Sept. 6, 1966 J. FRANGOS ETAL 3,270,919

AEROSOL DISPENSING APPARATUS

Filed April 16, 1964

FIG. 1

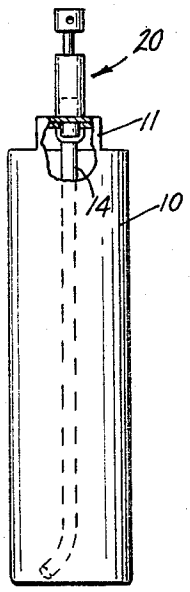


FIG. 2

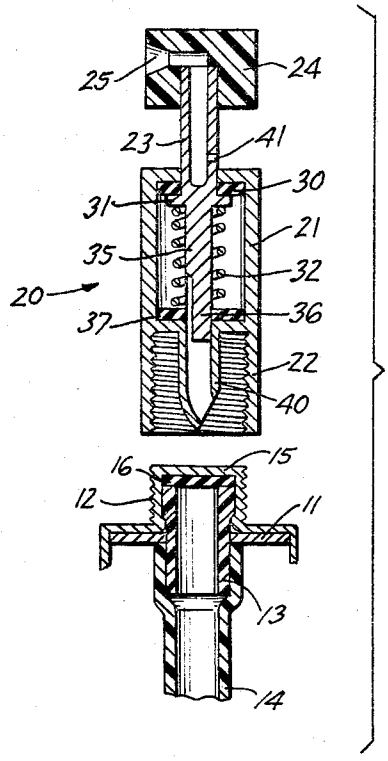


FIG. 3

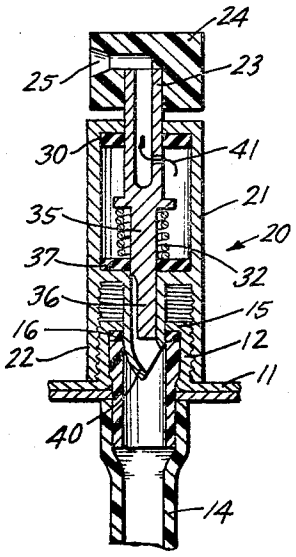
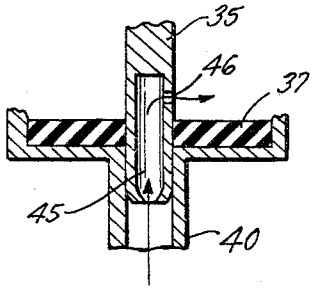


FIG. 4



INVENTORS
JOHN FRANGOS
MILTON SCHWARTZ

BY

Curtis, Morris & Safford
ATTORNEYS

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AEROSOL DISPENSING APPARATUS

John Frangos, Brooklyn, N.Y., and Milton Schwarz, Westport, Conn., assignors to Revlon, Inc., New York, N.Y.

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1 Claim. (Cl. 222—82)

This invention relates to dispensing fluid from pressure containers under propelling actioin of an aerosol or other propellant wthin the container and, more particularly, to valving and dispensing apparatus whereby a metered dose of material is dispensed upon each operation of a self-contained valve and dosaging mechanism for separate attachment to any of a variety of otherwise unvalved aerosol containers.

As will be understood, a wide variety of materials may be dispensed from pressurized containers under the action of gaseous or vaporizable propellant therein as with the so-called aerosol types of packaging. Generally in situations of this character, the material to be dispensed is admixed with a propellant (gas or highly volatile liquid, etc.) in a sealed container having a valved eduction tube therein whereby opening the valve prevides for the propellant to force the material to be dispensed up the eduction tube and out of the container.

Among the many materials which are conventionally so packaged and dispensed may be noted certain medicaments for inhalation therapy (such as stimulants for symptomatic emergency treatment of heart patients, vasoactive pharamaceuticals, etc.) as well as expensive and potent perfumes and similar materials where it is desired to have each application or dose rather carefully limited to no more than a relatively small amount and within considerably closer tolerances than may be readily achieved or assured merely by the individual user's voluntary or critical control of the dispensing mechanism itself.

If it is attempted to build into the conventional valving structure in each such aerosol dispenser or container an arrangement for metering each dose to within close tolerance critical limits, some difficulties may be experienced from a variety of sources. For example, the very nature of emergency inhalation therapy pharmaceuticals and expensive perfumes may indicate the desirability of having the entire container and valving mechanism formed as a relatively small vial with the entire metering and dosaging mechanism and dispensing valve arrangement having a gross outside diameter of not much more than ½ inch or ⅝ inch, and to be capable of dispensing metered doses of no more than 35–50 mg. of the material within the container upon each operation of the dispenser or valve. Also, for medical reasons and/or to comply with government regulations, such as those of the Federal Food and Drug Administration, it may be desired to have each such tiny dosage accurately dispensed to within 5% tolerance variations from dose to dose.

Considering such small dosages and close tolerance accuracy requirements, especially when combined with a desire to maintain the entire metering and dosaging apparatus and valve mechanism to relatively tiny sizes, and when the organic and/or solvent nature of the particular materials and propellants therefor is further considered, substantial difficulty may be encountered in manufacturing such small valving and dosaging apparatus to such close tolerance accuracy and utilizing adequately resistant materials for continued and repeated accurately reproducible dosaging performance at costs which remain, even with large production, within the desirably low range, especially when the user may exhaust each small container and be forced to replace it within a relatively short space of time such as once a month or something of that order.

Furthermore, although the aerosol dispensing of such materials may be highly desirable (as compared to air

pressure atomizers, eye droppers, etc.) for a variety of practical and medical and commercial reasons, the aerosol technique may be considered as having certain limitations which do not permit, for example, ready refilling of a used container (as is possible with regular atomizers or pharmacy-dispensed bottles) by anyone who does not have an adequate apparatus for doing so. Also, the utilization of aerosol-dispensed arrangement, particularly in the foregoing situations, may interject an extra and unnecessary element of cost, especially if an accurate metering valve must be factory-incorporated into each small container and repurchased anew by the user frequently whenever the container is exhausted.

According to this invention, however, there are provided inexpensive metering valve arrangements as a separate unit which may be accurately manufactured to the desired tolerances and utilized with a variety of refill containers or vials of desirably small size and substantially less expensive construction, thereby to provide minimal expense and the desired accurate metering valve or dosaging arrangement which may be utilized with any of a plurality of inexpensive and non-valved refill containers, thus to avoid the necessity of repurchasing a metering or dosaging or valving arrangement each time the container is exhausted and/or of using a less expensive or cheaply manufactured metering valve for critical dosaging operations; and, as a further feature of this invention, there is also provided for changing the removable valving arrangement from one container to another, even before the container is exhausted and without venting the pressurized container or admitting air into the sterile contents thereof even during removal and/or replacement of the valving arrangement.

With the foregoing and additional objects in mind, this invention will now be described in more detail, and other objects and advantages hereof will be apparent from the following description, the accompanying drawings, and the appended claims.

In the drawings:

FIG. 1 is a view in elevation of an aerosol container and dosaging and metering valving apparatus embodying and for practicing this invention;

FIG. 2 is a view on a somewhat larger scale and in axial section of the separable metering and dosaging valve arrangement of FIG. 1 and the mating portion of the container thereof shown as separate and prior to engagement;

FIG. 3 is a view similar to FIG. 2 but showing the dosaging and metering arrangement engaged with the replaceable pressurized container and with the valve shown in the position of dispensing a metered dose; and

FIG. 4 is a fragmentary detail of a modification for the metering end of the valve mechanism of FIGS. 2 and 3 especially adapted for use with materials having a tendency to cause swelling and distortion of rubber and/or plastic washers.

Referring to the drawings, in which like reference characters refer to like parts throughout the several views thereof, apparatus embodying and for practicing this invention is illustrated as comprising a container **10** (which may be of glass, plastic, metal, etc., in known manner) having a top closure **11** culminating in a threaded neck portion **12** (FIG. 2) encasing an interior portion **13** from which depends an eduction tube **14** leading to adjacent the bottom of the container and up which eduction tube liquid or fluid materials to be dispensed are forced by the pressure of the propellant within the container. The top surface **15** of threaded neck portion **12** is formed of relatively soft and thin piercible metal or plastic, and overlies in protective manner a self-sealing soft rubber seal **16** adapted in conjunction with neck portion **12** and top surface **15** to maintain pressurized conditions

within the container, yet to be readily pierced by a sharp instrument and with soft seal **16** being adapted, in known manner, to maintain a seal around any instrument piercing therethrough into container **10** and to be self-closing upon the withdrawal of any such piercing means.

As will be apparent from the foregoing, container **10** and closure **11** and the aforementioned sealing means are provided separately and without any valving means whatsoever for dispensing fluid from container **10**, thus readily providing for packaging and selling the container **10** and fluid material therein in surgically sterile condition if desired and/or otherwise completely enclosed and isolated from air as may be important with the sale of pharmaceutical products. A separate and detachable and reusable metering valve and dosaging arrangement is indicated generally at **20** as including a hollow valve body **21** having at the bottom thereof an internally threaded skirt portion **22** for threaded engagement over and around threaded neck **12** on container **10**.

Valve **20** also includes a valve stem **23** reciprocable in valve body **21** and preferably carrying at the top thereof a control button or cap **24** having therein a dispensing orifice **25**. Valve stem **23** communicates between the inside and outside valve body **21** through a seal **30**, and includes a shoulder portion **31** against which acts a spring **32** tending to urge valve stem **23** into upward or closed position as shown in FIG. 2. Also forming a part of valve stem **23** is a metering valve member **35** having a reduced diameter or off-set portion **36** at the bottom thereof. At the lower portion of hollow valve body **21** is a lower seal **37** through which passes metering valve portions **35** and **36** with the related configuration indicated generally by comparison of FIGS. 2 and 3 whereby, when the valve stem **23** is in the upper position shown in FIG. 2, reduced diameter portion **36** is adjacent seal **37** and extending through a passage through the seal adjacent to reduced diameter portion, while, in the lower position of the assembly as in FIG. 3, metering valve portion **35** completely closes the opening through seal **37** against the passage of material therethrough.

Also at the bottom of valve body **21** is a sharp or pointed piercing inlet nipple **40**, substantially entirely within threaded skirt **22**, and arranged so that the lower piercing end of nipple **40** will pierce surface **15** and seal **16** in the closure of container **10** upon threading skirt **22** of metering valve **20** onto and around threaded neck **12** to provide the arrangement of these particular parts noted in FIG. 3 and also to provide communication with inlet nipple **40** and eduction tube **14** within container **10**.

An outlet port **41** is provided in valve stem **23** and communicating through the side thereof into an axial passage therethrough. In the normal or off position of the valve arrangement indicated in FIG. 2, outlet port or opening **41** is above seal **30** and out of communication with the interior of hollow valve body **21**. In the lower dispensing position of the arrangement indicated in FIG. 3, however, depressing valve stem **23** against the action of spring **32** has moved outlet port **41** to below seal **30** and into a position of flow communication between the inside of hollow valve body **21** and the axial passage in valve stem **23** for the passage and ejection of materials from valve body **21** up hollow stem **23** and out dispensing nozzle orifice **25** in cap **24**. As will also be apparent from the foregoing, the coordination of dimensioning and relationships of the parts is arranged, in well understood manner, so that the metering valve portion **35** will close and seal with lower seal **37** when valve stem **23** is depressed sufficiently for outlet port **41** therein to be moved below or out of sealing engagement with upper seal **30**, whereas any time outlet port **41** is raised sufficiently to be in sealing engagement with or above upper seal **30**, only reduced diameter portion **36** of the metering valve stem is adjacent lower seal **37** to permit passage of material from eduction tube **14** up past seal **37** into hollow valve body **21**.

As will be apparent from the foregoing, threading metering valve assembly **20** onto threaded neck **12** of container **10** causes piercing inlet nipple **40** to pierce rubber seal **16** and provide flow communication between inside of container **10**, through eduction tube **14** therein, and the interior hollow valve body **21** so that material within the container may be forced upwardly by propellant therein to fill hollow valve body **21** because of reduced diameter portion **36** being out of sealing engagement with lower seal **37**.

So long as valve stem **23** is in the upper or closed position of FIG. 2, there is no escape of material from valve body **21**. When cap **24** and valve stem **23** are depressed, however, into the position of FIG. 3, outlet port **41** is moved below upper seal **30** and permits flow of any material within valve body **21** outwardly through stem **23** and dispensing orifice **25** under the action of propellant therein. In such depressed position, metering valve **35** is in sealing engagement with lower seal **37**, then preventing further flow of material from eduction tube **14** into main valve body **21**, so the only material which can be dispensed up hollow stem **23** is that quantity which was previously contained within valve body **21**. Upon release of stem **23** and upward movement thereof under the action of spring **32**, of course, reduced diameter portion **36** then is moved adjacent lower seal **37** and an additional quantity of material fills valve body **21**, awaiting a subsequent dispensing upon depressing valve stem **23**. In this manner, and depending upon the volumetric capacity of valve body **21**, an accurately controlled and readily reproducible metered dosage of material is dispensed through dispensing orifice **25** each time valve stem **23** is depressed, and with the quantity of such dosage being accurately controlled merely through the selection and design of the particular size or internal effective storing capacity of valve body **21**.

With certain materials and/or solvents thereof to be dispensed from container **10**, however, there may be some constituents present which have a swelling or other disruptive action on a material such as rubber or synthetic elastomers which might be utilized for lower seal **37** and with the result that the central opening therein may tend to swell sufficiently to inhibit or interrupt passage of material therethrough even when it is only reduced to diameter portion **36** which is adjacent lower seal **37**. In such situations, it may be preferred to utilize, instead of merely a reduced diameter portion on mixing metering valve stem **35**, an arrangement somewhat as diagrammed in FIG. 4.

In this arrangement, the lower portion of metering valve stem **35**, instead of carrying a reduced diameter portion **36**, is formed of substantially the same outside diameter throughout its whole length, but includes an axial passage **45** therein and inlet port **46**. In the raised position of the needling valve arrangement shown in FIG. 4 (i.e., with main valve raised as in FIG. 2), material from within container **10** flows up eduction tube **14** and piercing inlet nipple **40** and through passage **45** in the valve stem to emerge therefrom through port **46** into the inside of valve body **21**. When the metering valve is to be closed (as in the dispensing position of the arrangement indicated in FIG. 3), depressing main valve **23** and metering valve stem **35** affixed thereto moves port **46** to a position in sealing engagement with or below lower seal **37** so as to prevent further flow of material from the container **10** into valve body **21**. Since the diameter of the entire metering valve stem in this embodiment is substantially the same, any swelling effects which may occur on lower seal **37** are prevented from interfering with the free and rapid flow of material from the container to the measured capacity interior of valve body **21**.

Accordingly, there are provided in accordance herewith arrangements of apparatus whereby precisely manufactured and accurate metering and dosaging valve means

are available as a small and reusable separate and detachable unit for use with virtually any number of different sealed pressurized containers **10**, and with the enhanced consideration that, since none of the sealed units is valved in any manner, each of them is not only less expensive than if it had valving means incorporated therein, but also more easily manufactured and more readily susceptible to specialized handling considerations and techniques as may be desired with medicaments or pharmaceuticals, and as are conventional with the manufacture and sale of certain pharmaceuticals in rubber-sealed vials for use with hypodermic syringes, and the like. Thus, both the containers **10** and the reusable dosaging valve mechanisms may be made virtually as small as desired (the diameter of the entire valving arrangement **20** being only a fraction of an inch, even for accommodating dosages of around 35–50 mg. of material) and the vials themselves may be made as small as desired without the added cost of having a valving and metering arrangement incorporated in each vial without the possibility of any reuse thereof. Similarly, as noted above, since the user need obtain but one dosaging device **20**, regardless of how many vials **10** he may require over a period of time, a precisely and close tolerance manufactured dosaging device is permissible without the need for such stringent economies (perhaps productive of manufacturing in accuracies) as would be the case if a new metering device had to be purchased each time the contents of a vial or container **10** were exhausted or had to be replaced. Furthermore, since the vial seal **16** is of the known self-sealing rubber type conventionally used for pharmaceutical vials and since piercing inlet **40** need not be much larger than a large hypodermic needle, the disclosed arrangement permits switching the dosaging device **20** from one vial to another even before the contents of either are exhausted and without admitting air into vials or otherwise disturbing what may be the sterile contents thereof.

While the forms of apparatus herein described are preferred embodiments of this invention, this invention is not limited to these precise forms of apparatus and changes may be made therein without departing from the scope of this invention which is defined in the appended claim.

What is claimed is:

In metering valve apparatus of the character described for repeated application as a dispenser of a measured quantity of materials including a gaseous propellant from any one of a number of sealed containers having a threaded neck with a pierceable seal thereon, the combination which comprises a hollow axially extending valve body having top and bottom walls defining therebetween a volume measuring chamber the capacity of which determines said measured quantity of materials to be dispensed, a valve stem axially reciprocable in said valve body and extending axially through both said top and bottom walls, first sealing means disposed adjacent said top wall of said valve body and surrounding said valve stem in sealing engagement therewith, second sealing means adjacent said bottom wall of said valve body and surrounding said valve stem in sealing engagement therewith, means at the upper end of said valve stem and above said top wall of said valve body forming an ejection orifice, a radial port in said stem axially spaced below said ejection orifice, an axially extending internal passage in said valve stem interconnecting said radial port with said ejection orifice providing flow communication from said volume measuring chamber and said orifice through said port and axial passage when said valve stem is moved to a position where said port is below said first sealing means and within said volume measuring chamber, a reduced diameter portion at the lower end of said valve stem and extending through said second sealing means providing flow communication into said volume measuring chamber when said valve stem is in a position such that said reduced diameter portion is adjacent said second sealing means but preventing said flow into said chamber when said reduced diameter portion is wholly below said second sealing means, the axial spacing relationships of said radial port and said reduced diameter portion of said valve stem being correlated with the axial extent of said volume measuring chamber between said first and second sealing means such that said radial port is above said first sealing means whenever said reduced diameter portion permits flow through said second sealing means into said chamber and said reduced diameter portion is below said second sealing means preventing flow into said chamber whenever said radial port is below said first sealing means permitting flow through said axial passage from said chamber, biasing means effective on said valve stem and within said chamber for urging said valve upwardly toward the position where said radial port is above said first sealing means, an abutment on said valve stem for engaging said top wall of said valve body for limiting said upward movement of said stem, a threaded skirt depending from said valve body for engaging said neck portion on said sealed containers, a generally cylindrical and pointed hollow nipple depending from said valve body and coaxially within said skirt and in flow communication with said chamber for piercing the sealed top of said containers as said skirt is threaded down on to said neck portion thereof, said hollow nipple being disposed to receive slidably said reduced diameter portion of said valve stem when said valve stem is depressed against the action of said biasing means and the hollow internal diameter of said nipple being larger than said reduced diameter portion of said valve stem permitting flow of material through said hollow nipple into said chamber.

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ROBERT B. REEVES, *Primary Examiner.*

RAPHAEL M. LUPO, LOUIS J. DEMBO, *Examiners.*

W. SOBIN, *Assistant Examiner.*