266		0.190	306		0.180	346		0.180
267		0.180	307		0.180	347		0.180
268		0.170	308		0.170	348		0.170
269		0.180	309		0.170	349		0.180
270		0.170	310		0.170 5:11pm-	350	1x	0.180
271		0.180-9:46am	311		0.180	351		0.180
272		0.180-9:49am	312		0.170	352		0.170
273		0.180	313		0.170	353		0.150
274		0.170	314		0.180	354		0.160
275		0.180	315		0.170	355		0.180
276		0.180	316	1x	0.160	356		0.180
277		0.150	317		0.180 21 July	357		0.160
278		0.180	318		0.180 air	358		0.190
279		0.180	319		0.160 30.0 C	359		0.160
280		0.180 4:49pm-	320		0.180 5:17pm-	360		0.160

NOTE: prototype R29 is not used between 24 July 2004, 8:40am to 24 July 2004, 10:22pm ; and cap (45) and seal (44) is on neck (43) during this period of rest ; TOTAL hours at rest between trial 601 to trial 602: 14 hours. Further, prototype R29 is allowed to rest for periods of between 5 to 10 hours, without cap (45); and dispenses a pbod on the first subsequent trial.

TABLE X R29 L (cont.) Experiment X

Liquid (50) = REFRESH LIQUIGEL(lot No. 30469) prototype R29
(ALLERGAN, INC.) (expire: Mar 06)

TRIAL	O	D(in)	TRIAL	O	D(in)	TRIAL	O	D(in)
21 July 2004(21.07.04)								
361		0.180-5:33pm	409		0.190	457		0.180
362		0.180 air	410		0.170	458		0.170
363		0.190 27.7 C	411		0.190	459		0.160
364		0.180	412		0.180 7:19pm-	460		0.160
365		0.160	413		0.180	461		0.180
366		0.180	414		0.160	462		0.170
367	1x	0.160	415	1x	0.170	463		0.150
368		0.180	416		0.180	464		0.160
369		0.190	417		0.170	465		0.160
370		0.190	418	2x	0.160	466		0.160
371		0.180	419		0.180	467		0.180
372		0.190	420		0.180-6:49pm	468		0.160
373		0.170	421		0.190 air	469		0.160
374		0.150	422		0.170 27.5 C	470-7:25		0.160
375		0.170	423		0.170	471 pm		0.160
376		0.170	424		0.170	472		0.160
377	2x	0.180	425		0.160	473		0.150
378		0.170 air	426		0.170	474	1x	0.170
379		0.180 28.0 C	427		0.170	475		0.160
380		0.180-5:46pm	428		0.160	476		0.170
381	1x	0.200	429		0.140	477		0.160
382		0.180	430		0.170-6:57pm	478		0.150
383		0.180	431		0.180-6:59pm	479	1x	0.170
384		0.180	432		0.180	480		0.170
385		0.180	433		0.170	481		0.160
386		0.180	434		0.150	482		0.150
387		0.180	435		0.150	483		0.150
388		0.180	436		0.160	484		0.150
389	1x	0.190	437		0.170 7:34pm-	485		0.160
390		0.190-5:52pm	438	1x	0.140	486		0.150
391		0.160	439	1x	0.170	487		0.150
392		0.180	440		0.170	488		0.160
393		0.160	441		0.160	489		0.180
394		0.190	442		0.150	490	1x	0.160
395		0.160	443		0.170	491		0.160
396		0.170	444		0.160	492		0.150
397		0.180	445		0.170	493		0.160
398		0.180 air	446		0.150	494		0.160
399		0.170 29.1 C	447		0.180	495		0.160
400		0.180-5:58pm	448		0.170	496		0.160
401		0.180-6:37pm	449		0.170	497		0.150
402		0.180	450		0.150-7:11pm	498		0.170
403		0.190	451		0.160	499		0.140
404		0.180	452		0.160 7:45pm-	500		0.170
405		0.180	453		0.160 9:11pm-	501		0.160
406		0.180	454		0.180 air	502		0.160
407		0.180	455		0.170 28.5 C	503		0.150
408		0.170	456		0.160	504		0.150

TABLE X R29 L (cont.) Experiment X
Liquid (50) = REFRESH LIQUIGEL(lot No. 30469) prototype R29
(ALLERGAN, INC.) (expire: Mar 06)

TRIAL	O	D(in)		TRIAL	O	D(in)		TRIAL	O	D(in)
21 July 2004 (21.07.04)										
505		0.150		545		0.160		585		0.180
506		0.170		546		0.150		586		0.160
507		0.160		547		0.170		587		0.190
508		0.170		548		0.160		588		0.160
509		0.150		549		0.160		589		0.180
510		0.150	9:43pm-	550		0.170	10:23pm-	590		0.180
511	1x	0.150		551		0.160	10:25pm-	591		0.190
512		0.160		552		0.170		592		0.170
513		0.150		553		0.160		593		0.160
514		0.150		554		0.160		594		0.180
515		0.170		555		0.170		595	1x	0.150
516	1x	0.130		556		0.160		596	1x	0.160
517	1x	0.160		557		0.170	air	597		0.160
518	2x	0.150		558		0.150	28.0 C	598	1x	0.170
519		0.140		559		0.160	21 July	599		0.170
520		0.140-air		560-9:50		0.170	10:30pm-	600	1x	0.170
521		0.170	28.8 C	561	pm	0.160				
522		0.160		562		0.150	8:40am-	601		0.180
523		0.150		563		0.170	24 July			
524		0.170		564	1x	0.160				
525		0.140		565		0.160	10:22pm-	602		0.180
526		0.170		566		0.170	24 July	603		0.170
527	1x	0.170		567		0.170	air	604		0.150
528		0.180		568		0.170	29.0 C	605		0.160
529		0.170		569		0.160		606		0.160
530		0.170	9:58pm-	570		0.160		607		0.150
531		0.160-9:31pm		571		0.170		608		0.160
532		0.180		572		0.160	10:27pm-	609		0.170
533	1x	0.160		573		0.140	10:29pm-	610		0.170
534		0.160		574		0.150	11:26pm-	611		0.160
535		0.160	10:03pm-	575		0.160	air	612	1x	0.170
536		0.170		576		0.160	28.7 C	613		0.170
537		0.170		577		0.170		614		0.150
538	1x	0.150		578		0.180		615		0.130
539	2x	0.170		579		0.150		616		0.160
540		0.160		580		0.160		617	1x	0.160
541		0.180	10:18pm-	581		0.180		618		0.170
542	1x	0.120		582		0.180		619		0.160
543	1x	0.170		583		0.160	11:33pm-	620		0.160
544		0.160		584		0.170	24 July			

NOTE: explanation of table data: The entry indicated below means: the air temperature is 28.0 C at 10:30 pm on 21 July 2004; and trial No. 600 is executed at 10:30 pm on 21 July 2004; and the diameter of liquid on test paper is 0.170 inches; and there is one overspray drop (or hollow body), which is 0.008 inches diameter.

air
28.0 C
21 July
10:30pm-600 1x 0.170

SUMMARY OF TABLE X R29 L DATA

D = measured diameter of liquid on test paper, in inches;
O = overspray ; 1x = one drop ; 2x = 2 drops, etc.;
no entry = no overspray

TOTAL TRIALS: **620**

TOTAL CONSECUTIVE SUCCESSFUL TRIALS: **620**

maximum dia./v = **0.200 / 8 ul**
minimum dia./v = **0.120 / 4.5 ul**
standard deviation (volume): 0.5

average diameter on test paper: **0.169**

average volume: **6.5 ul**

volume / quantity of occurrence

8.0 ul =	1	5.6 ul =	54
7.5 ul =	27	5.3 ul =	8
7.0 ul =	196	5.0 ul =	2
6.5 ul =	191	4.5 ul =	1
6.0 ul =	140		---
	Total trials =		620

total trials with overspray: **48**

NOTE: these volumetric quantities are estimates based on experimental data.

NOTE: CONSECUTIVE meaning: there are no attempts to dispense a pbod during the above-noted periods of rest between trials.

IMPORTANT NOTE: ten occurrence of overspray is observed to be a **hollow body** (i.e. one ball of liquid encloses one ball of air). All occurrence of overspray is measured to be approximately 0.008 inches diameter. In light of the results of Experiment Q, it is contemplated that a possible source of the overspray is residual liquid is ejected immediately after the pbod is ejected.

AVERAGE TIME DISTRIBUTION IN EXPERIMENT X

The following indicates the approximate average time Inventor utilized to execute the respective steps of Experiment X:

Begin, pick up bottle; and rotate bottle such that outlet (25) is observable:	4 s
Begin, to collapse bottle; and liquid reaches near outlet (25):	7 to 10 s
begin, release collapsing force; and axis of tube (27) is vertical:	4 to 5 s
begin, place bottle at rest position; and pick up scale and magnifying glass; and measure diameter of liquid:	10 to 12 s
begin place scale and magnifying glass on table; writing results in laboratory notebook with ink pen;writing trial No. on test paper and notebook:	10 to 12 s
AVERAGE TOTAL TIME PER TRIAL:	45 seconds

TABLE U R29 L Experiment U

20 July 2004(20.07.04) Liquid(50):REFRESH LIQUIGEL prototype R29

Person No. 1: age at time of trial: 74 years
general health: 4
eye glasses: yes bi-focal

RESULTS person No. 1 : trial No. 1 : successfully dispensed pbod having 0.180 in. dia. on test paper. This person requires relatively more detailed instructions. i.e. this person has difficulty understanding instructions. This person made the following comment: I believe I am capable to utilize prototype R29 to instill a pbod on my eye.

- -

Person No. 2: age at time of trial: 11 years
general health: 10
eye glasses: no

RESULTS person No. 2: trial No. 1 : 0.170 in.
trial No. 2 : 0.180 in.
trial No. 3 : 0.180 in.

- -

person No. 3: age at time of trial: 60 years
general health: 8
eye glasses: yes tri-focals

RESULTS person No. 3:

trial No.		trial No.	
1	0.190	6	0.200
2	0.100	7	0.200
3	0.200	8	0.200
4	0.200	9	0.200
5	0.210	10	0.200
		11	0.230

EXPLANATION OF TABLE Q R11 L DATA

Quantity of liquid (50) injected into tube (301) is 7 ul ;
D = estimated diameter of discrete pbod in millimeters (mm);
v = volume of residue in tube (302) in microliters.
NOTE: overspray does NOT occur for any trials in Experiment Q, therefore, this item is omitted in the following tables.

NOTE: trials Nos. 12 to 39 indicate the location and length of the residual liquid in tube (302). Dash (-) = air ; "x" = liquid. The table contains a series of dashes (-) and "x" . There is a total of thirty characters for each line (i.e. trial No. 13 contains 28 dashes and 2 "x"). Each character represents 1 mm length of tube (302). Tube (302) is 30 mm length, therefore 30 characters per line. Therefore, each character represents the respective location (i.e. in trial 13, the residual liquid in tube (302) is 2 mm length; and located at the upper end of tube (302); and air occupies the lower 28 mm length).
"v" equals the calculated volume of the residual liquid (tube 302).
In trial No. 22, "1" equals 0.5 mm length.

TABLE Q R11 L 13 FEB 2004(13.02.04) EXPERIMENT Q
PROTOTYPE R11

Liquid (50) = REFRESH LIQUIGEL (ALLERGAN) = 7 ul
UPC: 300239205307

Trial Nos. 1 to 10 successfully dispense a pbod, each having an estimated diameter of 3.0 mm; and no overspray occurs.

TRIAL #	D(mm)	lower end 30 25 20 15 10 5 0 upper end	v(ul)
12-7:47pm	3.0	----xx----------xx----------	1.2
13 air	3.0	----------xx	0.6
14 24.0 C	3.0	----------	0.0
15	3.0	----------xx--	0.6
16-8:39pm	3.0	----------x---x----xx-	1.2
17	3.0	----xx----x------x----x-------	1.5
18	3.0	-----x-x---x-----x----------x-	1.5
19	3.0	----------x----x---xx--x---	1.5
20	3.0	---------x------x-----x-------	0.9
		30 25 20 15 10 5 0	
21	3.0	---------x-------x-x-x-x------	1.5
22	3.0	----------l-l-l-l-l-l-l-l--	1.2
23	3.0	----------x----x--x-----x	1.2
24	3.0	----------x----	0.3
25	3.0	----------x--------x--	0.6
26	3.0	-------x----------x----xxx--	1.5
27	3.0	----------	0.0
28	3.0	-------x----------x--	0.6
29	3.0	----------xx----	0.6
		30 25 20 15 10 5 0	
30	3.0	----------x----x--xx-------	1.2
31	3.0	----------x--x--x---------	0.9
32	3.0	----------x----------	0.3
33	3.0	----------x------x----	0.6
34	3.0	----------	0.0
35	3.0	---------x----------x----x-	0.9
36	3.0	----------x----xx--	0.9
37	3.0	-----x-------x-x-x---x--x-----	1.8
38	3.0	-----x-------x--x--x--x-------	1.5
39	3.0	----------x-x-x----x----x-	1.5

TABLE Q R11 L (cont.) EXPERIMENT Q
PROTOTYPE R11

Liquid (50) = REFRESH LIQUIGEL (ALLERGAN) = 7 ul

TRIAL No.	D(mm)	TRIAL No.	D(mm)	TRIAL No.	D(mm)	TRIAL No.	D(mm)
40	3.0—air	81	3.0	122	3.0	163	3.0
41	3.0 26.7C	82	3.0	123	3.0	164	3.0
42	3.0	83	3.0	124	3.0	165	3.0
43	3.0-9:30pm	84	3.0	125	3.0	166	3.0
44	3.0 13 FEB	85	3.0	126	3.0	167	3.0
45	3.0 2004	86	3.0	127	3.0	168	3.0
46	3.0	87	3.0	128	3.0	169	3.0
47	3.0	88	3.0	129	3.0 11:05am-	170	3.0
48	3.0	89	3.0	130	3.0	171	3.0
49	3.0	90	3.0	131	3.0	172	3.0
50	3.0	91	3.0	132	3.0	173	3.0
51	3.0	92	3.0 10:16am-	133	3.0	174	3.0
52	3.0-11:44am	93	3.0	134	3.0	175	3.0
53	3.0 14 FEB	94	3.0	135	3.0	176	3.0
54	3.0 2004	95	3.0	136	3.0	177	3.0
55	3.0	96	3.0	137	3.0	178	3.0
56	3.0	97	3.0	138	3.0	179	3.0
57	3.0	98	3.0	139	3.0	180	3.0
58	3.0	99	3.0	140	3.0	181	3.0
59	3.0 6:06pm-	100	3.0	141	3.0	182	3.0
60	3.0	101	3.0-9:54am	142	3.0	183	3.0
61	3.0	102	3.0 16 FEB	143	3.0	184	3.0
62	3.0	103	3.0 2004	144	3.0	185	3.0
63	3.0	104	3.0	145	3.0	186	3.0
64	3.0	105	3.0	146	3.0	187	3.0
65	3.0	106	3.0	147	3.0	188	3.0
66	3.0-12:13pm	107	3.0	148	3.0	189	3.0
67	3.0	108	3.0	149	3.0	190	3.0
68	3.0	109	3.0	150	3.0	191	3.0
69	3.0	110	3.0	151	3.0	192	3.0
70	3.0	111	3.0	152	3.0	193	3.0
71	3.0	112	3.0	153	3.0	194	3.0
72	3.0	113	3.0	154	3.0	195	3.0
73	3.0	114	3.0	155	3.0	196	3.0
74	3.0	115	3.0	156	3.0	197	3.0
75	3.0	116	3.0	157	3.0	198	3.0
76	3.0 air	117	3.0	158	3.0	199	3.0
77	3.0 24.5 C	118	3.0	159	3.0	200	3.0
78	3.0 15 FEB	119	3.0	160	3.0	201	3.0
79	3.0 2004	120	3.0	161	3.0	203	3.0
80	3.0-5:37pm	121	3.0	162	3.0 11:26am-	204	3.0

TABLE U R29 L (cont.) Experiment U
15 August 2004(15.08.04) Prototype R29
Liquid (50) = REFRESH LIQUIGEL (lot No. 30469) (ALLERGAN, INC.)

Person No. 1:	trial No.	results
same person	1	steps executed incorrectly / no liquid ejected
of 20 July	2	pbod / 0.170 in. dia. / no overspray
2004	3	steps executed incorrectly / pendant drop
	4	steps executed incorrectly / no liquid ejected
11:04-	5	steps executed incorrectly / pendant drop
am	6	pbod / 0.180 in. dia. / no overspray

NOTE: this is the same person No. 1 (age 74), which executed Experiment U on 20 July 2004; the general health of this person is now rated at 3; on 15 August, this person has a broken left wrist, which was broken about 30 July 2004; wearing a cast; having moderate continuous pain; using EXTRA STRENGTH TYLENOL for pain; reluctant to execute experiment; required complete instructions of the experimental steps; is unable to remember the appropriate experimental steps ; used right hand to execute experiment.

TABLE X R29 L (cont.) Experiment X
Liquid (50) = REFRESH LIQUIGEL(lot No. 30469) prototype R29
Trials Nos. 621 to 670 dispense pbods having a dia. Between 0.150 to 0.180; and four occurrence of overspray.

Trial	O	D	Trial	O	D
671		0.200-11:33am	676		0.160
672		0.180 air	677		0.180
673		0.180 27.0 C	678		0.150
674		0.170	679		0.170
675		0.180	680		0.160-11:38am 15 Aug 2004

The above tables of empirical data are labeled according to the experiment, the prototype utilized in the experiment, and the liquid (50) utilized in the experiment. For example, TABLE X R29 L is Experiment X, prototype R29, and liquid (50) is REFRESH LIQUIGEL.

Gas (60) is air for all trials in all experiments. The present Inventor executes all trials in all experiments, except as noted in Experiment U.

EXPERIMENT V RESULTS: prototype R29; liquid (50) = REFRESH LIQUIGEL; vertical orientation (opposite direction of a gravity vector): Trial No. 1 dispenses a pbod having a narrow parabolic path, where the height is about 5 cm, and the horizontal distance is about 1 cm. Trials No. 2 to 5 are not successful. Trials Nos. 6 and 7 dispense a pbod (similar path to trial No. 1). Trial Nos. 8 to 10 are not successful. Trial No. 11 dispenses a pbod (similar

path to trial No. 1); and each pbod contains approximately 3 ul of liquid (50). Dose (77) is about 3 ul; and dose (10) is about 0.7 ul; and each pbod contains approximately three bubbles (75).

EXPERIMENT H RESULTS: prototype R29; liquid (50) = REFRESH LIQUIGEL: horizontal orientation: Trial No. 1 dispenses a pbod a horizontal distance of about 7 cm. Trials Nos. 2 to 4 are not successful. Trials Nos. 5 and 6 dispense a pbod a horizontal distance of about 4 cm. Trials Nos. 7 to 10 are not successful. And each pbod contains approximately 3 ul of liquid (50). Dose (77) is about 3 ul; and dose (10) is about 0.7 ul; and each pbod contains approximately three bubbles (75).

EXPERIMENT L RESULTS: prototype R29; liquid (50) = REFRESH LIQUIGEL: 45 degree orientation: Trial No. 1 is not successful. Trial No. 2 and 3 dispenses a pbod having a parabolic path. Trial Nos. 4 to 7 are not successful. Trial Nos. 8 and 9 dispense a pbod having a parabolic path; and each pbod contains approximately 3 ul of liquid (50). Dose (77) is about 3 ul; and dose (10) is about 0.7 ul; and each pbod contains approximately three bubbles (75).

The following is a summary of the events, which occur in Experiment X. Including, first the bottle (40) is in a position similar as shown in FIG. 1, and dispensing tip (100A) does not have cap (45); and cap (42) and seal (41) form a leak-tight seal; second, bottle (40) is rotated to a position shown in FIG. 5 such that structure (22) is immersed in liquid (50); and third, liquid (50) flows from left to right in FIG. 5; and fourth, liquid (50) stops flowing upon reaching outlet (25) as shown in FIG. 5 (i.e. FIG. 5 depicts both a dynamic state and a static state); fifth, liquid (50) flows from right to left in FIG. 5; and sixth, liquid (50) stops flowing upon reaching opening (35) as shown in FIG. 6 (i.e. the lower end of dose (77) is at opening (35) in FIG. 6), and the upper portion of tip (100A) contains a dose (77) of liquid (50), and a portion of this dose (77) is disposed between structure (22); seventh, a motive gas (65) imposes this dose (77) to flow from top to bottom in FIG. 7 as shown by the vertical arrow; eighth,

motive gas (65) forms a dose (10) of gas (60), and dose (77) encloses this dose (10), and dose (10) has the form of a plurality of bubbles (75), and this dose (10) is the complete dose of gas in pbod (70). FIG. 7 does not show the inherent phenomenon, which causes dose (10) to be formed.

The following is a summary of the events, which occur in Experiment V. Including, first, structure (22) is surrounded by air; and second, structure (22) is immersed in liquid (50) for a period of approximately 2 to 3 seconds; and third, a dose of liquid (50) inherently flows between the two flat walls of structure (22) (i.e. capilary); and fourth, the bottle is rotated such that structure (22) is surrounded by gas (60); and fifth, a motive gas (65) forms a dose (10) of gas (60), and this dose (10) has the form of a plurality of bubbles (75), and this dose (10) is the complete dose of gas in one pbod (70).

The events in Experiment H, and Experiment L are similar to the above-described events of Experiment V.

EXPERIMENT E RESULTS: prototype R22; liquid (207) is REFRESH LIQUIGEL (ALLERGAN,INC.): Experiment E forms a succession of identical bubbles (204). For a collapsing speed of about 0.1 cm per second, the diameter of the bubbles is approximately 0.03 cm, and spaced about 0.09 cm equally distant; and this trial contains about 30 bubbles. Several additional consecutive trials are executed having identical results to the above-described results of Experiment E.

(Experiment E results) For a collapsing speed of about 0.4 cm per second, the bubbles are about 0.007 cm diameter, and spaced about 0.04 cm equally distant, and this trial contains about 70 bubbles (seventy). Several additional consecutive trials are executed having identical results to the above-describes results.

To summarize the events in Experiment E, including, first,bottle (200) contains air (212); and second, about sixty microliters of liquid (207) is disposed in tip (201) such that the upper surface (211) is about 0.2 cm above opening (35); and third, tip (201) is place on bottle (200); and fourth, a pressure drop over opening (35) imposes liquid (207) to flow down into tube (202); and fifth, upon near

depletion of liquid in tip (201), a succession of identical bubbles (204) is formed in the upper portion of tube (202); liquid (207) encloses bubbles (204).

EXPERIMENT E RESULTS: Variations of prototype R22 have disensed pbods. For example, where the length of tube (202) is 1 cm or 0.5 cm; and the pbod contains about 7 ul liquid (207).

MANUFACTURES

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BEST MODE FOR CARRYING OUT THE INVENTION

The present discolsure includes several pioneering discoveries. Including, a complete dose of gas formed essentially by a motive gas; and a pbod formed utilizing inherent residual liquid in a discharge tube; and a pbod ejected from any indiscriminate selected initial velocity; and a succession of identical bubbles capable of forming the complete dose of gas in one pbod.

The best mode for carrying out these present discoveries is set forth in the present respective experiments and prototypes. The best mode to form a complete dose of gas is imposing an appropriate motive gas to flow through an appropriate flow channel. Where this motive gas imposes a dose of liquid to flow through the flow channel; and the motive gas forms the complete dose of gas.

ALTERNATE EMBODIMENTS

There are many variations of dispensing tip (100A), which are capable of dispensing a pbod. Several of these embodiments are set forth in Coffelt, Jr. U.S. patent application No. 10/827,901 filed 19 April 2004 (19.04.04). For example, structure (22) may have an arch shape. The prototypes in 10/827,901 dispense pbods, and it is contemplated that these alternate embodiments will have successfull results in

conjuntction with Experiment X. Experiment X and the prototypes of 10/827,901 should have similar results to the above results. The prototypes in 10/827,901 have dispensed 3 ul pbods having initial velocities of 135 degrees, 45 degrees, including other orientations.

There are clearly many well known methods to verify the location of dose (77) in FIG. 6. And also, many well known methods to verify the quantity of dose (77).

For example, the dispensing tip can be integrally formed with a lens. Therefore, allowing dose (77) to be observed in FIG. 6. This observation of dose (77) can be enhanced by utilizing a dose verification system. This dose verification system is summarized as a tube having the characteristic of two distinct different translucencies. The tube containing no liquid will have a first translucency [a]; and the tube containing a liquid will have a second translucency [b]. This change in translucency can be attained by the tube having a smooth outer surface; and a rough inner surface. Observing the tube without liquid produces an approximate translucent image; and observing the tube with liquid produces a transparent image. This change in translucency can be enhanced by having a black surface on the far side semi-annular surface of the tube. For this example, a dry tube appears to be light gray color; and the tube having liquid appears to be black color. Therefore, this distinct change in color confirms that the liquid is present in the tube.

The present figures of the drawing show the tubes having a straight axis. The tubes utilized in the present prototypes have an arcuate shaped axis. This inherent arcuate shape is a result of the method of storage of the tube. i.e. bulk storage on a roll. The radius of this arc is estimated to be about 13 cm. NOTE: The initial velocity of the pbod in Experiment X is approximately parallel to a gravity vector. Initial velocity meaning the speed and direction immediately below outlet (25).

Alternate liquids are capable to form a pbod. Including, water, i.e. AQUAFINA DRINKING WATER, (Bottling Group, LLC), TIMOLOL 0.5 % or 0.3 %, VISINE, CLEAR EYES.

FIG.6 depicts a particular dispensing position. And in light of the results of Experiments V, H, and L, there are clearly many alternate orientations of the dispenser, which will dispense a pbod. For example, For a 3 ul pbod, FIG. 6 can be rotated by any desired angle, and this rotated view of FIG. 6 depicts a dispensing position.

Experiments show that the most likely source of the overspray in Experiment X is residual liquid ejected immediately after the pbod is ejected. In light of the the results of Experiment Q, it is contemplated that variations of prototype R29 will have no overspray. Also, variations of the viscosity of the liquid may eliminate the overspray.

The present specification contains specific embodiments of apparatus utilized to form the present novel pbod systems, and these embodiments are presented for example only. And there are many alternate configurations, which are capable of forming the present novel pbod systems. Where these alternate configurations can be empericaly determined. For example, alternate attachment means, which do not form chemical reactions with liquid (50); alternate shapes; alternate dimensions; alternate material i.e. glass; alternate liquid (50); alternate viscosities of liquid (50); alternate gas (60) i.e. Hydrogen or Helium, motor fuel i.e. commonly referred to as nitrous oxide; alternate doses of liquid (50) i.e. 1 ul, 2 ul, or 3 ul including others; alternate ranges of dose (77); alternate quantity of dose (10); alternate collapsing speeds; alternate collapsing distance of the bottle walls; alternate rest positions i.e. a rest position where structure (22) is immersed in liquid (50); and alternate configurations of the bottle (40).

The present specification contains specific embodiments of the present novel pbod systems, and these specific embodiments are provided for example only. Further, the present inventions are clearly pioneering discoveries, and the present inventions are not limited to the specific embodiments set forth herein, and only such limitations should be imposed as are set forth in the appended claims.

* * * * *

CLAIMS

I claim:

1. A pbod system comprising:

a dose of liquid composing one first ball;

a complete dose of gas composing a plurality of balls;

said ball of liquid encloses said balls of gas composing one pbod wherein,

said complete dose of gas is composed essentially by a motive gas; and each said dose, said liquid, said gas, said motive gas is capable to compose one pbod;

one said pbod is assembled on demand.

2. The pbod system according to claim 1 wherein, said assembly comprises: first, said ball of liquid is disjointed from said gas; and second, said ball of liquid encloses said gas.

3. A pbod system comprising:

a complete dose of gas composed essentially by a motive gas;

said dose of gas composing a plurality of balls;

said dose of gas is the complete dose of gas in one pbod.

* * * * *

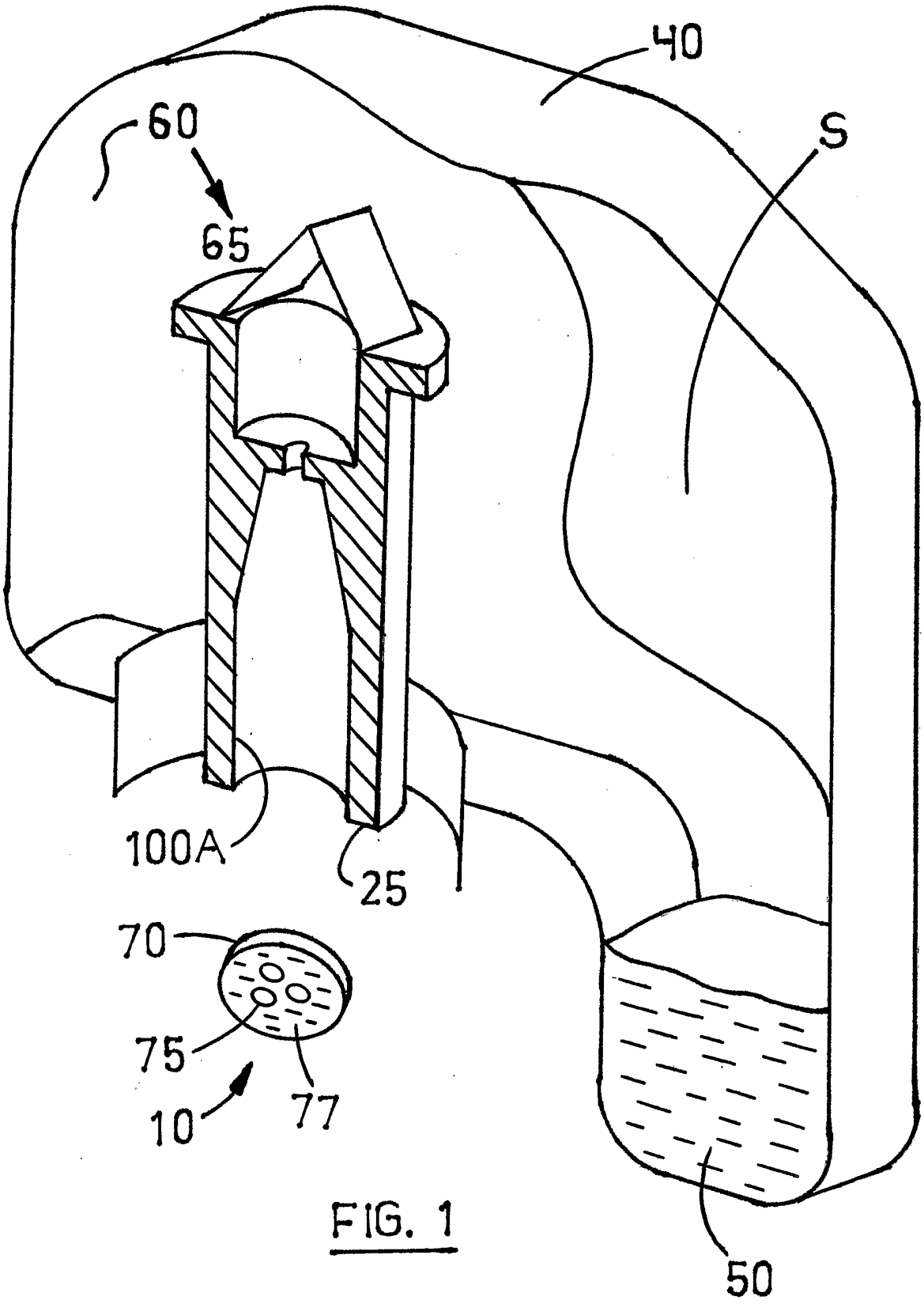

FIG. 1

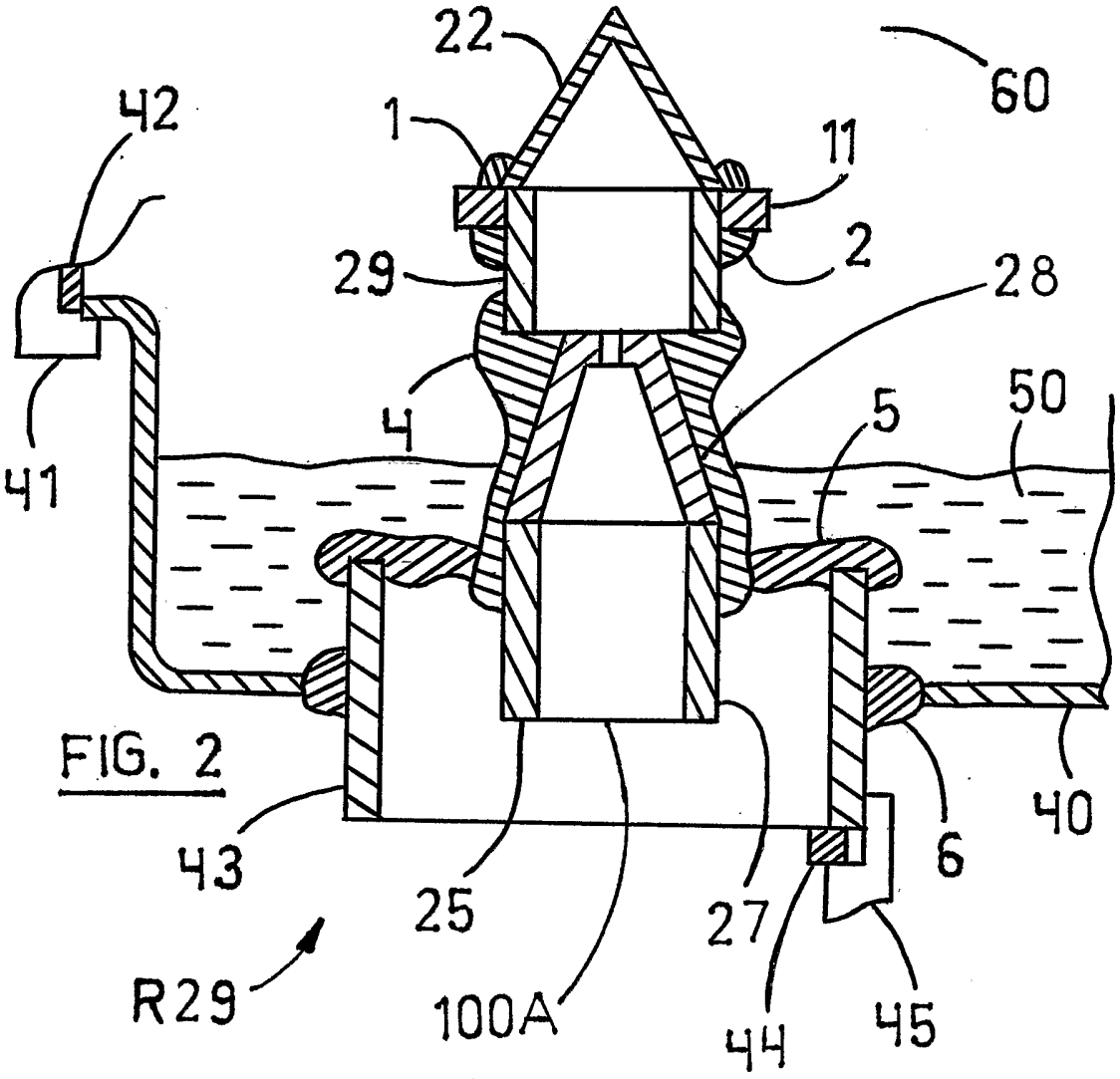

FIG. 2

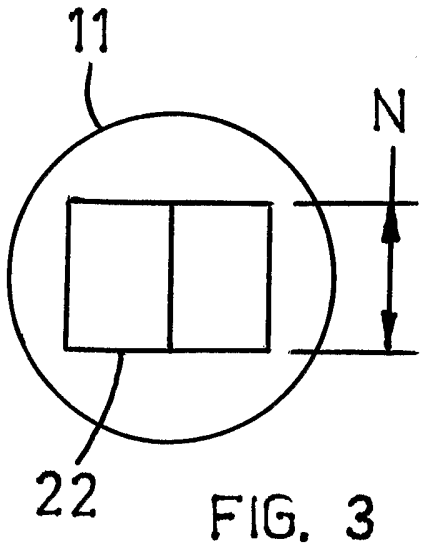

FIG. 3

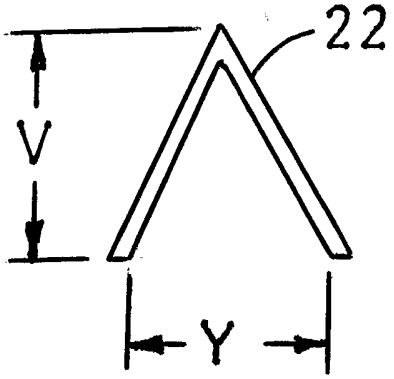

FIG. 4

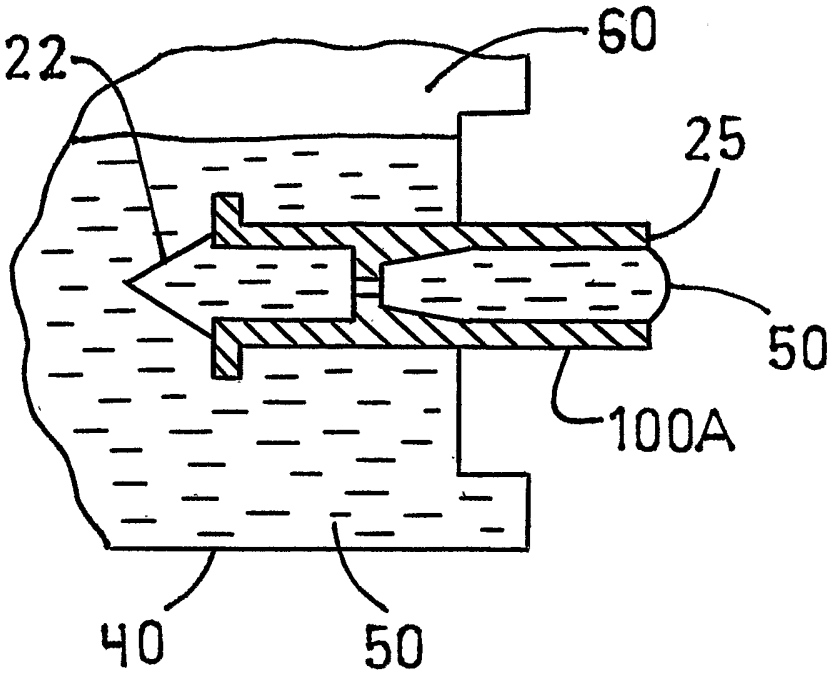

FIG. 5

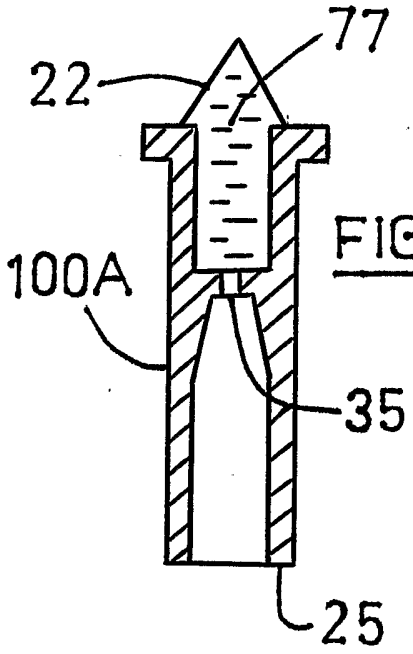

FIG. 6

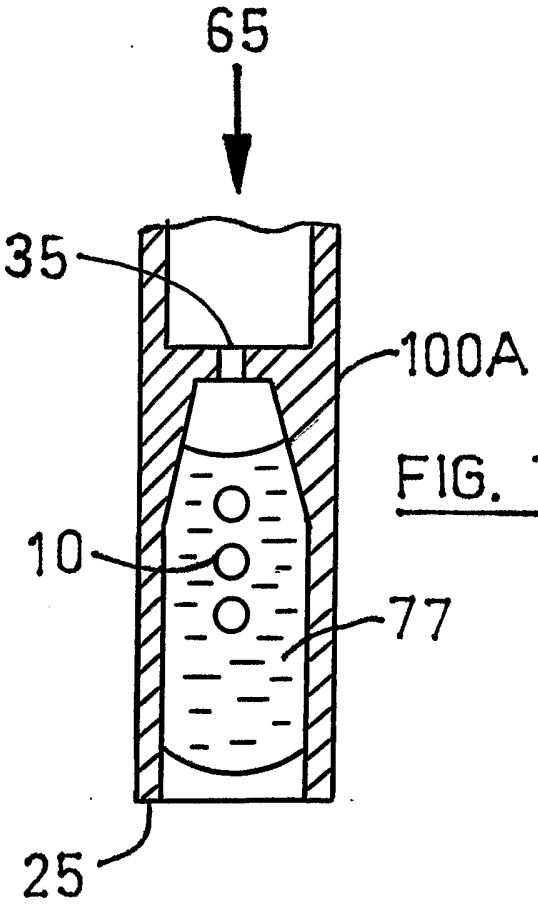

FIG. 7

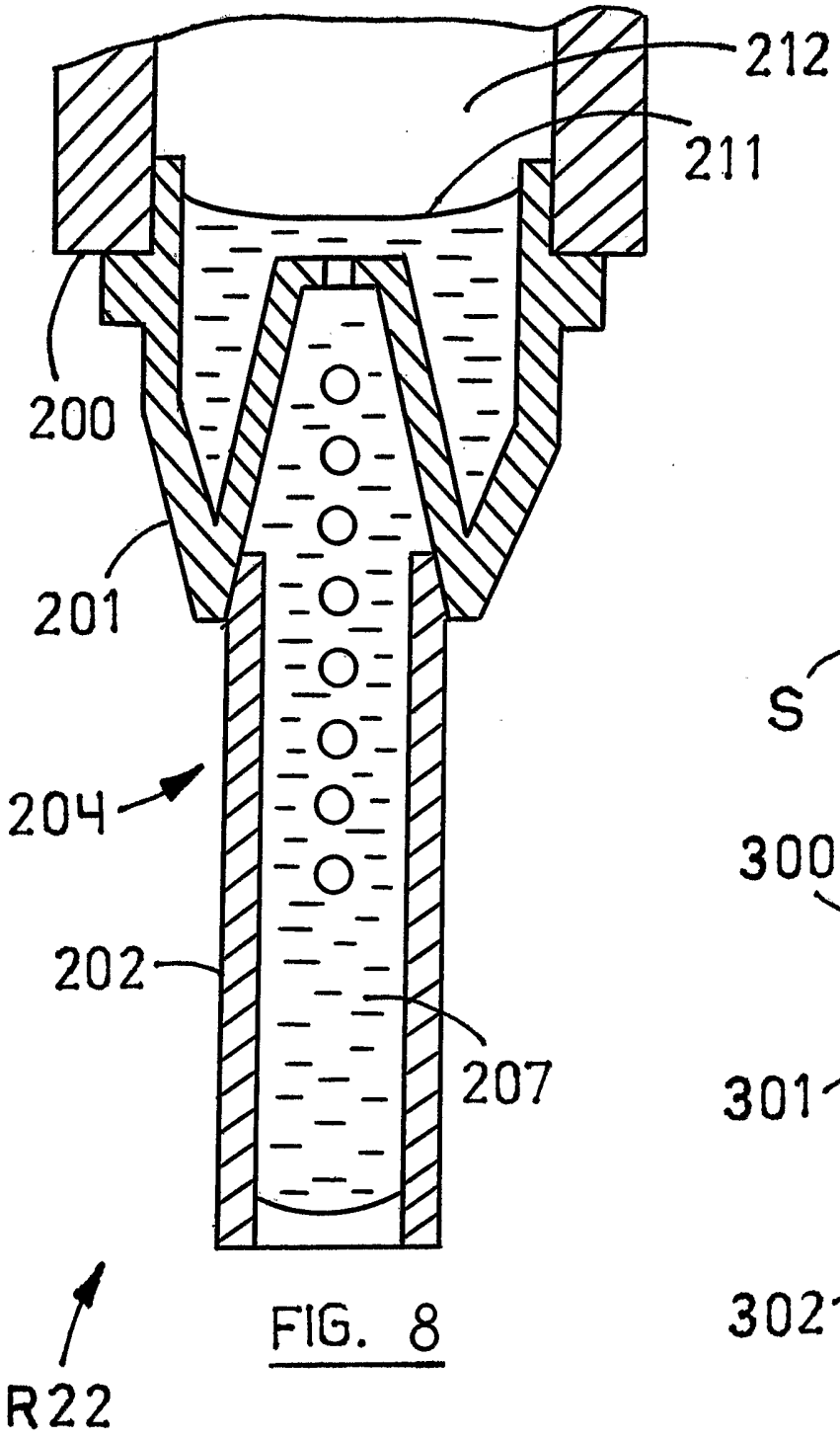

FIG. 8

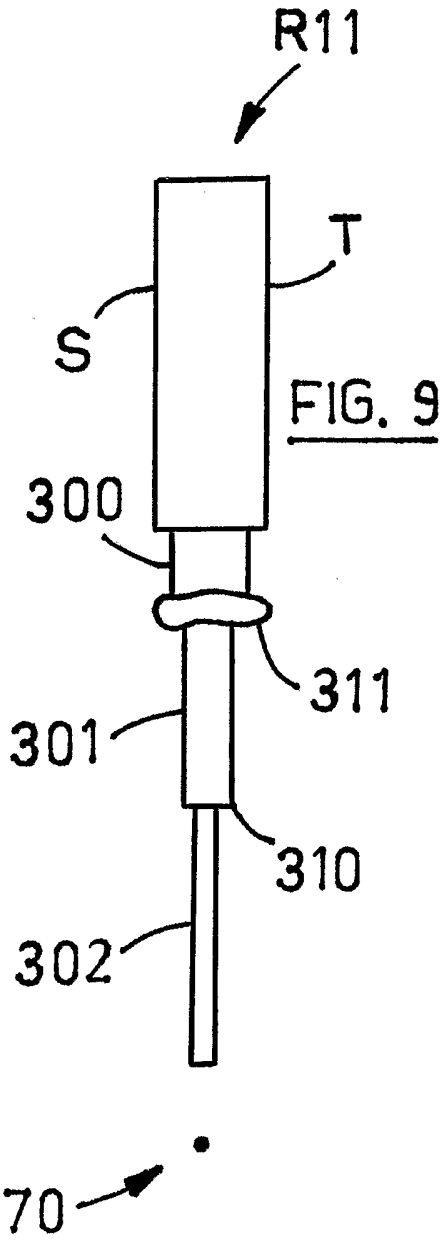

FIG. 9