# United States Patent

**Marand**

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## [54] AIR PRESSURE OPERATED DISPENSER


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[73] Assignee: **Ciba-Geigy Corporation**



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[51] **Int. Cl.**.....**B67d 5/54**

[58] **Field of Search**.....222/133, 175, 193, 400.5, 402, 222/503; 128/276, 278



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[57] **ABSTRACT**

A dispensing device in which the product to be dispensed is aspirated and sprayed by the discharged pressurized air. A valve assembly has a product flow path therethrough and a compressed air flow path therethrough. The valve stem of the assembly is actuated to open the flow paths, and aspirating means is provided at the upper end of said stem for bringing one end of each of said flow paths together. A piston-cylinder assembly is provided on the device having a cylinder with one end around the end of the compressed air flow path, a piston slidable in the cylinder, and a piston rod on said piston and extending out of the other end of said cylinder. A product containing sac has a neck thereon sealed around the end of the product flow path. An actuator means is connected between the piston rod and the valve assembly for moving the valve stem relative to the valve body for opening the flow paths when the piston is moved to the inner end of the cylinder adjacent the valve assembly to provide a predetermined amount of compressed air.


**8 Claims, 3 Drawing Figures**

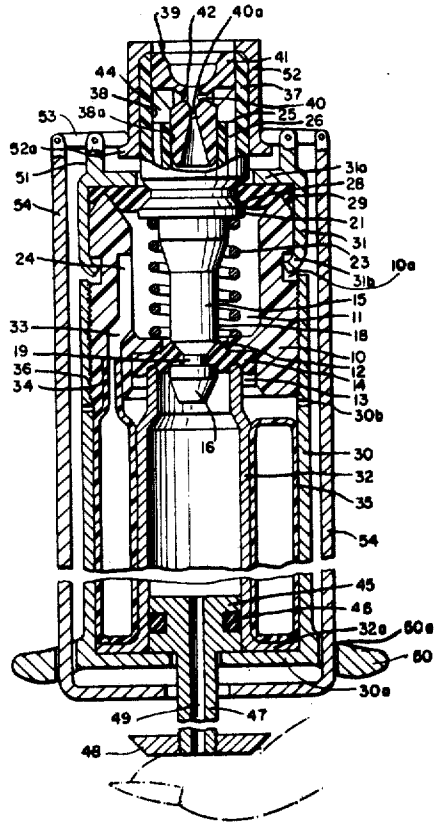
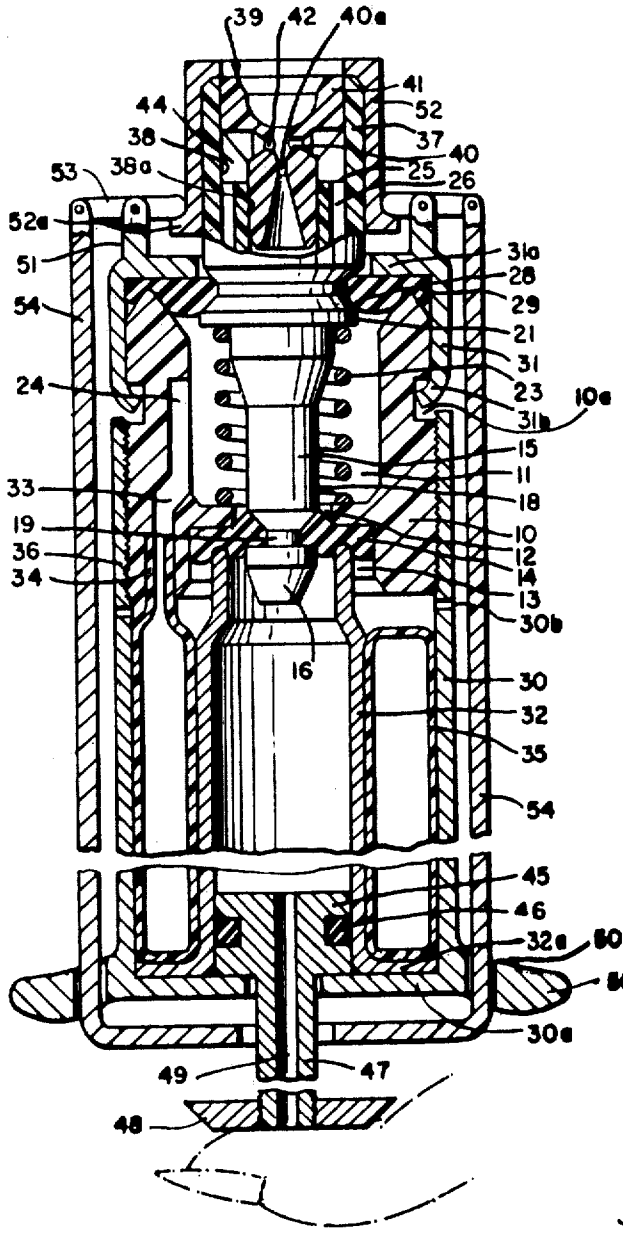


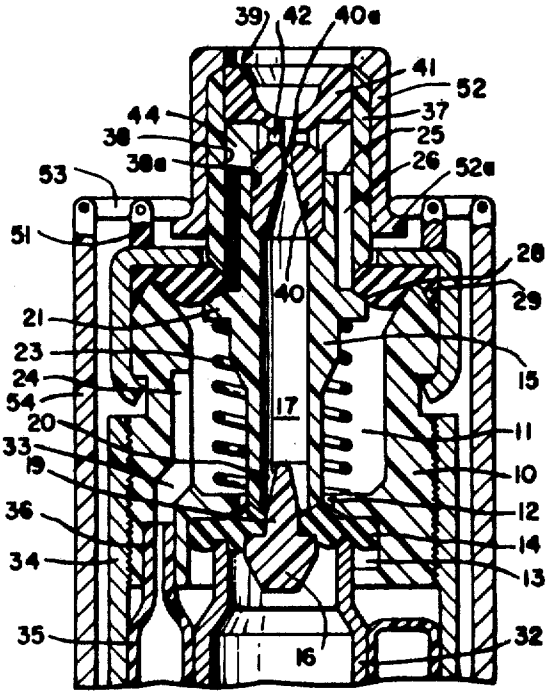
FIG. 1




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FIG. 2



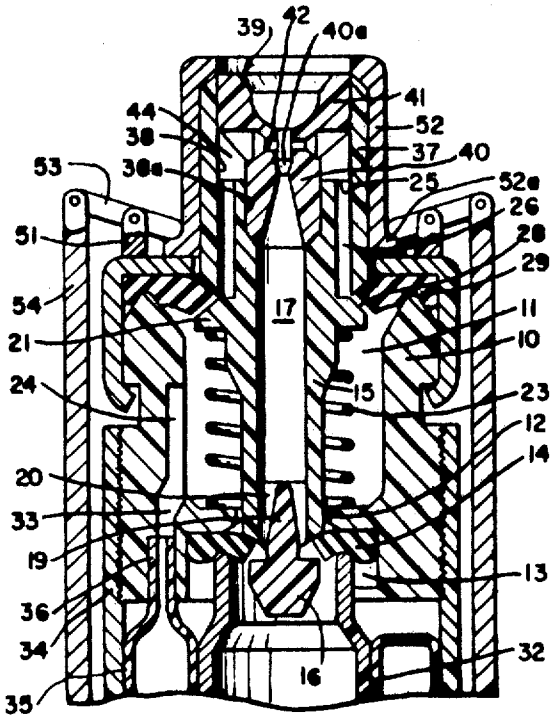




FIG. 3

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# AIR PRESSURE OPERATED DISPENSER

## BACKGROUND OF THE INVENTION

This invention relates to a dispenser for fluids, and more particularly to a device for aspirating a fluid and dispensing it as a spray by means of compressed air.

## PRIOR ART

The art of dispensing fluid materials is very highly developed. More recently there have been great advances in the art of dispensing fluid materials by means of a compressed propellant while keeping the fluid and propellant separate prior to dispensing. These recently developed so-called double aerosol type dispensers are quite satisfactory, but nevertheless have some disadvantages, particularly where they must be made in small sizes. Many of these disadvantages are also common to the single phase dispensers, where the propellant and the material to be dispensed are stored in the mixed condition in the dispenser prior to dispensing.

Among these disadvantages is leakage of propellant from the propellant cartridge during storage, which reduces the shelf life of the dispenser. Additionally, the problem of exactly matching the amount of propellant with the amount of material to be dispensed is often difficult because of this leakage problem. Also because of differences between the various materials being dispensed, a proper amount of propellant for one material will not suffice or will be in excess of that necessary for dispensing all of another material. In the first instance, part of the product is wasted, and in the second instance, part of the propellant is wasted.

In addition, if it is desired to dispense only a measured quantity of material, special valving means must be developed. Otherwise, the amount of material dispensed is proportional to the time of actuation of the device, and there is no way to accurately insure that the user will properly time the actuation to dispense the desired measured quantity.

A further disadvantage is that with compressed gas type propellants, when the propellant is running low, the dispensing of the last of the material to be dispensed can be carried out only at a very slow rate, as compared to when the dispenser is initially filled with propellant, when dispensing takes place rapidly.

Moreover, when conventional aerosol propellants are used to dispense medicaments in inhaler type devices, potentially toxic propellants are inhaled by the user along with the medicament. In many cases, this is undesirable and pharmaceutical marketers would prefer to have the product dispensed by air instead of a chemical vapor conventionally used as propellants.

Many of these disadvantages could be overcome if, instead of using compressed conventional propellant gases, air was used as a propellant and was compressed each time the dispensing operation was to be carried out. Conventional squeeze bulb and poston-cylinder atomizers operate somewhat in this fashion, but have the serious drawback that the compression is carried out gradually, and the aspiration is thus gradual, the amount of material being dispensed being dependant on how fast and with what force the squeeze bulb or the piston-cylinder means is operated.

## OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the present invention to provide a dispensing device which utilizes compressed air for aspiration in a manner so as to overcome all of the recited disadvantages of the aerosol type dispensers.

It is a further object of the present invention to provide a dispensing device which utilizes compressed air that is compressed each time dispensing takes place, but which releases the compressed air suddenly only after the pressure has been built to the maximum.

It is a still further object of the present invention to provide a dispensing device which utilizes compressed air for dispensing, which dispenses a measured amount of material at each actuation of the device, which is extremely safe to use, and which cannot dispense more than the measured amount of material.



It is a still further object of the present invention to provide a dispensing device which can be stored without loss of a propellant and which therefore has a shelf life limited only by the life of the material to be dispensed, and which can also be stored without fear of an explosion of a compressed propellant.

These objects are achieved by providing a dispensing device which has a valve assembly with a valve body and a hollow valve stem movable through said valve body. The valve assembly has a product flow path therethrough and a compressed air flow path therethrough, part of one of these flow paths being through the stem. Aspirating means are provided at the upper end of the stem to bring the flow paths together. Obturating means are operatively associated with the stem for obturating the flow paths. The flow paths open out of the bottom of the valve body. A piston cylinder assembly has a cylinder around the end of the compressed air flow path having a piston slidable therein, and sealed around the end of the product flow path is the neck of a product containing sac. A piston rod is connected to the piston for moving the piston into the cylinder, and actuator means is connected between the piston rod and the stem for moving the stem and the valve body together to open the flow paths when the piston reaches the inner end of the cylinder, thus releasing the compressed air from the cylinder and opening the flow path for the product for aspirating the product and dispensing it in a spray.

## BRIEF DESCRIPTION OF THE DRAWINGS

Other and further features of the invention will be described in the following specification and claims, taken with the accompanying drawings, in which:

FIG. 1 is a sectional elevation view of the dispensing device according to the present invention, with the parts in positions for the start of a dispensing operation;

FIG. 2 is a sectional elevation view of the upper part of the device shown in FIG. 1; and

FIG. 3 is a view similar to FIG. 2 in which the parts are shown in their positions at the end of a dispensing operation.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIGS. 1 and 2, there is shown a dispensing device according to the invention. The dispensing device is constituted by a valve assembly, a piston-cylinder assembly, a product containing sac, a housing enclosing these elements, and an actuating linkage.

The valve assembly is similar to that disclosed in U.S. Pat. application Ser. No. 778,905 in the name of Marand. It has a valve body **10** having a hollow interior **11**, which opens out of the top of the valve body **10**. A bore **12** extends downward from the hollow interior **11** and opens into a downward open recess **13** in the bottom of the valve body **10**. Positioned in the downward open recess **13** is an annular obturating gasket **14**.

A hollow valve stem **15** extends through the hollow interior **11**, and has a cylindrical portion **18** extending through the bore **12** and spaced only slightly therefrom, so that the surface defining the bore **12** forms a loose bearing for the valve stem **15**. A conical head **16** is provided on the bottom end of the stem **15**, and between the cylindrical portion **18** and the conical head **16** is a reduced diameter portion **19** in which the inner edge of the annular gasket **14** is tightly engaged.

The stem has a hollow bore **17** therein, and from the lower end of the bore **17** extend vertical passages **20**, which open out of the stem in the reduced diameter portion **19**. In the rest position of the stem, as shown in FIG. 1, in which the stem is in the raised postion relative to the valve body **10**, the inner edge of the annular gasket **14** closes off or obturates the openings at the lower ends of the vertical passages **20**.

The valve stem has a flange 21 thereon. A return spring 23 is positioned between the flange and the bottom of the hollow interior 11, and tends to urge the stem 15 in the upward direction. Fin-like projections 24 are provided of the inner surface of the valve body 10 and project into the hollow interior 11. The upper ends of the projections 24 are at a level such that they are abutted by the flange 21 and act as stops for the downward movement of the stem 15.

On the exterior peripheral surface of the upper part of the stem 15 above the flange 21 are a plurality of radially projecting ribs 25 extending parallel to the axis of the stem, and defining between them passages 26. At the lower ends of the ribs 25 and outwardly thereof on the upper part of the flange 21 is a downward and outward tapered surface 28. Engaged with this surface 28 is the inner portion of the downward facing surface of a further annular obturating gasket 29 for obturating flow of the product. This gasket has the outer portion of the downward facing surface engaged with the upper end of the valve body 10, so that in the normal or rest position, as shown in FIG. 1, the annular gasket 29 closes off the top of the hollow interior 11 between the stem and the valve body.

Extending downward from the hollow interior 11 on one side of the valve body 10 is a product passage 33 which opens into a further downward open recess 34 in the bottom of the valve body.

The valve stem 15 has an upper cylindrical portion 37, which is integral with the outer edges of the ribs 25, and which extends upward beyond the end of the portion of the valve stem 15 having the hollow bore 17 therein. The interior of the upper cylindrical portion 37 defines a larger upward opening recess 38 at the upper end of the valve stem 15. In the upper portion of the valve stem within the upper cylindrical portion 37 is a smaller upward opening recess 38*a* into which is fitted aspirating means in the form of a nozzle insert generally indicated at 39. The nozzle insert has a Venturi portion 40, which has the lower portion fitted into the recess 38a. The Venturi portion 40 is longer than the recess 38a is deep, so that the Venturi portion extends beyond the outer end of the recess 38*a*. The nozzle insert has a larger diameter portion 41 on the upper end thereof, the outer diameter of which fits tightly within the upward opening recess 38. This portion 41, together with the upper ends of the ribs 25, defines a product supply chamber 44. The Venturi nozzle insert 39 has a Venturi nozzle 40*a* therein, with radial product passages 42 opening into it through the Venturi portion 40 from the product supply chamber 44.

The piston-cylinder assembly has a cylinder 32, the upper end of which is in sealing engagement with said valve assembly around bore 12. In this embodiment it is engaged with the lower surface of the annular obturating gasket 14. The upper end of the cylinder 32 is thus closed by the gasket 14 and the conical head 16 extending through the gasket. The cylinder 32 has a flange 32a at the end thereof remote from the valve assembly. The outside diameter of the flange 32a is preferably about the same as the outside diameter of the valve body 10.

A piston 45 is slidable in the cylinder 32 and a piston ring 46 is positioned in a groove around the piston. A piston rod 47 extends from the piston 45 out through the open end of the cylinder 32 and a pressure member 48 is mounted on the end of the rod. A vent bore 49 extends through the rod and the piston.

There is defined between the flange 32a and the lower end of the valve body 10 an annular recess in which is positioned an annular flexible collapsible prouuct containing sac 35. The product containg sac 35 has a discharge outlet 36 on the upper end thereof which extends upward and into sealing engagement with the valve body in the recess 34 into which the product passage 33 opens.

Surrounding the above described parts and holding them in the described relationship is a housing, which, in this embodiment, is a two part housing. The upper part 31 has a top flange 31*a* flanged over the upper surface of the further annular gasket 29 and a bottom flange 31b turned into groove 10*a* provided in the outer peripheral wall of the valve body 10. The upper housing part 31 thus tightly clamps the valve body 10 and the annular gasket 29 together. A lower housing part 30 has the upper end threaded to the valve body 10 and extends downward so as to define the outer periphery of the annular recess for the sac 35. The bottom 30*a* of the lower housing part extends inwardly and supports the flange 32*a* on the end of cylinder 32. The bottom has an opening therein for piston rod 47. The lower housing part 30 also has openings 30*a* in the outer peripheral wall thereof to admit air to the annular recess in which is positioned the product containing sac 35.

Extending outwardly from the bottom of the lower housing part 30 are diametrally opposite finger grips 50, which, in this embodiment, are integrally formed with the housing part 30.

Actuator means are provided, which, in this embodiment, comprise an actuator sleeve 52 on the upper cylindrical portion 37 of the valve stem 15. The actuator sleeve 52 has the upper end flanged over the end of the upper cylindrical portion 37, and has a laterally projecting flange 52*a* on the lower end thereof. Engaged with the flange 52*a* are two diametrally opposed levers 53 which are pivotally mounted on projections 51 mounted on the top flange 31*a* of the upper body portion 31. Pivotally connected to the free ends of the levers 53 is an actuator 54 which is a generally U-shaped frame which extends along the sides of the device and beneath the end of the lower housing portion 30, extending through apertures 50*a* in the finger grips 50. The closed end of the actuator 54 has an aperture therein through which the piston rod 47 extends.

In operation, starting with the parts in the positions shown in FIGS. 1 and 2, the device is gripped by the finger grips 50, and a finger is placed over the end of the bore 49 opening out of the pressure member 48. A force is then exerted to force the piston 45 into the cylinder 32. This causes the air pressure in the cylinder to build up, the cylinder being closed at one end by the valve assembly and at the other end by the finger over the vent bore 49. This movement is continued until the piston nears the bottom of the cylinder, at which time the pressure member 48 abuts the actuator 54. At this point, the pressure within the cylinder has been built up to a maximum. Further movement of the pressure member 48, in addition to moving the piston, also moves the actuator in the same direction the piston is moving. This causes pivoting of the levers 53 so as to move the actuator sleeve 52 toward the valve assembly, thus moving the valve stem 15 into the valve assembly.

Up to this point, the bore 17 in the stem has been sealed off from the interior of the cylinder 32 by the obturating gasket 14, which completely seals off the vertical passages 20. In addition, the hollow interior 11 is sealed off from the passages 26 between the ribs 25 along the outside of the upper portion of the stem 15 by the gasket 29 and its sealing engagement with the tapered surface 28 on the upper part of flange 21 and with the upper end of the valve body 10 around the hollow interior 11.

As shown in FIG. 3, upon movement of the valve stem 15 into the valve body 10 by movement of the actuator sleeve 52, the hollow stem 15 moves downward through the hollow interior 11, two actions take place. One of these is the flexing downward of the obturating gasket 14, so that the upper surface around the hole therethrough is engaged by the downwardly and inwardly tapered surface leading to the reduced diameter portion 19. The inner periphery of the obturating gasket 14 is moved away from the lower ends of vertical passages 20, thus opening a compressed air flow path from the interior of cylinder 32 through the bore 17 to the Venturi portion 40 of nozzle insert 39.

Depending on the exact construction, slightly before or slightly after the opening of the passages 20, the downward flexing of the annular gasket 29 proceeds to a point where the downwardly and inwardly tapered portion of the lower end of the upper cylindrical portion 37 engages the upper surface of annular gasket 29, and the inner periphery of the gasket 29 moves away from the tapered surface 28 on the upper part of

flange 21. This establishes an opening between the hollow interior 11 and the passages 26, and a product flow path from the interior of the hollow interior 11 and the passages 26. A product supply chamber 44 is sealed off from the atmosphere. The reduced pressure in the Ventrui nozzle 40a is thus communicated to this flow path through the radial product passages 42, and the product to be dispensed is aspirated from the product containing sac 35. Aspiration will continue until the compressed air in the cylinder 32 is exhausted.

As the product is aspirated from the product containing sac, the sac will collapse under the effect of the pressure of the atmosphere around the dispensing device, which acts on the sac 35 through the openings 30b in the lower housing part 30.

After completion of aspiration, release of the force on the actuator 54 for moving the hollow stem 15 inwardly of the valve assembly enables the return spring 23 to urge the hollow stem 15 to the rest position of FIG. 2, thereby returning the parts of the valve assembly to the position shown in FIG. 1. The finger is then removed from the end of vent bore 49 and the rod 47 and piston 45 are drawn out of the cylinder to the FIG. 1 position.

It will be understood that the inward movement of the stem 15 is limited by the engagement of flange 21 with the projections 24 in the hollow interior of valve body 10, and that movement of the stem 15 in the outward direction is limited by the engagement of the flange 21 with the gasket 29, which in turn is restrained by the top flange 31a on the upper housing part 31.

The device has many advantages. While the compression of the air is carried out gradually, the release of the compressed air occurs suddenly and only after compression has reached a maximum. Thus, the maximum aspiration effect is produced rather than a gradual aspiration, such as is produced with conventional squeeze bulb or piston-cylinder type atomizers. Moreover, the device is extremely compact, the housing parts 30 and 31 serving to hold most of the various parts together, and the use of the cylinder and piston enabling the provision of the product containing sac in the recess defined thereby. The provision of the nozzle insert 39 within the upper end of the hollow stem makes this part compact and especially useful for dispensing a product in a direction substantially axially of the device. The use of the piston-cylinder arrangement eliminates the need for a compressed or liquefied propellant and a separate container therefor, which in turn eliminates any problems of compatability of the propellant with the product being dispensed from the sac. In addition, it eliminates problems of shelf life of the device due to leakage of any such propellant container, and always assures that there will be a supply of air under pressure to aspirate the product.

Because the amount of compressed air available for aspiration is inherently limited by the size of the device, it inherently dispenses a measured dose. By properly designing the piston-cylinder assembly and properly dimensioning the various orifices and flow paths within the valve assembly, it is possible to control the amount of the product dispensed. The amount of product dispensed depends mainly on the size of the piston chamber. This results in the delivery of a specific amount of air, which in turn aspirates a specific quantity of product. The pressure created in the chamber depends mainly on the length of the piston stroke, and this pressure will effect the characteristics of the spray pattern of product delivered. If the structure is changed so that the size of the pressure chamber, i.e. the cylinder 32, remains constant, but the stroke of piston 45 is longer or shorter, the pressure created will be different, but the quantity of air delivered will remain about the same. Thus, the spray characteristics will change, but the quantity of product delivered will remain basically the same. Conversely, if the size of the pressure chamber is changed (increased or decreased in size) and the length of the piston stroke is kept the same the characteristic of the spray pattern will remain generally the same, but the quantity of product delivered will either increase or decrease. Varying the size of the various orifices will also effect the spray pattern and delivery rates, and any desired spray pattern and amount of dispensed material can be obtained by proper design of the device.

Because of the fact that the device provides only a predetermined, i.e. by the design of the device, amount of compressed air for aspirating, the device can never dispense more than a given amount during any one actuation cycle. The device is therefore inherently extremely safe for use in dispensing medicaments, for example. Oral inhalation of medicaments is made safer since only air and medicament, rather than potentially toxic propellents and medicament, are taken into the lungs.

Many variations in the construction of the device will be apparent. The housing for the valve assembly has been described as having two parts, an upper part 31 and a lower part 30. This is for convenience in assembly, it being easier to simply flange under the flange 31b with the projections 51 in the desired position, and then thread the lower housing part 30 onto the valve body 10. However, these two parts could be integral, and the cylindrical wall thereof simply indented into the groove 10*a*, or beneath the bottom of the valve body 10. The cylinder 32 has been shown as separate from the lower housing part 30. This makes it possible to simply position the cylinder against the gasket 14 and then thread the lower housing part onto the valve body without it being necessary to turn the cylinder. This prevents the upper end of the cylinder 32 from cutting or scoring the gasket 14. However, these two parts could be made integral, and the housing 30 could be crimped into place. The actuator means could be different. For example, the valve assembly and housing could be placed in a holder having finger grips thereon with the end of the valve stem abutted against the holder, and the inner end of the cylinder shaped to block movement of the piston when it reaches the inner end. Engagement of the piston with the blockage would force the valve assembly toward the valve stem, with the same results as the movement of the valve stem into the valve assembly. Instead of having a simple vent bore blocked by the finger of the user, the piston could be provided with a one way valve permitting flow of air only into the cylinder when the piston is being drawn out of the cylinder.

The dispenser device described above is self contained and can be used to dispense a material, such as a medicament or a deodorant, directly to the location at which it is to be used.

It will be appreciated that although the terms upper, lower, top and bottom have been used in describing the device according to the invention, these terms have been used for convenience in referring to the device in the position in which it is shown in the drawings, and are not intended to be any limitation on the position in which the device can be used.

The terms "cylinder" and "cylindrical" as used throughout the specification are not intended to be limited to right circular cylinders, but are intended to include any desired shape generated by a straight line moving parallel to an axis, so that the cross-section of the cylinder can be circular, square, triangular, or any other such geometrical shape. Likewise, the term "annular" is intended to include any shape which can fit around any such cylinder.

It will also be appreciated that while the seals between the various pistons and cylinders have been shown as gaskets sliding along the walls thereof, these gaskets can be omitted in many instances and replaced by friction fits between the parts.

What is claimed is:

1. A dispensing device comprising: a valve assembly having a valve body, a valve stem movable through said valve body, said valve assembly having a product flow path therethrough and a compressed air flow path therethrough, part of one of said flow paths being through said stem, obturating means associated with said stem for obturating said flow paths and actuated by said stem on movement of said stem to open the flow paths, and aspirating means at the upper end of said stem for bringing one end of each of said flow paths together, the other ends of the flow paths opening out of the valve body remote from said aspirating means, a piston-cylinder assembly having a cylinder with one end around the end of the compressed air

flow path, a piston slidable in said cylinder, a piston rod on said piston and extending out of the other end of said cylinder; product containing means coupled to the end of the product flow path remote from the aspirating means; and said piston and piston rod and said valve assembly being operatively associated for moving said valve stem relative to said valve body for causing said obturating means to open said flow paths when said piston is moved to the inner end of said cylinder adjacent said valve assembly.

2. A dispensing device comprising: a valve assembly having a valve body, a hollow valve stem movable through said valve body, said valve assembly having a product flow path therethrough and a compressed air flow path therethrough, part of one of said flow paths being through said stem, obturating means associated with said stem for obturating said flow paths and actuated by said stem on movement of said stem to open the flow paths, and aspirating means at the upper end of said stem for bringing one end of each of said flow paths together, the other ends of the flow paths opening out of the bottom of the valve body; a piston-cylinder assembly having a cylinder with one end around the end of the compressed air flow path, a piston slidable in said cylinder, a piston rod on said piston and extending out of the other end of said cylinder; a product containing sac having a neck thereon sealed around the end of the product flow path; and an actuator means connected between said piston rod and said valve assembly for moving said valve stem relative to said valve body for causing said obturating means to open said flow paths when said piston is moved to the inner end of said cylinder adjacent said valve assembly.

3. A dispensing device as claimed in claim 2 in which said piston rod and said piston have a bore therethrough.

4. A dispensing device as claimed in claim 2 in which said cylinder is engaged with the axial portion of said valve assembly, a housing around said valve assembly and said cylinder and defining an annular space around said cylinder, said product sac being an annular sac and being positioned in said space, said housing having at least one aperture therein for admitting air to said space.

5. A dispensing device as claimed in claim 2 in which said obturating means are associated with said stem to open said flow paths when said stem is moved into said valve body, and said actuator means is connected with said valve stem for moving said valve stem into said valve body.

6. A dispensing device as claimed in claim 5 in which said actuator means comprises an actuator sleeve on said valve stem, at least two levers pivotally mounted on said valve assembly and having one end engaged with said sleeve, an an actuator pivotally connected to the other end of each of said levers and to said piston rod.

7. A dispensing device as claimed in claim 2 in which said device has finger grips thereon for enabling the device to be gripped.

8. A dispensing device as claimed in claim 7 in which said device has a housing around said valve assembly, cylinder and said sac holding them in association said finger grips being on said housing.

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