United States Patent

Ferris

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[54] DISPENSING FOR MEDICAMENTS

[72] Inventor: **Frank Donald Ferris,** 5481 Plaza de Ray, San Jose, Calif. 95123

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[52] **U.S. Cl.** **128/222**

[51] **Int. Cl.** **A61j 07/00**

[58] **Field of Search** ..... 128/215, 173 R, 173 H, 222, 128/201, 208

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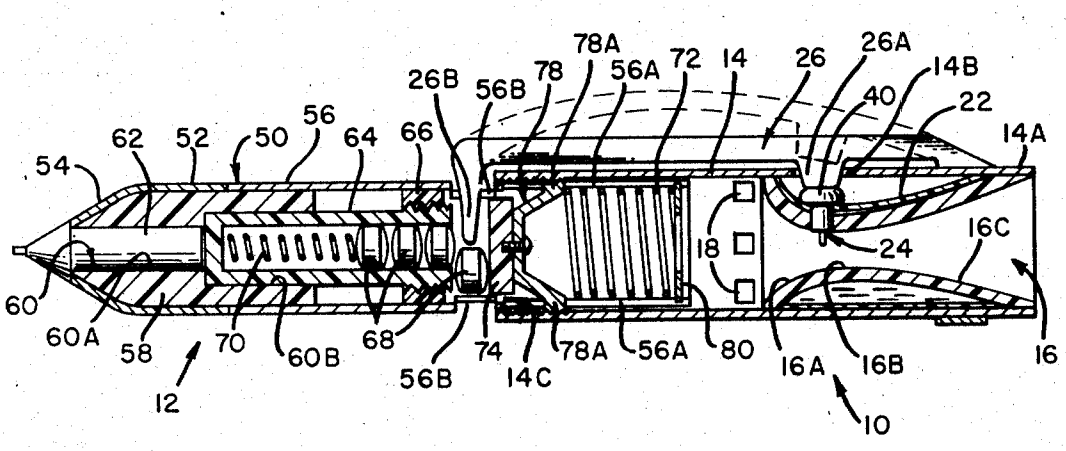
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Primary Examiner—Joseph S. Reich
Attorney—Victor R. Beckman

[57] **ABSTRACT**

A medicament dispensing apparatus which includes a first housing and a nozzle of the convergent-divergent type having an inlet and outlet adjacent the opposite ends of a nozzle chamber. A reservoir for liquid medicament is located outside the nozzle chamber adjacent the throat of the nozzle, and a metering and dispensing valve is positioned adjacent the throat for injecting a measured amount of medicament from the reservoir into the nozzle. Upon inhaling at the outlet of the nozzle the medicament injected into the nozzle is drawn into the mouth of the patient. A tablet storage and dispensing device in a second housing is provided adjacent the inlet end of the nozzle and includes a tablet container within said second housing. A container closure member for the tablet container is carried by the first housing, and a resilient member normally urges the container and closure together in air-tight engagement. A resilient member inside the container urges a stack of tablets therein into engagement with the closure. When the container and closure are separated, a tablet actuating arm is movable across the inner face of the closure to remove a tablet therefrom. The tablet actuating arm is included on a movable actuating member which also includes a valve actuating arm for operation of said metering and dispensing valve. The tablet storage and dispensing means may be replaced by an aerosol container for injection of medicament therefrom at the inlet of the nozzle chamber from whence it may be drawn through the nozzle by inhalation of the patient.

5 Claims, 7 Drawing Figures



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SHEET 1 OF 2

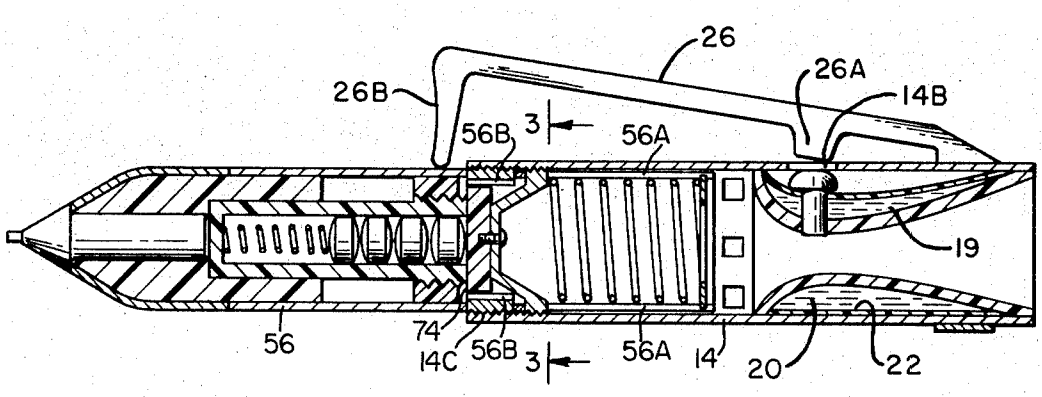


FIG-1

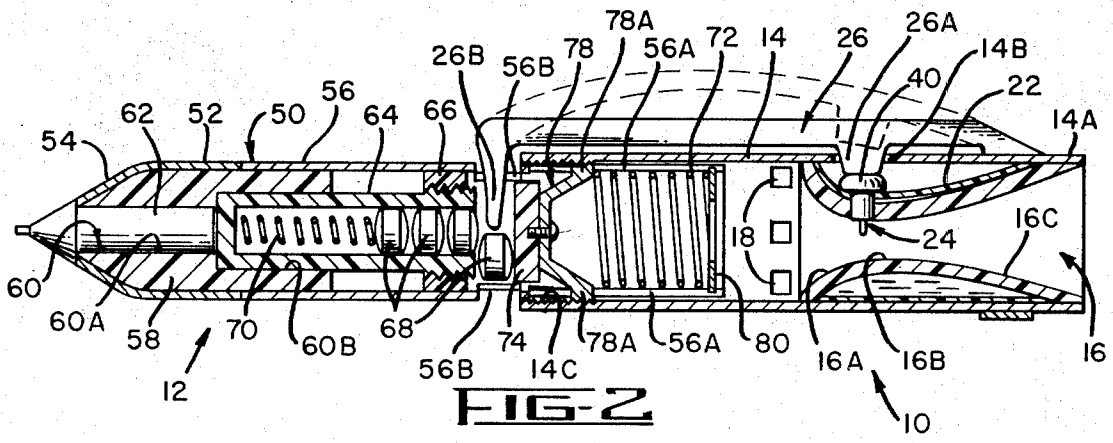


FIG-2

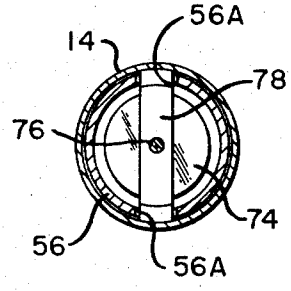


FIG-3

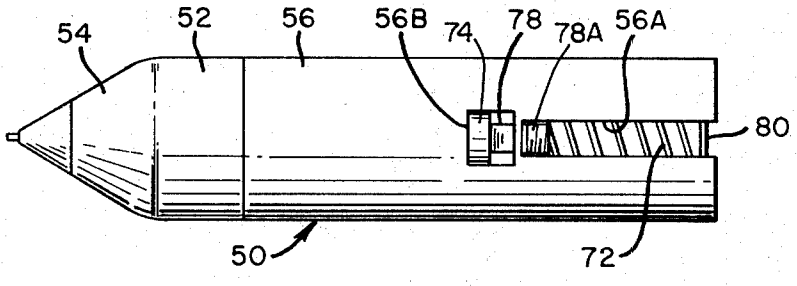


FIG-4

INVENTOR.
FRANK DONALD FERRIS

Victor R. Beckman

BY

ATTORNEY

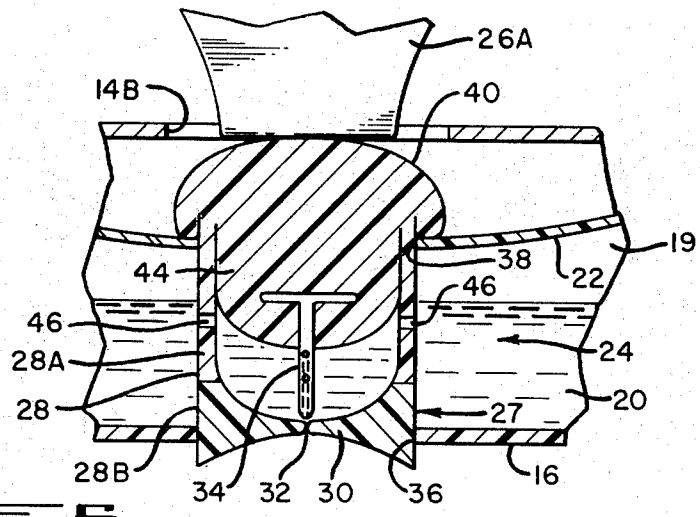


FIG-5

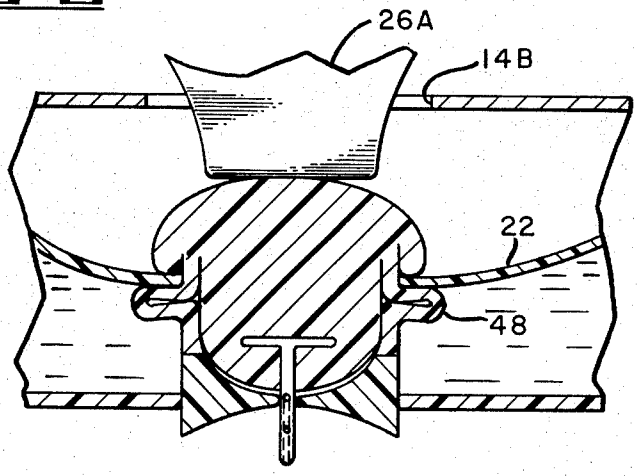


FIG-6

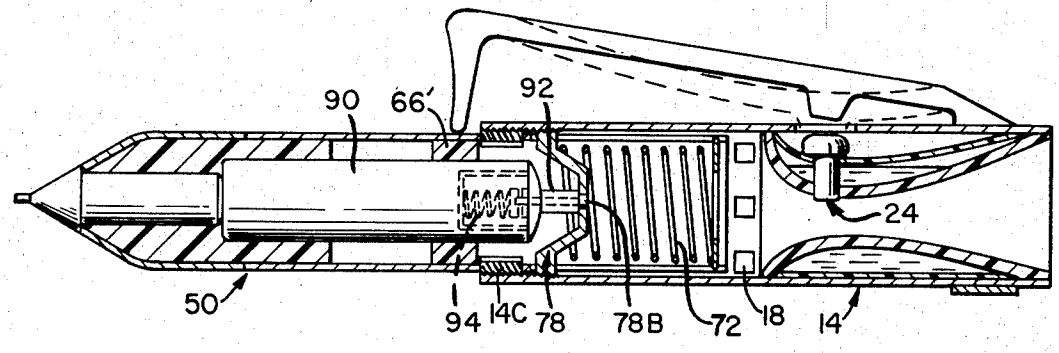


FIG-7

INVENTOR.
FRANK DONALD FERRIS

BY Victor R. Beckmann
ATTORNEY

DISPENSING FOR MEDICAMENTS

BACKGROUND OF THE INVENTION

A patient often is required to carry medicament with him for periodic use or for use in emergencies. Some medicaments such as liquids are not easily carried and/or readily dispensed by conventional dispensing methods and means. With many prior art arrangements liquid medicament either is dispensed from an aerosol container for inhalation thereof or is poured into a measuring container and swallowed. Inhalation of a measured amount of medicament is not practicable or possible with most prior art dispensers, nor do most prior art dispensers provide for the simultaneous dispensing of different medicaments such as liquid and tablets.

SUMMARY OF THE INVENTION

The medicament dispensing apparatus of this invention comprises a first tubular housing in which there is positioned a nozzle having a convergent-divergent chamber. A reservoir for liquid medicament is located outside the chamber adjacent the throat of the nozzle and a measuring and dispensing valve is secured to the nozzle intermediate the opposite ends thereof for communication between the reservoir and nozzle. In operation, a measured amount of medicine from the reservoir is injected into the nozzle upon manual actuation of the valve, which medicine is drawn into the patient's mouth upon inhaling at the nozzle outlet. The high velocity of air passing through the nozzle aids in vaporizing the medicine to facilitate entry into the patient's lungs. The valve may be repeatedly operated for additional dosages of medicine.

A second dispensing means such as a tablet dispenser or aerosol dispenser is provided adjacent the inlet end of the nozzle. The tablet dispenser includes an axially movable second tubular housing for a container of tablets of medicine. A container closure is carried by the first housing, and spring means resiliently urge the closure into sealing engagement with the tablet container. When the first and second housings are pulled apart axially the closure is separated from the container and the stack of tablets is urged toward the closure with the outermost tablet in engagement therewith. A movable actuating member on the first housing is engageable with the tablet to urge the same across the face of the closure and out of the dispenser. The actuating member may include means for actuation of the measuring and dispensing valve for simultaneous liquid and tablet dispensing upon actuation thereof if desired. Separately operated tablet and valve actuating means may be provided if desired.

The aerosol dispenser which may be employed in place of the tablet dispenser comprises means for mounting an aerosol can containing medicament in the second housing. Spring biasing means resiliently urge the stem of the aerosol can into engagement with a bracket secured to the first housing, but with insufficient force to effect actuation of the aerosol can valve. By manually urging the first and second housings together the aerosol can valve is opened for discharge of medicament-containing aerosol into the inlet of the nozzle from whence it is drawn into the mouth of the patient during inhalation.

The invention will be better understood from the following description when taken in conjunction with the accompanying drawings. In the drawings, wherein like reference characters refer to the same parts in the several views:

FIG. 1 is a longitudinal vertical cross-sectional view of a novel medicament dispensing apparatus embodying this invention;

FIG. 2 is a view which is similar to that of FIG. 1 but showing the liquid and tablet dispensing means in actuated condition;

FIG. 3 is a cross-sectional view taken along line 3—3 of FIG. 1;

FIG. 4 is an enlarged plan view of the second tubular housing removed from the first housing;

FIG. 5 is an enlarged vertical cross-sectional view through the measuring and dispensing valve included in the liquid dispensing section of the apparatus, and showing the valve in a normally closed unactuated condition;

FIG. 6 is a view which is similar to that of FIG. 5 but showing the valve in the open, actuated condition; and

FIG. 7 is a longitudinal cross-sectional view of the apparatus and showing an aerosol dispenser at the inlet to the nozzle in place of the tablet dispenser.

Reference now is made to FIGS. 1 and 2 of the drawings wherein the novel medicament dispensing apparatus of this invention is shown comprising a rear liquid dispensing section **10** and forward axially aligned tablet dispensing section **12** which sections are relatively axially movable. Although not limited to any particular size, an overall size of the apparatus may be approximately that of a writing instrument.

The liquid dispensing section **10** comprises a first cylindrical-shaped housing or casing **14** inside and at the rear of which there is mounted a nozzle **16** of the convergent-divergent type. The nozzle chamber includes a converging, convexly curved wall portion **16A** at the inlet end thereof, a narrow throat portion **16B**, and diverging, straight or curved wall portion **16C**. In the illustrated arrangement the nozzle walls are of an approximately uniform thickness, and are formed of a suitable rigid material such as metal, plastic, hard rubber, or the like. The throat axis may be asymmetrically positioned with respect to the inlet and outlet portions of the nozzle with the throat radially off-set from the longitudinal axis of the apparatus to provide adequate mounting space for a measuring and dispensing valve **24**, described below.

Air inlet apertures **18** are provided in the first housing **14** adjacent the inlet end of the nozzle **16**, and the nozzle exit portion **16C** terminates adjacent the open discharge or outlet end of the housing **14**. The rear end of the housing **14** comprises a mouthpiece designated **14A** which the patient may insert in his mouth for inhaling through the nozzle. When the patient so inhales, air is drawn into the device through the apertures **18** and passes through the nozzle **16** and into the mouth of the patient, not shown. Medicine injected into the nozzle is inhaled along with the air.

A reservoir **19** for fluid medicine **20** is provided adjacent the throat of the nozzle. In the illustrated arrangement the reservoir is formed adjacent the radially outer wall surface of the nozzle between the nozzle and a flexible tube or sleeve **22** which surrounds the nozzle

and is secured thereto at opposite ends of the sleeve. The measuring and dispensing valve **24** is affixed to the nozzle **16** adjacent the nozzle throat **16B** and at the side of the asymmetrically positioned throat which is farthest spaced from the first housing **14**. By utilizing a nozzle with a radially off-set throat sufficient space is provided between the nozzle **16** and housing **14** to accommodate the valve **24**.

The nozzle **16**, sleeve **22** and valve **24** may comprise an integral unit which is removable from the housing **14** by sliding the same rearwardly from the open end thereof. Suitable alignment means, not shown, may be provided for maintaining the valve **24** in alignment with a movable actuating member **26** to assure operative engagement between the valve actuating arm **26A** of the member **26** and the valve **24** through aperture **14B** in the housing **14** when the member **26** is depressed as illustrated in FIGS. **2** and **6**. One end of the member **26** is rigidly fastened to the housing **14**, and the member is of such size and material to resiliently return to the position illustrated in FIG. **1** after either the section adjacent arm **26A** or arm **26B**, or both sections are depressed and released.

The measuring and dispensing valve **24** and its operation are best illustrated in FIGS. **5** and **6** to which Figures reference now is made. The valve comprises a cylinder **27** formed with a side wall **28** and end wall **30**. For convenience of construction the cylinder side wall may be formed of upper and lower sections **28A** and **28B** secured together by cement or other suitable means, not shown. The end wall **30** is formed with a self-sealing central aperture **32** which normally is closed but through which a tube or hollow needle **34** may be extended. When the tube is withdrawn the aperture **32** recloses. As illustrated, the radially inner end of the cylinder **27** is attached to the nozzle at an aperture **36** in the nozzle wall adjacent the throat thereof whereby fluid may be injected into the nozzle through the tube **34**. Any suitable means such as cement, not shown, may be used to secure the valve to the nozzle. The valve body also extends through an aperture **38** formed in the resilient sleeve **22** in sealing engagement therewith adjacent an enlarged diameter head **40** formed at the upper end of the valve. The valve is positioned such that the head **40** thereof is adjacent the aperture **14B** in the casing wall **14** through which the valve actuating arm **26A** of the actuating lever **26** may be extended for operation of the valve.

The head **40** comprises the head of a movable member such as a piston or plunger **44** which is axially movable inside the cylinder **27** and which plunger carries the tube **34**. The upper end of the tube **34** is of T-shape and is embedded in the lower end of the piston for rigid attachment thereto. In the raised position of the plunger illustrated in FIG. **5**, the tube **34** is removed from the aperture **32**, and fluid medicine **20** in the reservoir **19** outside the nozzle is free to enter the cylinder **27** through ports **46** in the cylinder sidewall. When the plunger **44** is depressed by actuation of the lever **26** the resilient cylinder wall portions spread outwardly as seen in FIG. **6** to form a folded annular section **48**, thereby allowing plunger **44** to form a sliding friction seal with cylinder **27**. Closing of the ports **46** is effected by such movement of the piston or plunger **44** past the ports. As the plunger is depressed to its lowermost position the tube **34** extends through the aperture **32** and a measured amount of fluid medicine inside the cylinder **28** is dispensed under pressure into the nozzle from whence it is drawn into the patient's mouth upon inhalation at the nozzle outlet **14A**. The liquid medicine streams with considerable force from the end of tube into the nozzle to aid in the vaporization thereof. Another contributing factor in the vaporization of the liquid is the extremely high velocity of the air stream drawn through the nozzle into which the liquid is injected.

When the actuating lever **26** is released the resiliency of the cylinder walls **28** returns the same to the normal extended cylindrical shape illustrated in FIG. **5** where the cylinder again refills with liquid medicine **20** through the ports **46** so long as a sufficient supply of medicine remains in the reservoir. When the supply of liquid medicine in the reservoir is no longer sufficient to fill the cylinder the nozzle **16** with the attached valve **24** and resilient sleeve **22** may be slid from the open end of the housing **14** and replaced with one having a full reservoir of medicine.

The tablet dispenser **12** (see FIGS. **1** and **2**) is located at the end opposite the nozzle **16** and includes a second tubular housing **50** comprising a forward end member **52** having a tapered forward end **54**, and a rear end member **56** having a portion coaxially positioned inside the first housing **14** in axially slidable relationship therewith. The housing sections **52** and **56** are in light press-fit engagement with an internal tubular body **58** to secure the same together. The body **58** is formed with an axial bore **60** having a small diameter end **60A** adapted to carry a writing instrument such as a mechanical pencil, ball point pen, conventional fountain pen, or the like; a mechanical pencil being shown in the drawings. Such writing instruments are of well known construction and require no detailed showing or further description.

A vial or container **64** of plastic or other suitable material is removably mounted inside the large diameter rear end **60B** of the bore and may be supported adjacent its open end by a resilient bushing **66** threadedly secured to the threaded end of the container and press-fitted inside the housing section **56**. The container **64** contains a stack of tablets or wafers **68** of medicine, or the like, which stack is urged rearwardly toward the open end of the container by compression spring **70** inside the container and abutting the forward-most tablet. A stronger compression spring **72** urges the second housing **50** together with the tablet container **64** therein rearwardly (i.e. to the right as viewed in FIGS. **1** and **2**), which movement is limited by engagement of the mouth of the container with a container closure **74** as seen in FIG. **1**. The stack of tablets thereby is urged into the container against the action of spring **70** and an air tight seal is provided between the container and its closure as viewed in FIG. **1**.

The container closure **74** is attached to a generally C-shaped bracket **78** as by a centrally located screw **76** which extends through a hole in the bracket and threadedly engages the closure. The bracket is formed with opposite radially outwardly directed leg portions **78A** which are threaded at their outer peripheries for engagement with internally threaded portion **14C** of the first housing **14**. The leg portions **78A** extend

through elongated slots **56A** diametrically located at the rear end of the housing portion **56** for non-rotative, axial movement of the second housing **50** within the first housing **14**. The bracket **78** also serves as an abutment for one end of the spring **72**, the other end of the spring engaging a washer **80** attached adjacent the rear end of the second housing **50**. The spring **72** normally is under compression to axially urge the second housing **50** into the first housing **14** with the mouth or rim of the tablet container **64** in tight sealing engagement with the container closure **74**.

To dispense a tablet **68** the housing **50** is pulled forwardly from the housing **14** against the action of spring **72** and into the position illustrated in FIG. **2**. The spring **70** simultaneously expands to urge the rear end tablet of the stack of tablets from the container **64**, with the rear end tablet frictionally supported between the adjacent tablet (or spring **70** if only one tablet remains) and the plane forward face of the closure **74**. A pair of diametrically opposed apertures **56B** are formed in the housing section **56** which apertures normally are covered by the housing **14** but which are exposed when the housing **50** is extended to open position. In the open condition the apertures **56B** are in alignment with the rear end tablet which abuts the container closure, and also in alignment with the tablet actuator arm **26B** of actuator member **26**. When the forward free end of member **26** is depressed as illustrated by the broken line position thereof in FIG. **2** (after first having pulled the second housing **50** forwardly relative to the first housing **14**) the actuator arm **26B** engages the rearmost tablet to urge the same radially outwardly from the lower aperture **56B**, as shown. As a result, a tablet **68** is dispensed upon operation of the actuating member **26**. (If it is desired to simultaneously dispense fluid medicine and a tablet, the flexible actuating member **26** also may be depressed adjacent the arm portion **26A** as well as portion **26B** as illustrated in full line position in FIG. **2**. Due to the flexibility of the member **26** which may be made of polyurethane, or the like, the arm portions thereof may be independently actuated or simultaneously actuated as desired. Thus, if no tablet **68** is required, the housing **50** may be left in the retracted position (FIG. **1**) when the actuating member **26** is depressed, in a manner such as illustrated in broken line position shown in FIG. **7**, to actuate only the measuring and dispensing valve **24** but not dispense a tablet.)

The apparatus of this invention is readily convertible for use as an aerosol dispenser for discharging a medicament-containing aerosol into the nozzle from whence it may be inhaled into the mouth of the patient. Such an aerosol dispenser is shown in FIG. **7** wherein the tablet container is shown replaced by an aerosol container **90** which contains a desired medicament. The rearward end of the container **90** is supported by a bushing **66** inside the housing **50**. The container may be of conventional construction and is shown comprising a dispensing stem **92** which serves also as a valve operator for opening the container valve (not shown) when the stem is depressed. When the stem is released a spring **94** inside the container returns the stem to an extended, valve closed, condition. As mentioned above, such valve actuating means for aerosol containers are well known and require no detailed showing or description. For use as an aerosol dispenser the bracket **78** is removed from the housing, the closure member **74** is removed from the bracket, and the bracket **78** is replaced in the housing but in the opposite facing direction. The compression spring **72** now urges the second housing **50** into rearward retracted position inside the first housing **14** with the end of the stem **92** abutting the bracket **78** at the central aperture **78B** therein. The force of spring **72** is not so great, however, as to overcome the force of the aerosol container spring **94**; therefore the aerosol valve normally remains closed. To actuate the valve to open position for discharging medicament from the aerosol container it is necessary to press rearwardly on the second housing **50** to depress the stem **92** against the bracket **78** which is secured at **14C** to the rear housing member **14**. The medicament-containing aerosol is thereby discharged from the stem **92**, through the aperture **78B** and into the nozzle **16** from whence it may be drawn into the patient's mouth by inhaling at the discharge end of the nozzle in the manner described above. When the housing is released the spring **94** returns the aerosol container valve to closed condition against the action of the spring **72**. Fluid medicament **20** from the reservoir **19** also may be dispensed by depressing the actuating member **26** to bend the same into the broken line position shown in FIG. **7**. When released, the actuating member **26** returns to the illustrated solid line position by reason of the resiliency thereof for reclosing of the valve **24**.

The apparatus of this invention are not limited to any particular fluid medicine or for dispensing any particular kind of tablets. As an example only, the fluid which is dispensed into the nozzle may comprise amyl nitrite, a medicament for treatment of heart disease patients, and the tablets may comprise nitroglycerin, also for use by heart patients. Since the liquid and tablets are stored in air-tight hermetically sealed containers they may be highly volatile yet substantially without loss thereof. Amyl nitrite which is both highly volatile and has a disagreeable odor is well adapted for use in the apparatus. Although oral inhalation of the fluid medicine is described it will be apparent that the invention is not so limited but is readily adapted for inhalation by other means, such as nasally.

The invention having been described in detail in accordance with the requirements of the Patent Statutes, various other changes and modifications may suggest themselves to those skilled in this art. for example, one modification includes the use of separate and independently actuated valve and tablet actuating members in place of the single actuating member **26**. Alternatively, the actuating portion **26A** of the member **26** may be eliminated by use of a valve **24** having a head **40** which normally extends upwardly through the aperture **14B** in the housing **14** for direct finger-actuation thereof by the patient. It is intended that the above and other such changes and modifications shall fall within the spirit and scope of the invention as defined in the appended claims.

I claim:

1. A dispensing apparatus for dispensing fluid medicament comprising,

a nozzle having a converging-diverging chamber with air inlet and outlet portions at opposite ends thereof,

air inlet means adjacent the inlet end of the nozzle,

means for injecting a measured dose of fluid medicament into the nozzle chamber,

the fluid medicament injected into the nozzle chamber being drawn into the patient inhaling air through the nozzle,

a reservoir for fluid medicament outside the nozzle chamber,

said means for injecting a measured dose of fluid medicament into the nozzle chamber including a measuring and dispensing valve,

means for manually actuating the valve for injecting a measured dose of fluid medicament into the nozzle chamber from said reservoir,

said measuring and dispensing valve including a cylinder having side and end walls formed with a port in the side wall opening into the reservoir of fluid medicament and a self-sealing aperture in the end wall communicating with the nozzle chamber,

a member sealing with and reciprocably movable within said cylinder and movable by said means for manually actuating the valve, and

means for closing the port in the cylinder side wall and opening the self-sealing aperture in the cylinder end-wall when the reciprocably movable member is actuated by said valve actuating means for transfering fluid from the cylinder into the nozzle chamber.

2. A dispensing apparatus for dispensing fluid medicament comprising,

a nozzle having a converging-diverging chamber with air inlet and outlet portions at opposite ends thereof,

air inlet means adjacent the inlet end of the nozzle,

means for injecting a measured dose of fluid medicament into the nozzle chamber,

the fluid medicament injected into the nozzle chamber being drawn into the patient inhaling air through the nozzle, and

a resilient sleeve surrounding the nozzle and together with the outer wall of the nozzle comprising a reservoir for fluid medicament.

3. A dispensing apparatus for dispensing medicaments comprising,

a nozzle having a converging-diverging chamber with air inlet and outlet portions at opposite ends thereof,

air inlet means adjacent the inlet end of the nozzle,

means for injecting a measured dose of fluid medicament into the nozzle chamber,

the fluid medicament injected into the nozzle chamber being drawn into the patient inhaling air through the nozzle,

a first housing surrounding the nozzle and including an end portion extending axially from the inlet end of the nozzle,

a second housing axially slidably mounted at the axially extending end portion of the first housing,

a container for a stack of tablets carried by one of said housings,

a closure member for the tablet container carried by the other of said housings,

resilient biasing means normally resiliently biasing the closure member into engagement with the container to seal the same, and

actuating means for operation of said medicament injecting means and for dispensing a tablet from the tablet container when the container closure is removed from the container, said actuating means being operable for simultaneous and for independent operation of said medicament injecting means and tablet dispensing means.

4. The dispensing apparatus as defined in claim 3 including,

means forming a tablet discharge opening in one of said first and second housings, and

means resiliently urging the stack of tablets against the closure member in both the container open and container closed position of the container closure,

the actuating means for operation of said medicament injecting means and for dispensing a tablet from the tablet container including tablet actuating means for moving a tablet along a face of the closure member and through said tablet discharge opening to remove the same therefrom when the container closure is removed from the container.

5. A dispensing apparatus for dispensing fluid medicament comprising,

a nozzle having a converging-diverging chamber with air inlet and outlet portions at opposite ends thereof,

air inlet means adjacent the inlet end of the nozzle,

means for injecting a measured dose of fluid medicament into the nozzle chamber,

the fluid medicament injected into the nozzle chamber being drawn into the patient inhaling air through the nozzle,

a first housing surrounding the nozzle and including an extended end extending axially beyond the inlet end thereof,

a second housing axially slidably mounted at the extended end of the first housing,

a medicament-containing pressurized container having a depressable actuating stem carried by one of said first and second housings for discharge of medicament from the container upon depression of the stem,

a bracket carried by the other of said first and second housings, and

resilient biasing means resiliently urging the actuating stem into engagement with the bracket with a force below which the actuating stem is depressed for medicament discharge, said housings being further axially movable in the direction of the resilient biasing means for depression of the stem to discharge medicament from the container and into the inlet end of the nozzle for inhalation by the patient through the nozzle.

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