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Nozawa et al.

[11] **3,746,261**

[45] **July 17, 1973**

[54] **LIQUID SPRAYING DEVICE**

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

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[52] **U.S. Cl.** **239/333,** 222/182, 222/384

[51] **Int. Cl.** **G01f 11/06**

[58] **Field of Search** 239/331, 333, 357; 222/182, 383, 384, 385

[56] **References Cited**

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Primary Examiner—M. Henson Wood, Jr.
Assistant Examiner—Michael Mar
Attorney—Richard K. Stevens, Richard C. Harris et al.

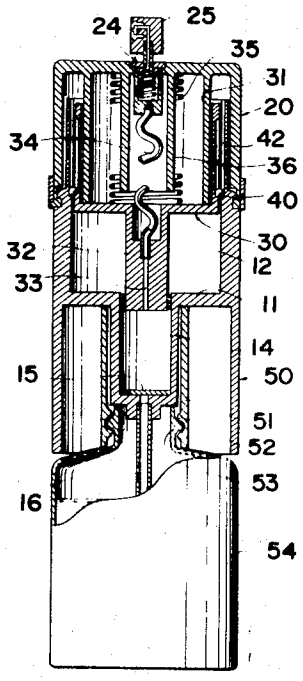
[57] **ABSTRACT**

This invention relates to a liquid spraying device.

Said device comprises a container containing a liquid therein, a rotay spray 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 spray head is turned and moved downwardly by the biasing force of a restoring spring.

Said device is characterized in that said container being provided therein with a liquid pressurizing chamber, a suction line depending from said liquid pressurizing chamber and a liquid tank storing a liquid therein and having said suction line extending thereinto, said slide means is formed on its side wall with means for converting the force with which said rotary spray head is turned into a force with which said slide means can be moved upwardly, and a valve assembly having a nozzle communicating with said pressurizing chamber is disposed in the center of said rotary spray head.

6 Claims, 8 Drawing Figures



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4 Sheets-Sheet 1

Fig. 1

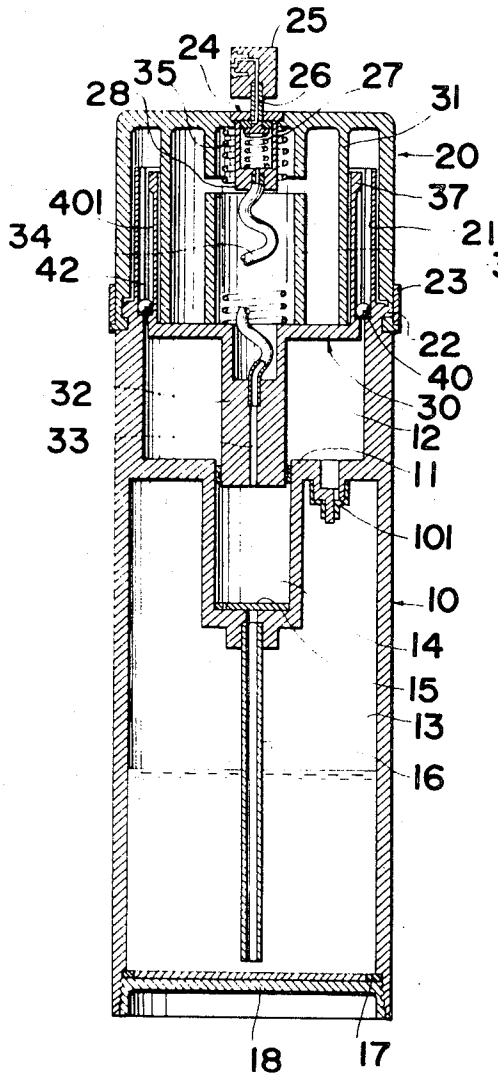

Fig. 2

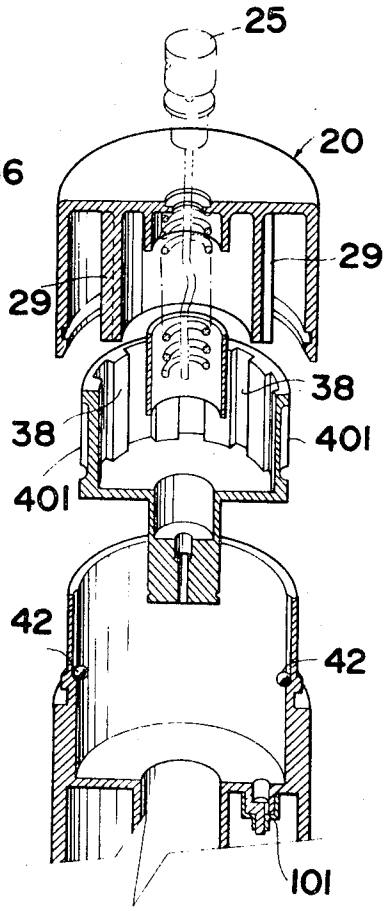

Fig. 3

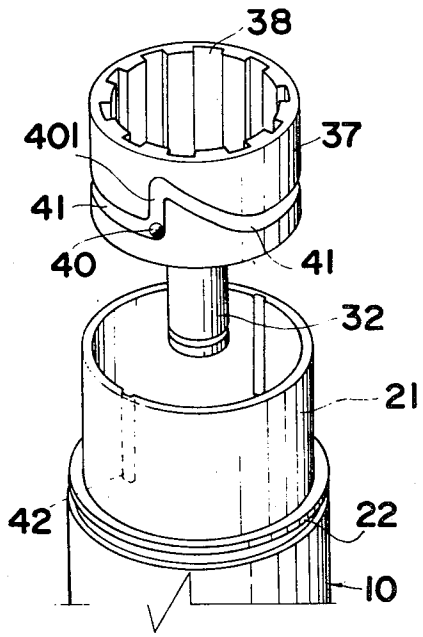
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Fig. 4

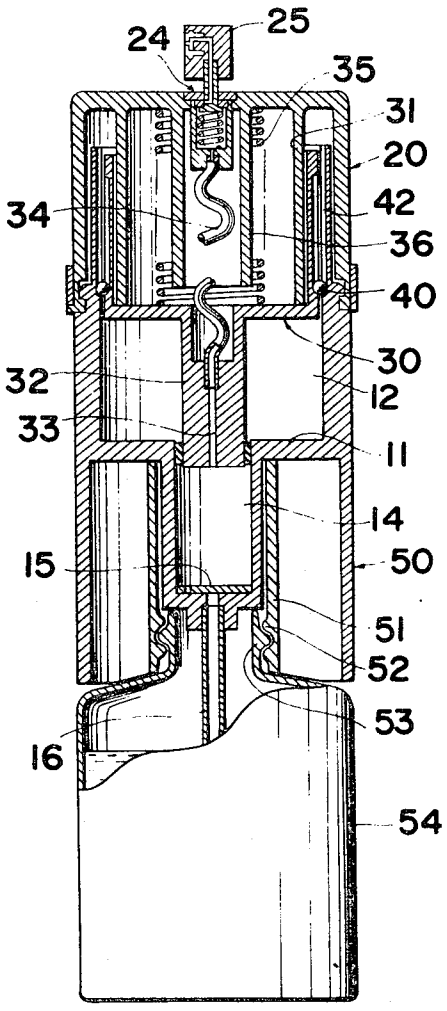
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Fig.5

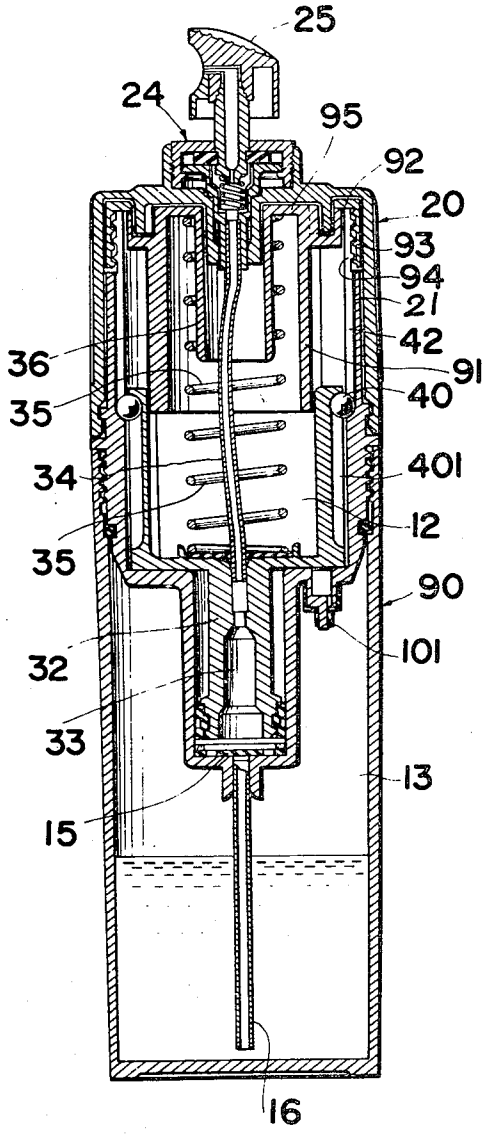
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Fig.6

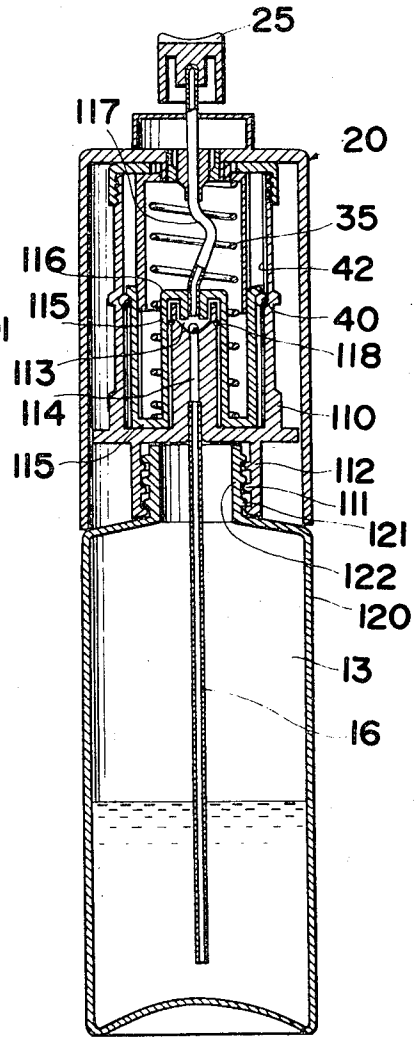
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Fig.7

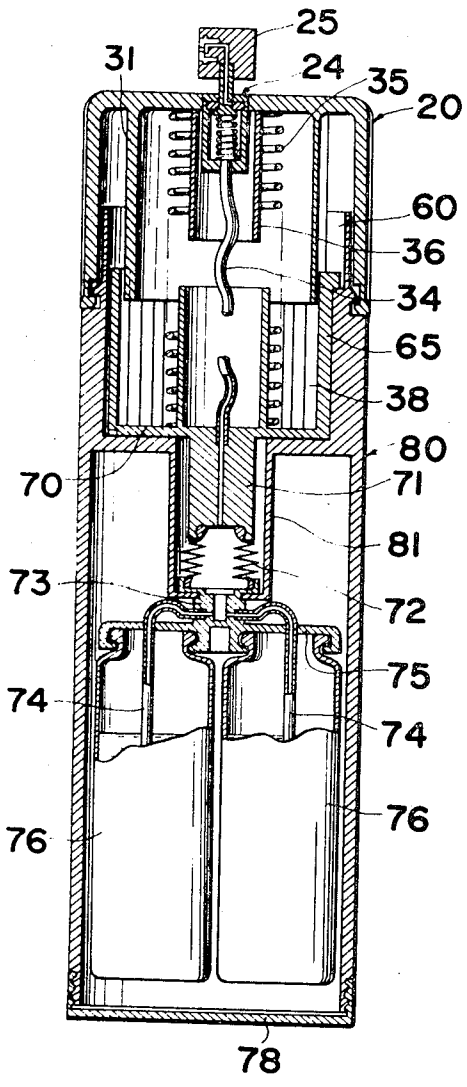
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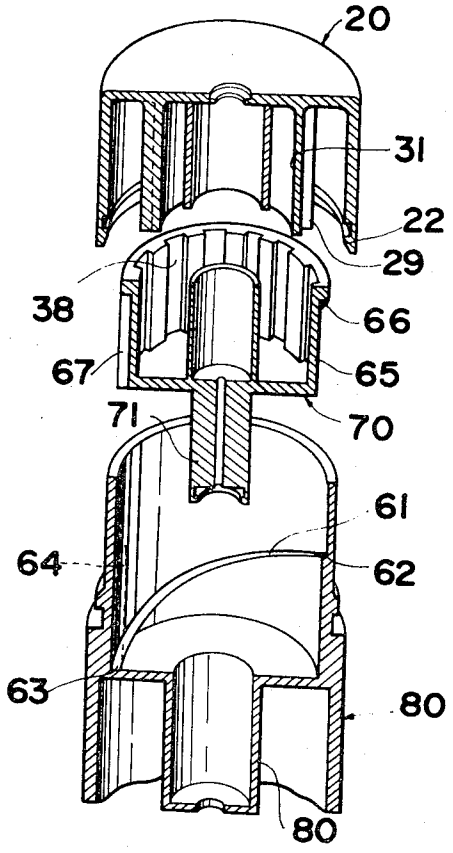
Fig.8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LIQUID SPRAYING DEVICE

This invention relates to relatively small 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 dilut1ng 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 as from Japanese Pat. No. 540,493 (Patent application publication No.21,956/68). The device disclosed in said patent permits a quantity of liquid to be drawn by suction into the liquid pressurizing chamber upon depression of the spray head provided on the upper portion of the container, the liqud in the pressurizing chamber being pressurized by means of a compression spring, the spray head being restored to its original position with respect to the container as the liquid is sprayed in mist form through the nozzle by the action of the valve assembly. Stated differently, this device is of the type in which the spray head is telescopically provided on the container so that the liquid is drawn by suction into the pressurizing chamber when the spray head is in a contracted position and the liquid is sprayed in mist form when the spray head is restored to its extended position. Some disadvantages are associated with the device of this type. 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.

Another object of the invention is to provide a liquid spraying device in which the container comprises interchangeable a liquid tank so that the liquid tank can be replaced by a new liquid tank when the liquid in the former is exhausted.

Another object of the invention is to provide a liquid spraying device in which a plurality of take-out lines are connected at one end to the lower end of the pressurizing chamber and at the other end to small containers containing different types of liquids, so that a mixture of different liquids can be sprayed in mist form.

Another object of the invention is to provide a liquid spray device which can be easily held in the hand and operated by depressing a pushbutton so long as the liquid in the device is under pressurized condition.

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 an exploded perspective view of the device of FIG. 1 showing its essential portions;

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

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

FIG. 5 is a vertical sectional view of the liquid spraying device comprising a third embodiment of the invention;

FIG. 6 is a vertical sectional view of the liquid spraying device comprising a fourth embodiment of the invention;

FIG. 7 is a vertical sectional view of the liquid spraying device comprising a fifth embodiment of the invention; and

FIG. 8 is an exploded perspective view of the device of FIG. 7 showing its essential portions.

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** having a valve **15** mounted at its lower portion. A liquid drawing line **16** is connected at one end thereof to the lower end of pressurising chamber **14** and almost reaches at the other end thereof to the bottom of tank **13** which mounts therein a bottom cover **18** through a packing **17.** An air valve **101** is mounted on the underside of transverse wall **11** to keep the pressure in liquid tank **13** 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.** Said peripheral rib **21** 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 wall **21** of the container **10.** A band **23** is applied to the outer circumferential surface of the lower end portion of spray head **20** to preclude dislodging of the head **20** from 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 flexible tube 34 is connected at one end to the upper end of passage 33 and at the other end to the small cylindrical body 28 of valve assembly 24. A coil spring 35 is mounted between the underside of the top wall of spray head 20 and the upper surface of the bottom wall of slide means 30. A protective sleeve 36 surrounds coil spring 35.

Slide means 30 is formed at its upper half portion with a cylindrical portion 37 which is formed on its inner surface with a number of axially arranged spline-like ribs 38 maintained in engagement with a number of axially arranged grooves 29 formed on the outer circumferential surface of guide means 31 in spray head 20. Thus, if spray head 20 is turned, cylindrical portion 37 of slide means 30 will rotate therewith.

Formed on the inner circumferential surface of a cylindrical wall 21 are a number of lengthwise grooves 42 of a size which is sufficiently large to hold one half portion of each of a number of steel balls 40 (two such grooves 42 being provided in this embodiment to be disposed in diametrically opposed relationship with each other). A number of axial grooves 401 are formed on the outer circumferential surface of the cylindrical portion 37 of slide means 30 as shown in FIG. 2 and FIG. 3 in positions corresponding to those of grooves 42 (two such axial grooves 401 being provided in this embodiment to be disposed in diametrically opposed relationship with each other). The lower end of one axial groove 401 is connected to the lower end of an inclined peripheral groove 41 which is connected at the upper end to the upper end of the other axial groove 401 which is connected at the lower end to the lower end of the other inclined peripheral groove 41 which is connected at the upper end to the upper end of one axial groove 401, so that two axial grooves 401 and two peripheral grooves 41 form a tortuous path disposed along the entire periphery of the cylindrical portion 37 of slide means 30.

The other half portion of each of steel balls 40 is disposed in the tortuous path formed by inclined peripheral grooves 41 and axial grooves 401 as aforementioned. Since steel balls 40 are disposed between the grooves 42 in cylindrical wall 21 and the inclined peripheral grooves 41 and axial grooves 401 in cylindrical portion 37, the cylindrical portion 37 of slide means 30 will be moved upwardly while rotating by the action of steel balls 40 which are moved along the tortuous path as cylindrical portion 37 rotates through 360° in conjunction with the turning of spray head 20. Thus, steel balls 40, grooves 42, inclined peripheral grooves 41 and vertical grooves 401 constitute means for converting the force with which the spray head is turned into a force which moves slide means 30 upwardly.

FIG. 1 shows two steel balls 40 in positions in which each of them is is disposed at the lower end of each inclined peripheral groove 41 and at the lowermost end of each axial groove 401 as shown in FIG.3. When steel balls 40 are disposed as shown in FIG. in slide means 30 is disposed in its upper position, so that a quantity of liquid is drawn by suction from liquid tank 13 into pressurizing chamber 14 to fill it as piston 32 is moved upwardly. Since slide means 30 is normally urged by the biasing force of spring 35 to move downwardly and steel balls 40 are disposed in the axial groove 401, the liquid filled in pressurizing chamber 14 is pressurized by the downward movement of piston 32.

The pressurized liquid in pressurizing chamber 14 moves through flexible pipe 34 to valve assembly 24. Thus, if nozzle 25 is depressed, the pressurized liquid can be sprayed in mist form or discharged through the nozzle.

If nozzle 25 is opened, the pressure of liquid in pressurizing chamber 14 will be reduced. However, piston 32 is maintained in its lower position by the biasing force of spring 35 so as to keep the liquid pressure in pressurizing chamber 14 at a predetermined level.

In moving downwardly into upper cylindrical chamber 12, slide means 30 moves perpendicularly without being deflected from its course because it is guided by axially arranged ribs and grooves 38 and 29, steel balls 40 and axial grooves 401. If nozzle 25 is operated continuously or intermittently, slide menas 30 will assume its lower position in which the underside of slide means 30 abuts the bottom of cylindrical chamber 12. In this state, all the pressurized liquid has been consumed and one cycle of operation is completed. At this time, steel balls 40 are each disposed at the upper end of each inclined peripheral groove 41 and at the uppermost end of each axial groove 401. If rotary spray head 20 is turned at this time, slide means 30 will be moved upwardly to the position shown in FIG. 1 as it is guided by steel balls 40 and inclined peripheral grooves 41, thereby drawing a quantity of liquid by suction from liquid tank 13 into pressurizing chamber 14 to be ready for the next following spraying operation.

The provision of air valve 101 in transverse wall 11 partitioning the container into upper and lower chambers as aforementioned permits balance to be maintained in pressure between the upper and lower chambers when rotary spray head 20 is turned or nozzle 25 is operated and slide means 30 is moved upwardly and downwardly so that the operation of spraying the liquid in mist form may not be interfered with.

FIG. 4 shows another embodiment of this invention in which the liquid tank is in bomb form. Container 50 has a lower portion of smaller length than the embodiment shown in FIG. 1 and is formed with a sleeve 51 in the interior of lower portion. Sleeve 51 is formed in the lower end portion of its inner peripheral surface with a threaded portion 52 which is adapted to threadably receive therein an external threaded portion 53 formed at the mouth of a bomb 54. When all the liquid contained in bomb 54 is exhausted, it can be replaced by another bomb. Other parts of this embodiment are similar to those described with reference to the first embodiment.

FIG. 5 shows a third embodiment which is characterized by comprising a cap ring 92 formed integrally with guide means 91 and disposed intermediate between head 20 and cylindrical wall 102. In other respect, the construction is similar to that of the first embodiment.

A threaded portion 93 is formed on the inner circumferential surface of cap ring 92 which is threadably connected to a threaded portion 94 formed at the front end of the outer circumferential surface of cylindrical wall 102. By this arrangement, the biasing force of coil spring 35 is not exerted directly on head 20 but borne

by an upper surface portion **95** of guide means formed separately from the head and the threaded connection between the ring cap and the cylindrical wall. This ensures that the head is firmly secured to the container and never disconnected even if they are connected together by means of rib-and-groove connection.

FIG. **6** shows a fourth embodiment in which a cylindrical chamber **110** provided in head **20** has a sleeve **112** projecting downwardly from its underside. Sleeve **112** is formed with a threaded portion **111** which is threadably connected to a threaded portion **121** formed at a front end portion **122** of the outer circumferential surface of a bomb **120.** This arrangement permits a bomb to be detachably connected to head **20** by threadable connection.

Formed in the central portion of the interior of cylindrical chamber **110** is a pressurizing chamber **113** which is connected at its lower end to a passageway **114** and a suction line. The upper end of pressurizing chamber **113** is closed by a middle portion **116** of slide means **115** inserted for sliding motion in cylindrical chamber **110.** A flexible tube **117** communicating with pressurizing chamber **113** is also maintained in communication with a valve assembly provided with a nozzle extends through the middle portion **116** of slide means **115.**

A ring **118** is interposed between pressurizing chamber **113** and slide means **115** adjacent thereto so as to the maintain pressurizing chamber in sealed condition.

In this embodiment, dislodging of head **20** due to the biasing force of spring **35** is precluded by the ring cap alone. In other respects, the construction of this embodiment is similar to that of the third embodiment.

This embodiment offers the advantages of being able to effect replacements of bombs and being able to obtain an overall compact size in a liquid spraying device by providing the pressurizing chamber **113** in the cylindrical chamber **110.**

FIG. **7** and FIG. **8** show a fifth embodiment in which a pair of inclined offset portions **61** and a plurality of vertical portions **64** each connecting together an uppermost portion **62** and a lowermost portion **63** of one of the pair of inclined offset portions **61** are provided on the inner circumferential surface of a cylindrical chamber **60** of a container **80.** A pair of inclined offset portions **66** and a plurality of vertical portions **67** are formed on the outer circumferential surface of a cylindrical portion of slide means **70** in positions corresponding to those of inclined portions **61** and vertical portions **64** on cylindrical chamber **60.**

This embodiment is distinguished over the first and second embodiments by the fact that the steel balls and grooves are eliminated and the slide means and guide means are maintained in engagement with each other through the inclined offset portions, so that the slide means can be moved vertically as the head is turned.

Thus, this embodiment offers the advantage of being easy to fabricate because no grooves need be formed in the cylindrical portion. Another feature of the embodiment lies in the provision of a bellows **72** between a lower portion **71** of slide means **70** and a wall **81** provided in the interior of container **80** for pressurizing the liquid in the pressurizing chamber. The use of the bellows offers the advantage of the volume of the pressurizing chamber being able to be increased and reduced with a smaller force than would be the case if a a piston were used. Another feature is that distributor means **73** formed integrally with a discal portion **75** for supporting a plurality of bombs **76** is mounted at the lower portion of bellows **72.** Distributor means **73** also comprises a plurality of flexible tubes **74** which are each connected at one end to the distributor means and at the other end to bomb **76.** A cover **78** is threaded to the lower end of container **80** to facilitate replacement of the bombs in the container by new ones. The provision of a plurality of bombs in the container permits a mixture of two or more similar or dissimilar liquids to be sprayed in fine mist form.

From the foregoing description, it will be appreciated that this invention permits a liquid to be discharged or sprayed in mist form smoothly by drawing by suction a quantity of liquid from the liquid tank or bomb provided in the container into the pressurizing chamber and depressing the pushbutton with the finger. It is possible to pressurize the liquid in the container merely by turning the spray head. The invention offers the advantages of ease of operation and no danger of damage to the movable parts which are not exposed.

In another aspect of the invention, the liquid tank in the form of a bomb is detachably connected to the container, so that it is possible to readily replace the old bomb by a new one when the liquid in the former is exhausted.

In another aspect of the invention, a ring cap is provided between the cylindrical wall defining the cylindrical chamber and the head so as to prevent dislodging of the head from the container.

In further aspect of the invention, the pressurizing chamber is provided in the cylindrical chamber so as to permit to obtain an overall compact size in a liquid spraying device.

In further aspect of the invention, there is provided distributor means comprising a number of takeout lines each of which communicates at one end with the pressurizing chamber and at the other end with one of small vessels containing dissimilar liquid and detachably attached to the container, so that a mixture of liquids can be dispensed in fine mist form.

What is claimed is:

1. A liquid spraying device comprising a container containing a liquid therein, a rotary spray 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 spray head is turned and moved downwardly by the biasing force of a restoring spring, characterized in that said container being provided therein with a liquid pressurizing chamber, a suction line depending from said liquid pressurizing chamber and a liquid tank storing a liquid therein and having said suction line extending thereinto, said slide means is formed on its side wall with means for converting the force with which said rotary spray head is turned into a force with which said slide means can be moved upwardly, and a valve assembly having a nozzle communicating with said pressurizing chamber is disposed in the center of said rotary spray head.

2. A liquid spraying device as set forth in claim **1** further characterized in that a piston adapted to be inserted in said liquid pressurizing chamber is formed in the center of a lower portion of said slide means, and a liquid passageway is formed between said valve assembly and said piston.

3. A liquid spraying device as set forth in claim 1 further characterized in that at least one replaceable bomb is housed in said container.

4. A liquid spraying device as set forth in claim 1 further characterized in that a cap ring is provided between said cylindrial chamber and said rotary spray head.

5. A liquid spraying device as set forth in claim 1 further characterized in that said pressurizing chamber is provided in the cylindrical chamber disposed in an upper portion of the container.

6. A liquid spraying device as set forth in claim 1 further characterized in that said liquid pressurizing chamber is provided with a bellows for pressurizing the liquid therein.

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