

[54] SPRAYING DEVICE

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222/398, 402.13, 390, 402.2; 239/350

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Attorney—Richard K. Stevens et al.

[57] ABSTRACT

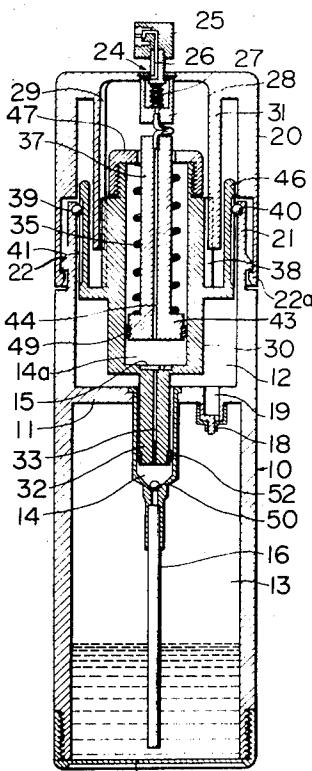
This invention relates to a spraying device.  
Said spraying device comprises a container containing

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

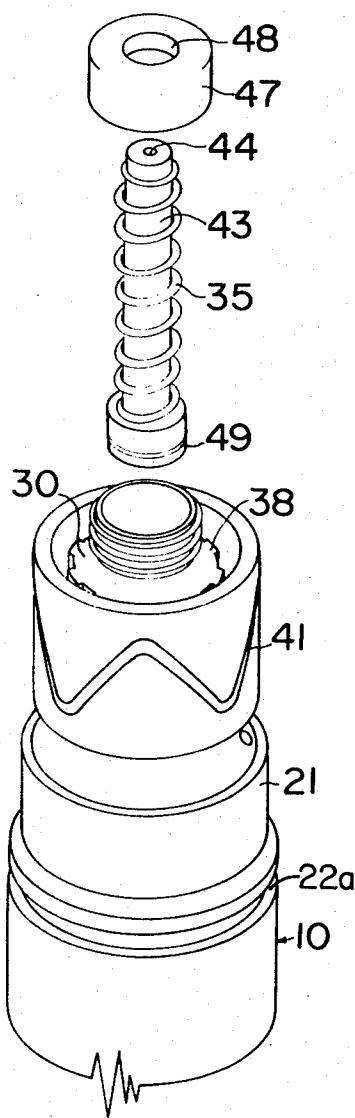


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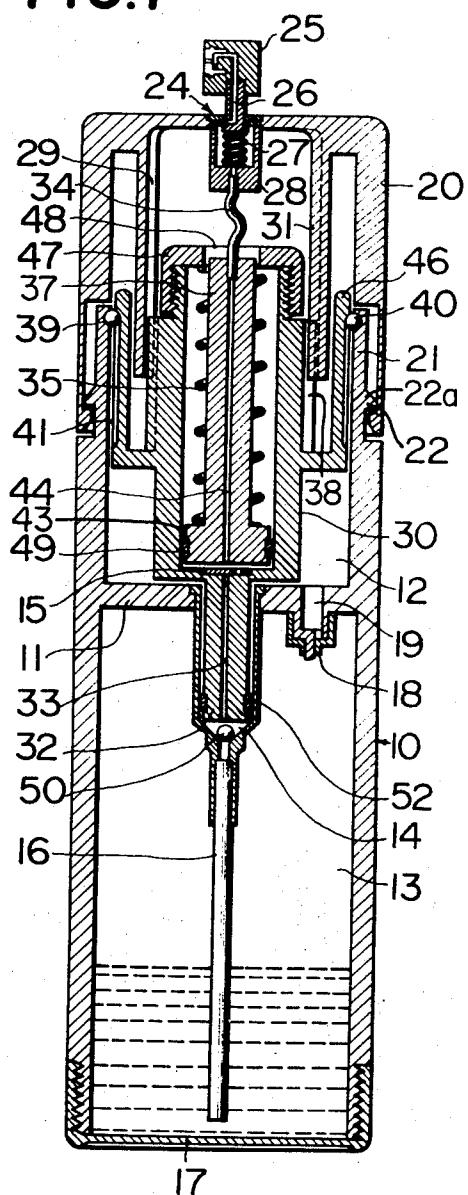
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**FIG. 3**



**FIG. I**

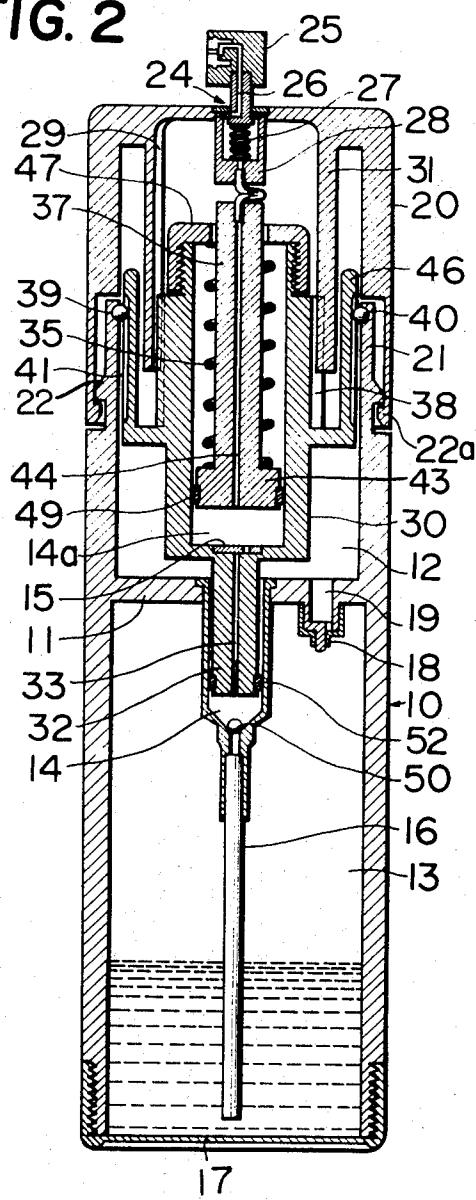


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**FIG. 2**



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FIG. 4

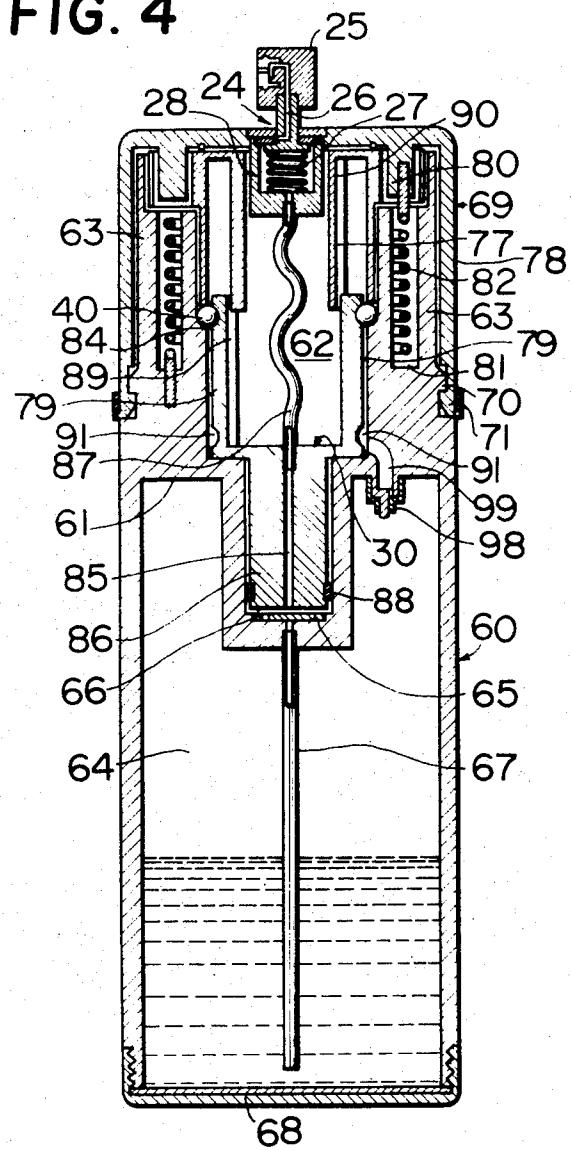
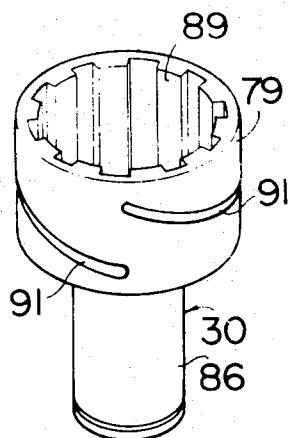


FIG. 5



## 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, and 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 in 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 aforementioned 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 the 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

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