# United States Patent [19]

**Nozawa et al.**

[11] **3,777,945**

[45] **Dec. 11, 1973**


[54] **SPRAYING DEVICE**


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[73] Assignee: **Yoshino Kogyosho Co., Ltd.,** Tokyo, Japan



[22] Filed: **June 8, 1972**

[21] Appl. No.: **260,960**

[30] **Foreign Application Priority Data**

June 10, 1971 Japan ..... 46/41277
June 24, 1971 Japan ..... 46/45896

[52] **U.S. Cl.** ..... **222/394**
[51] **Int. Cl.** ..... **B65d 83/14**
[58] **Field of Search** ..... 222/375-385, 222/398, 402.13, 390, 402.2; 239/350



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*Assistant Examiner*—Norman L. Stack, Jr.
*Attorney*—Richard K. Stevens et al.



[57] **ABSTRACT**

This invention relates to a spraying device.

Said spraying device comprises a container containing a liquid therein, a rotary head fitted over the top of said container, a cylindrical chamber formed in an upper portion of said container, slide means mounted in said cylindrical chamber and adapted to be moved upwardly and downwardly by the force with which said spray head is turned, and a piston mounted in the interior of said slide means and adapted to be moved upwardly as the slide means moves upwardly and moved downwardly by the biasing force of a spring mounted about said piston and serving as a restoring spring.

Said piston is formed therein with a central axial bore serving as a passage for the liquid.

Said spraying device is characterized by a transverse partition wall formed substantially in the central portion of said container to divide the container into an upper portion formed therein with a pressurizing chamber and a lower portion serving as a liquid tank, a liquid drawing line depending from the lower end of said pressurizing chamber into said liquid tank, means provided in the side wall of said slide means and the side wall of the upper portion of said container for converting the rotary movement of the rotary head into a reciprocating movement of the slide means, a valve assembly comprising a nozzle and mounted in the upper central portion of the rotary head, and a passage formed in said transverse partition wall and having an air valve mounted in its lower portion for preventing the pressure in the liquid tank from becoming lower than atmospheric pressure.


**6 Claims, 5 Drawing Figures**

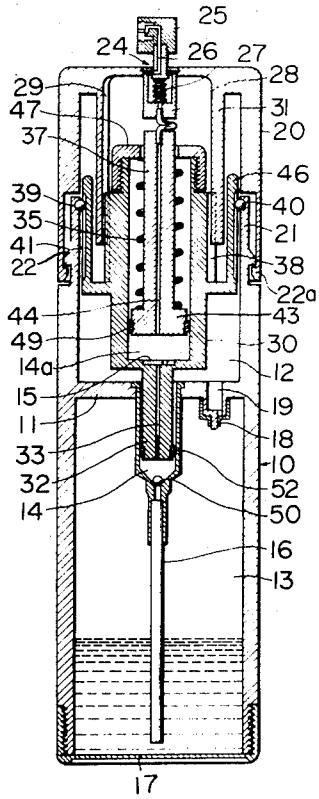
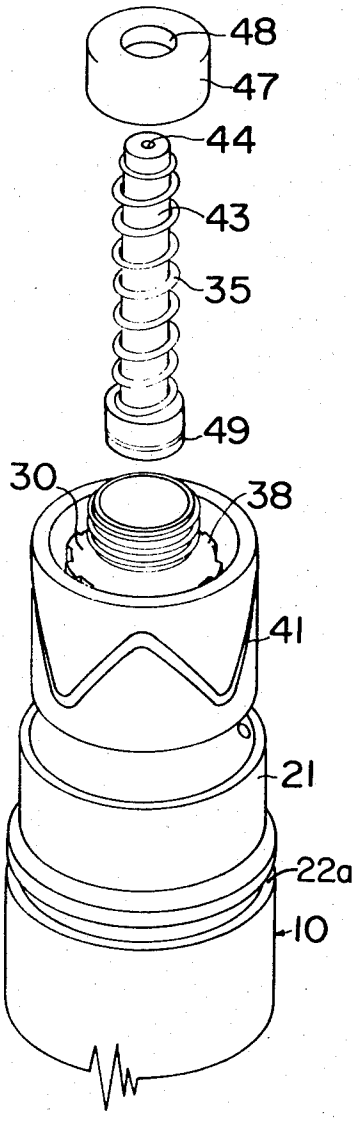


FIG. 3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22a
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FIG. 1

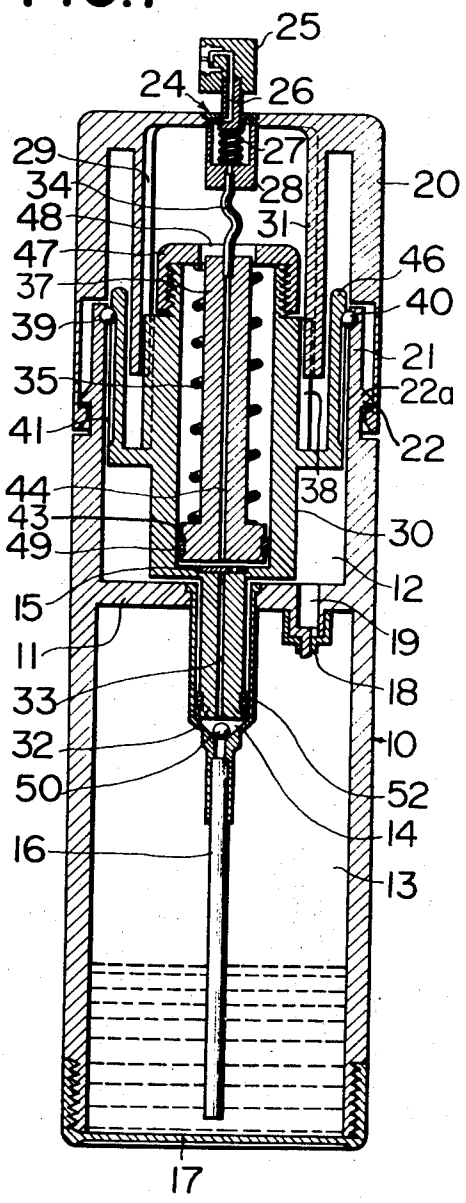
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FIG. 2

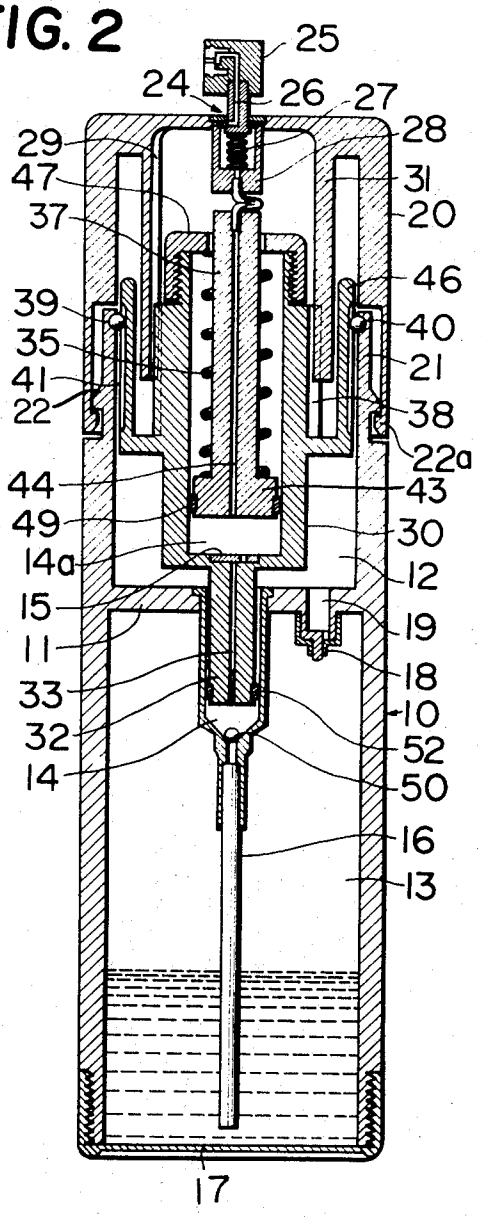
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FIG. 4

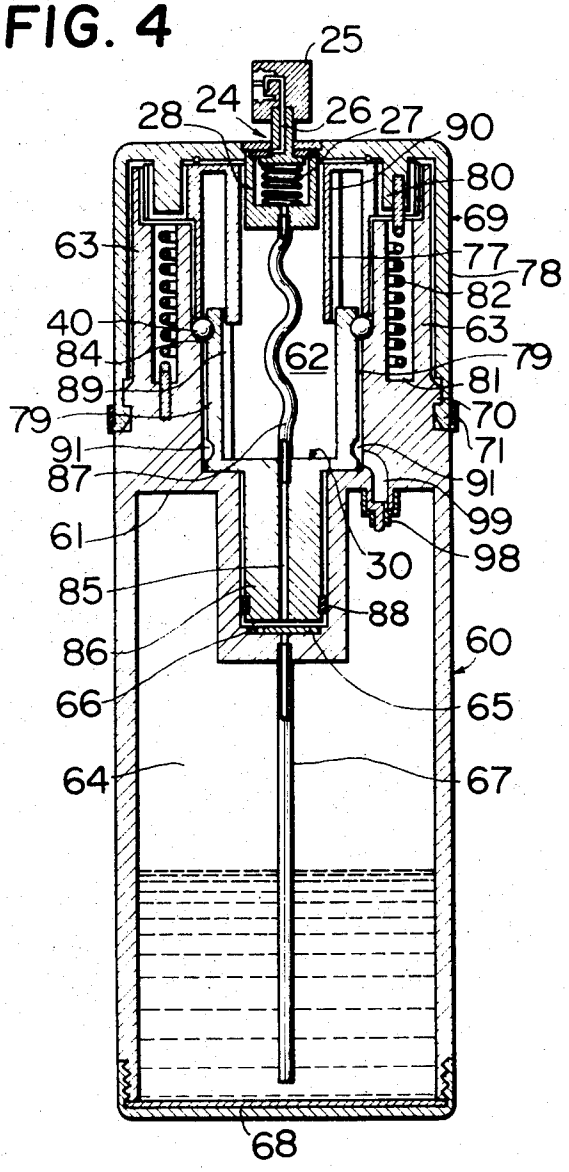
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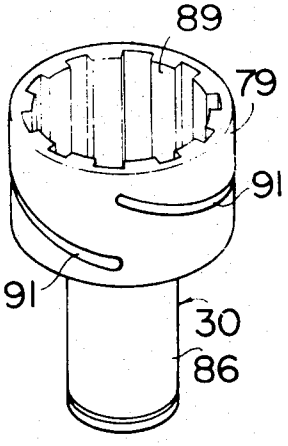
FIG. 5


89
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# SPRAYING DEVICE

This invention relates to liquid spraying devices of the type which produce spray mist similar to that produced by the common aerosol spray bomb, and more particularly it is concerned with a liquid spraying device which requires no pressurizing gas nor other foreign propellant in container, thereby eliminating the problems of contaminating and diluting the liquid to be dispensed and avoiding the explosion hazards which might otherwise occur when the container is discarded.

A spraying device of the type which requires no pressurizing gas in container and in which the bulk of the liquid stored in the device is merely under atmospheric pressure is known. This device has some disadvantages. It is complex in construction, and a considerable force is required to depress the head.

This invention provides an improvement in or relating to liquid spraying devices of the type which requires no pressurizing gas in container. The improvement consists in the provision of a rotary spray head housing therein, slide means which is moved upwardly to draw the liquid by suction into the pressurizing chamber when the spray head is turned and the liquid is pressurized by means of a restoration spring.

Accordingly, an object of this invention is to provide a liquid spraying device of the type which requires no pressurizing gas nor other foreign propellant in container and thereby eliminates the problems of contaminating and diluting the liquid to be dispensed and avoid the explosion hazards, andd which comprises a spray head of the rotary type including slide means housed therein, so that no movable parts are exposed and therefore damage to them are precluded.

Additional and other objects as well as features and advantages of the invention will become evident from the description set forth hereinafter when considered in conjunction with the accompanying drawings, in which:

FIG. 1 is a vertical sectional view of the liquid spraying device comprising a first embodiment of this invention;

FIG. 2 is a vertical sectional view of the device of FIG. 1 showing its operation state;

FIG. 3 is a perspective view of the sliding means of FIG. 1;

FIG. 4 is a vertical sectional view of the liquid spraying device comprising a second embodiment of the invention; and

FIG. 5 is a perspective view of the sliding means of FIG. 4.

FIG. 1 and FIG. 2 illustrate a first embodiment of this invention. There is shown a container **10** which is cylindrical in shape and which has a transverse wall **11** disposed substantially in its middle portion to partition the interior of the container into upper and lower portions. A cylindrical chamber **12** for housing therein slide means **30** is formed in the upper portion while a liquid tank **13** for storing therein a liquid to be sprayed is provided in the lower portion.

Disposed in the central portion of transverse wall **11** is a pressurizing chamber **14.** A liquid drawing line **16** is connected at one end thereof to the lower end of pressurizing chamber **14** and almost reaches at the other end thereof to the bottom of tank **13** which mounts therein detachably a bottom cover **17** to fill the tank with a quantity of liquid when required. A ball valve **50** is inserted between the lower end of pressurizing chamber **14** and liquid drawing line **16.** An air valve **18** and a passage **19** are mounted on the underside of transverse wall **11** to keep the pressure in liquid tank **13** and cylindrical chamber **12** from becoming negative.



A cylindrical wall **21** is formed on the outer peripheral surface of the container **10** and a peripheral groove **22** is formed on the inner circumferential surface of a spray head **20.** A spray head **20** which is of the same diameter as container **10.** The peripheral rib **22a** is formed on the outer surface of said wall **21.** Said peripheral rib **22a** and peripheral groove **22** are complementary with each other. Spray head **20** is fitted over the upper end of container **10** and held in place by inserting the peripheral groove **22** thereof in the complementary cylindrical rib **22a** of the container **10.**

A valve assembly **24** comprising a nozzle **25,** a valve body **26,** a spring **27** and a spring supporting small cylindrical body **28** is mounted in the upper middle portion of spray head **20.** The nozzle **25** of valve assembly **24** is not limited to the type shown and may be a nozzle for a milky liquid when a shaving cream or other milky liquid is to be discharged.

Guide means **31** for guiding slide means **30** in its vertical movement is mounted in the spray head **20** below valve assembly **24.** Slide means **30** comprises a piston **32** extending downwardly from the underside of the bottom wall of slide means **30** into the upper chamber **12** and formed with a central vertical bore or passage **33.** The lower end of piston **32** faces the upper portion of pressurizing chamber **14,** and piston **32** is movable into and out of pressurizing chamber **14** to reduce or increase the volume of the pressurizing chamber. A plunger ring **52** is provided at the lower end of piston **32** for sealing a space between piston **32** and pressurizing chamber **14.**

Slide means **30** is formed at its upper half portion with a number of axially arranged spline-like ribs **38** maintained in engagement with a number of axially arranged grooves **29** formed on the inner circumferential surface of guide means **31** in spray head **20.**

A cylindrical portion **46** is provided in the upper half of slide means **30** to project therefrom in adjacent relationship with the inner surface of cylindrical chamber **12.** A pressure adjusting piston **43** having a rod **37,** is inserted in the interior of slide means **30** axially thereof, and a spring support cover **47** is provided at the upper end of slide means **30.** A plunger ring **49** is provided at the lower end of piston **43** to seal a space between the inner surface of slide means **30** and the outer surface of piston **43.**

Formed in the middle of cover **47** is an opening **48** of a size sufficiently large to permit piston **43** to move vertically therethrough in and out of slide means **30.** If piston **43** moves upwardly, then a secondary pressurizing chamber **14a** is formed in the lower portion of the interior of slide means **30** as shown in FIG. **2.** A coil spring **35** serving as a restoring spring is mounted about piston rod **37** to extend from its lower end to cover **47** and normally urges piston **43** to move downwardly from its upper position by its biasing force.

Formed in the center of piston **43** is a vertical axial passage **44** which is connected at its upper end to the small cylindrical body **28** of valve assembly **24** by a flexible tube **34.**

A plurality of recesses **39** (two recesses disposed at diametrically opposed positions in the embodiment are shown) are formed in the upper portion of container **10** or on the inner wall surface of the upper portion of cylindrical chamber **12**, each of the recesses **39** being of a size such that it is sufficiently large to receive therein the semi-spherical portion of a steel ball **40**. An inclined peripheral groove **41** formed in wave-form as shown in FIG. **3** is provided on the outer wall surface of the cylindrical portion **46** of slide means **30** in a position corresponding to the positions of the plurality of recesses **39**, the groove **41** being of a size such that it is sufficiently large to receive therein the semi-spherical portion of each of steel balls **40**.

Steel balls **40** are received in the recesses **39** and inclined groove **41** as aforementioned. By this arrangement, the cylindrical portion **46** of slide means **30** moves in vertical by virtue of the provision of steel balls **40** as it moves in wave-like motion while being guided by the inclined guide **41** when cylindrical portion **46** is turned.

In the embodiment shown and described, the inclined groove **41** formed in wave-form has four crests and four valleys, so that slide means **30** moves in four reciprocating motions while the head **20** is turned through 360°. Thus, the recesses **39**, steel balls **40** and inclined peripheral groove **41** constitute means for converting the rotary movement of the rotary head into a reciprocating movement of slide means **30**.

The operation of the spraying device constructed as aforementioned will now be described. The slide means **30** shown in FIG. **1** is disposed in its lowermost position, with steel balls **40** each being disposed in one of the crests of inclined groove **41**.

FIG. **2** shows the spraying device after the head **20** is turned. Slide means **30** is shown as being moved to an upper position together with piston **43** by the action of steel balls **40** and inclined groove **41**.

If slide means **30** is moved upwardly as aforementioned, a quantity of liquid in liquid tank **13** will be drawn up by suction through liquid drawing line **16** into pressurizing chamber **14** by pushing a ball valve **50** upwardly. If head **20** is further turned so as to move steel balls **40** upwardly in sliding motion from their positions in the valleys of inclined groove **41** shown in FIG. **3**, slide means **30** will move perpendicularly downwardly without being twisted and the quantity of liquid in pressurizing chamber **14** will be introduced into the secondary pressurizing chamber **14a** formed in the lower portion of slide means **30** through the vertical bore **33** in piston **32**, and thence into the interior of slide means **30**. The piston **43** in slide means **30** is prevented from moving downwardly by the quantity of liquid introduced into the secondary pressurizing chamber **14a** in the lower portion of slide means **30**, so that piston **43** is maintained in its upper position. Thus, the lower portion of the space between the inner wall surface of slide means **30** and the outer wall surface of piston **43** is converted into a liquid sump **45** in which the liquid is stored.

If nozzle **25** is opened at this time, a quantity of liquid will be drawn from liquid sump **45** and move through central axial bore **44** formed in piston **43**, flexible tube **34** and valve assembly **24** to be ejected outwardly through nozzle **25**. As liquid is ejected through nozzle **25**, the pressure of liquid in liquid sump **45** tends to be lowered. However, this tendency is checked by the downward movement of piston **43** caused by the biasing force of spring **35**, so that the liquid pressure in liquid sump **45** is maintained at a predetermined level.

If the operation of opening nozzle **25** is performed continuously or intermittently, the downwardly moving piston **43** will ultimately reach its lowermost position in slide means **30**. At this time, liquid under pressure in liquid sump **45** will have been completely consumed. If head **20** is turned again to draw up a quantity of liquid from the liquid tank **13**, the aforementioned cycle can be repeated again to effect ejection of the liquid through the nozzle.

The optimum mode of operation of the embodiment of the spraying device described above would be to turn the head **20** so that it will make three or four complete revolutions and move the slide means **30** 12 to 16 times in reciprocating motion to store liquid in the liquid sump **45** before the nozzle **25** is opened.

FIG. **4** and FIG. **5** show a second embodiment of this invention. A container **60** shown is formed with a transverse partition wall **61** at substantially the middle of container **60** for dividIng the interior of container **60** into two portions or upper and lower portions.

A cylindrical chamber **62** for mounting a slide means **30** therein is defined by a cylindrical wall **63** in the upper portion of container **60**. A liquid tank **64** for containing a liquid to be dispensed is provided in the lower portion of container **60**. The transverse partition wall **61** is formed therein with a passage **99** mounting an air valve **98** as described with reference to the first embodiment to maintain balance in internal pressure in the container.

The transverse partition wall **61** is formed in the middle with a suction chamber **66** provided with a valve **65** at its bottom and adapted to serve as a pressurizing chamber. A liquid drawing line **67** extends from the lower end of pressurizing chamber **66** to the bottom of liquid tank **64**. A bottom cover **68** may be detachably attached to the lower end of liquid tank **64** to fill the tank with a quantity of liquid when required.

A rotary head **69** cylindrical in shape and having the same outer diameter as the lower portion of container **60** is fitted over the cylindrical wall **63**. The cylindrical wall **63** is formed on the outer wall surface of its lower portion with an outer peripheral rib **70** and an outer peripheral groove contiguous with each other while the rotary head **69** is formed on the inner wall surface of its lower portion with an inner peripheral groove and an outer peripheral rib **71**. Thus the rotary head **69** is held in position as the outer peripheral rib **70** of cylindrical wall **63** is snugly received in the inner peripheral groove of rotary head **69** and the inner peripheral rib **71** of rotary head **69** is snugly received in the outer peripheral groove of cylindrical wall **63**. A valve assembly **24** comprising a nozzle **25**, valve body **26**, spring **27** and spring support small cylindrical body **28** is mounted in the upper central portion of rotary head **69**.

A guide means **77** for guiding slide means **30** in its vertical movement is mounted in the central portion of rotary head **69** to be disposed perpendicularly. The aforementioned cylindrical wall **63** and a cylindrical body **79** extending upwardlY from the upper end of slide means **30** as subsequently to be described are disposed between a side wall portion **78** of rotary head **69** and the guide means **77**.

The cylindrical wall **63** defining the cylindrical chamber **62** as aforementioned is formed therein with a ver-

tical groove **81** of suitable depth so that the wall **63** is divided into an inner wall and an outer wall for mounting in a groove **81** between the two wall members a coil spring **82** which is supported at its upper end by a spring supporter **80** projected from the head **69** and which has a lower end embedded in cylindrical wall **63.** If rotary head **69** is turned several times, then energy of resilience is stored in coil spring **82** which urges the rotary head **69** to return to its original position.

A plurality of recesses **84** are formed on the inner wall surface of cylindrical wall **63,** each of the recesses **84** being of a size such that it is sufficiently large to receive therein the semi-spherical portion of each steel balls **40.** In the embodiment described, such recesses **84** are two in number and disposed in diametrically opposed positions.

Slide means **30** is formed with a piston **86** formed with an axial center bore or passage **85** therein. A flexible tube **87** connects the upper end of passage **85** to the small cylindrical body **28** of valve assembly **24.** Piston **86** is inserted in the pressurizing chamber **66** and has a plunger ring **88** attached to its lower end so as to seal a space between the outer wall surface of piston **86** and the inner wall surface of pressurizing chamber **66.**

The cylindrical portion **79** extending upwardly from the upper end of slide means **30** as aforementioned is formed in its inner wall surface with a number of vertically disposed ribs **89** which are adapted to be received in vertical grooves **90** formed on the outer wall surface of guide means **77** in the head **69,** so that guide means **77** and slide means **30** are interconnected in spline connection.

As shown iin FIG. **5** in a perspective view, the cylindrical portion **79** of slide means **30** is formed on its outer wall surface with a plurality of discrete inclined peripheral grooves **91** (two grooves in this embodiment), each groove extending from the upper marginal portion toward the lower marginal portion of the outer wall surface of cylindrical body **79.** The upper end of each inclined peripheral groove **91** corresponds in position to one of the recesses **84** formed on the inner wall surface of cylindrical wall **63,** the grooves **91** being of a size such that they are sufficiently large to receive therein the semi-spherical portion of each steel ball **40.**

Since steel balls **40** are disposed in inclined peripheral grooves **91** and recesses **84** as aforementioned, rotation of cylindrical portion **79** results in its moving upwardly while rotating as it is guided by inclined peripheral grooves **91** by virtue of the presence of steel balls **40** therein. Thus, the recesses **84,** steel balls **40** and inclined peripheral grooves **91** constitute means for converting the rotary movement of the rotary head **69** into a reciprocating movement of slide means **30.**

The operation of the embodiment constructed as aforementioned will now be described. The spraying device shown in FIG. **4** is in a state in which the rotary head **69** thereof is not turned yet, with each steel ball **40** being disposed at the upper end of one of the inclined peripheral grooves **91.** When the spraying device is in this state, the slide means **30** thereof is disposed in its lower position and no liquid in the liquid tank **64** is drawn by suction into the pressurizing chamber **66.**

If rotary head **69** is turned rightwardly, slide means **30** will be moved upwardly by guide means **77** in cooperation with steel balls **40** and inclined peripheral grooves **91.** Upward movement of slide means **30** causes a quantity of liquid to be drawn upwardly by suction from the liquid tank **64** through liquid drawing line **67** and valve **65** into pressurizing chamber **66.**

Rotary head **69** is urged by the energy of resilience stored in coil spring **82** to return to its original position. However, if a quantity of liquid is drawn up by suction into pressurizing chamber **66,** the pressure of liquid in the pressurizing chamber **66** overcomes the energy of resilience of coil spring **82,** so that rotary head **69** is kept in a position to which it has been turned.

If nozzle **25** is opened, then the liquid in pressurizing chamber **66** is moved upwardly through the passage **85** in piston **86** and the flexible tube **87** to the valve assembly **24** from which it is ejected outwardly. As the liquid in pressurizing chamber **66** is released through nozzle **25** in this way, the liquid pressure in pressurizing chamber **66** tends to be reduced. However, this tendency is cancelled out by the energy of resilience stored in coil spring **82** and piston **86** is moved downwardly; so that the liquid pressure in pressurizing chamber **66** can be maintained at a predetermined level.

If the aforemntioned operation of nozzle **25** is performed continuously or intermittently, the downwardly moving piston **86** will ultimately reach its lowermost position in pressurizing chamber **66.** At this time, the liquid under pressure in pressurizing chamber **66** will have been completely consumed. If head **69** is turned again to draw up a quantity of liquid from the liquid tank into pressurizing chamber **66,** the liquid in pressurizing chamber **66** can be ejected through the nozzle **25** by repeating the aforementioned cycle of operation.

From the foregoing description, it will be appreciated that the present invention permits a liquid contained in the liquid tank **64** in the container to be drawn up by suction into the pressurizing chamber or the liquid sump by turning the rotary head and then ejected or discharged through the nozzle by merely operating the nozzle without requiring to use a propellant medium. Since the liquid in the container can be pressurized by merely turning the rotary head, the spraying device according to this invention is very easy to operate. Besides, the movable parts of the device are not exposed to atmosphere and therefore prevented from suffering damage.

In the first embodiment of the invention, the provision of a piston in the interior of slide means to form a liquid sump therein permits a large quantity of liquid to be drawn up by suction from the liquid tank and stored in the liquid sump, so that the operation of nozzle can be facilitated. The provision of a pressure adjusting spring in the interior of slide means precludes exertion of a force of reaction on the rotary head by the pressurized liquid in the liquid sump, thereby preventing the hazards of the rotary head being dislodged from the container.

In the second embodiment of the invention, the provision of a coil spring for storing therein energy of resilience for urging the rotary head to return to its original position permits the rotary head automatically to be restored to its original position to be ready for a next liquid suction operation when thee liquid in the pressurizing chamber is exhausted after ejection thereof. This facilitates the ejection of liquid in fine mist form.

What is claimed is:

**1.** A spraying device comprising a container containing a liquid therein, a rotatable head fitted over the top of said container, a cylindrical chamber formed in an upper portion of said container, slide means mounted

in said cylindrical chamber defining on the lower part thereof a piston having an axiAl bore therein, said slide means movable upwardly and downwardly within said chamber, a transverse partition wall formed substantially in the central portion of said container to divide the container into an upper portion with a pressurizing chamber and a lower portion serving as a liquid tank, said pressurizing chamber receiving said piston defined on the lower part of said slide means, a liquid one way drawing line depending from the lower end of said pressurizing chamber into said liquid tank, means provided in the side wall of said slide means and the side wall of the upper portion of said container for converting rotary movement of the rotatable head into a reciprocating movement of the slide means, a valve assembly comprising a nozzle and mounted in the upper central portion of the rotatable head, conduit means extending from the axial bore of said piston to said valve assembly, means to force liquid from said pressurizing chamber to said valve assembly and a passage formed in said transverse partition wall and having an air valve mounted in its lower portion for preventing the pressure in the liquid tank from becoming lower than atmospheric pressure.

**2.** A liquid spraying device comprising a container containing a liquid therein, a rotary head fitted over the top of said container, a cylindrical chamber formed in an upper portion of said container, and slide means mounted in said cylindrical chamber and adapted to be moved upwardly by the force with which the rotary head is turned and moved downwardly by the biasing force of a restoring spring, said slide means being formed therein with a central axial bore serving as a passage for the liquid, and said restoring spring is provided between the rotary head and container for storing therein an energy of resilience for urging the slide means to return to its original position, a transverse partition wall formed substantially in the central portion of said container to divide the container into an upper portion formed therein with a pressurizing chamber and a lower portion serving as a liquid tank, and means provided in the side wall of said slide means and the side wall of the upper portion of said container for converting the rotary movement of the rotary head into a reciprocating movement of the slide means, a valve assembly comprising a nozzle and mounted in the upper central portion of the rotary head, and a passage formed in said transverse partition wall and having an air valve mounted in its lower portion for preventing the pressure in the liquid tank from becoming lower than atmospheric pressure.

**3.** A spraying device comprising a container containing a liquid therein, a rotary head fitted over the top of said container, a cylindrical chamber formed in an upper portion of said container, slide means mounted in said cylindrical chamber defining on the lower part thereof a piston having an axial bore therein, said slide means movable upwardly and downwardly within said chamber, a piston with rod mounted in the interior of said slide means and adapted to be moved upwardly as the slide means moves upwardly and moved downwardly by the biasing force of a spring mounted about the rod of said piston and serving as a restoring spring, said piston being formed therein with a central axial bore serving as a passage for the liquid, a transverse partition wall formed substantially in the central portion of said container to divide the container into an upper portion with a pressurizing chamber formed therein and a lower portion serving as a liquid tank, said pressurizing chamber receiving said piston defined on the lower part of said slide means, a liquid one way drawing line depending from the lower end of said pressurizing chamber into said liquid tank, means provided in the side wall of said slide means and the side wall of the upper portion of said container for converting rotary movement of the rotary head into a reciprocating movement of the slide means, a valve assembly comprising a nozzle and mounted in the upper central portion of the rotary head, conduit means extending from the axial bore of said piston with rod to said valve assembly and a passage formed in said transverse partition wall and having an air valve mounted in its lower portion for preventing the pressure in the liquid tank from becoming lower than atmospheric pressure.

**4.** A spraying device as set forth in claim **3,** further characterized by a secondary pressurizing chamber formed in the lower portion of said slide means as the piston with rod moves upwardly.

**5.** A spraying device as set forth in claim **3,** wherein said means for converting the rotary movement of the rotary head into a reciprocating movement of the slide means comprises at least one recess formed in the upper portion of container, an inclind peripheral groove formed in wave-form and provided on the outer wall surface of said slide means and at least one ball inserted in said recess and groove.

**6.** A spraying device as set forth in claim **3,** wherein said means for converting the rotary movement of the rotary head into a reciprocating movement of the slide means comprises at least one recess formed in the upper portion of container, at least one discrete inclined peripheral groove formed on the outer wall surface of said slide means and at least one ball inserted in said recess and groove.

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