

[72] Inventors **Hisao Takei;**
Nobumichi Hattori; Iwata Naoyuki; Seiji
Morita, Nitta Gun, Japan

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[73] Assignee **Mitsubishi Denki Kabushiki Kaisha**
Tokyo, Japan

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[33] **Japan**

[31] **56636/67, 56350/67, 64551/67 and**
83963/67

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Assistant Examiner—John J. Love
Attorney—Robert D. Flynn

[54] **ELECTRIC SPRAYER**
1 Claim, 14 Drawing Figs.

[52] **U.S. Cl..... 239/332,**
239/349, 239/373

[51] **Int. Cl..... B05b 9/04**

[50] **Field of Search..... 239/332,**
349, 340, 351, 353, 329, 330, 331, 334, 373;
222/400.5, 75 (Inquired)

ABSTRACT: In an electric sprayer, a valve system is provided in the liquid path between an opening of an electric pump and a jet of a nozzle. The valve system is connected to the on/off switch of the electric pump so as to keep the system closed when the switch is off (i.e., when the sprayer is not in use), to prevent leakage of spraying liquid from the nozzle jet due to the increased pressure within the container when the atmospheric temperature rises or when the sprayer is inverted.

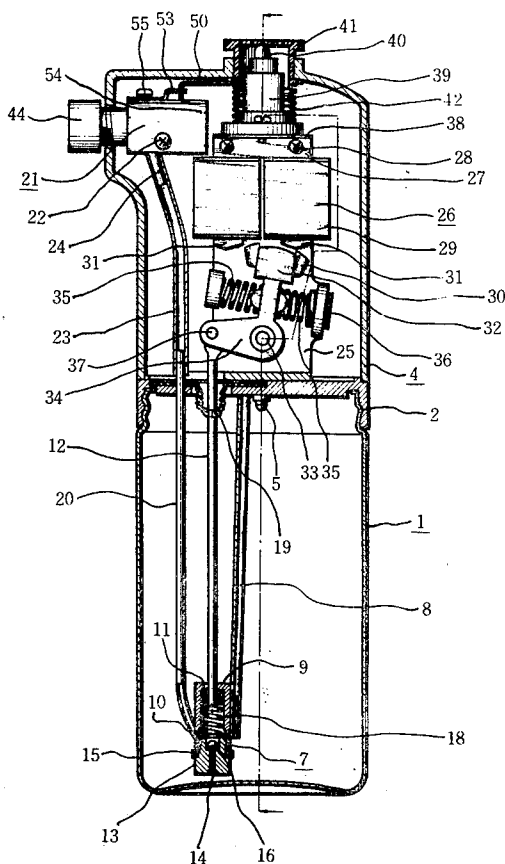


Fig. 1

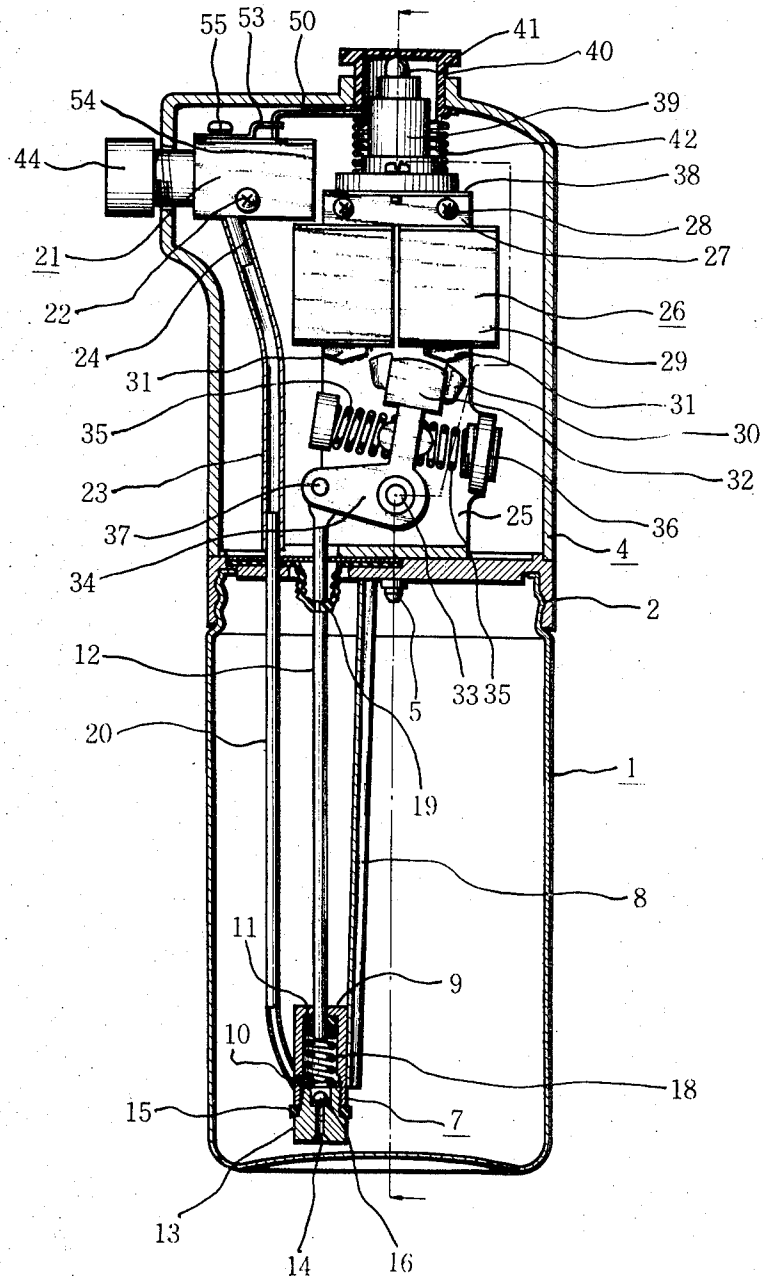


Fig. 2

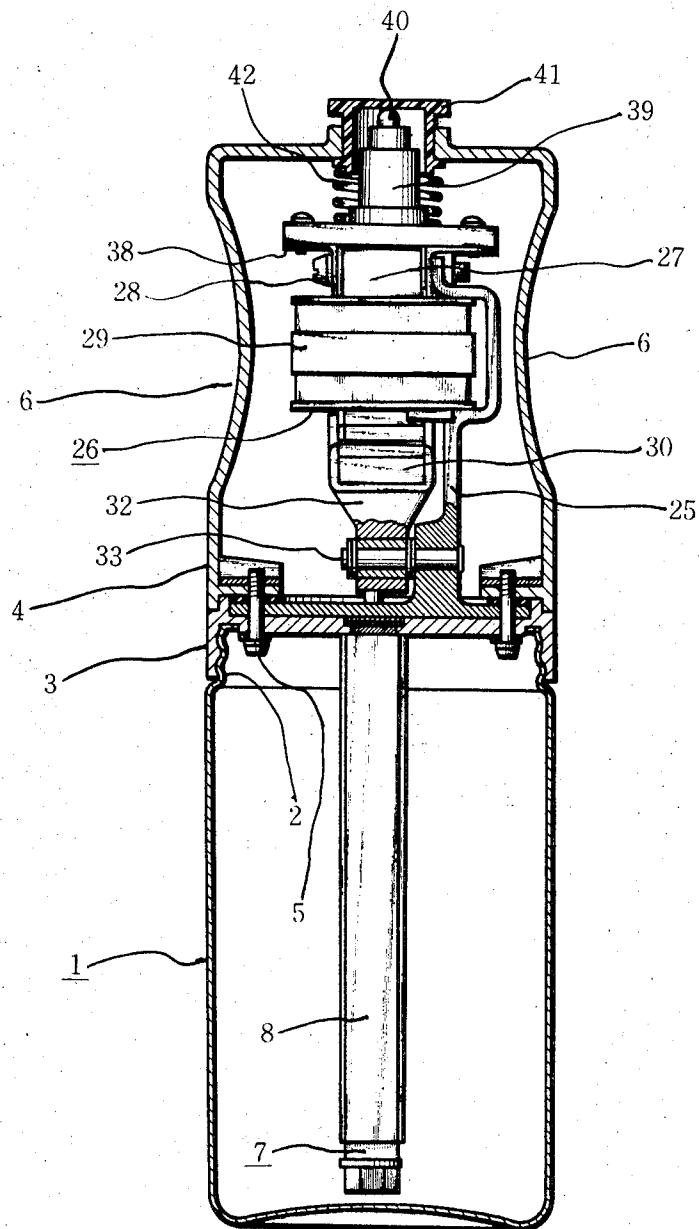


Fig. 3

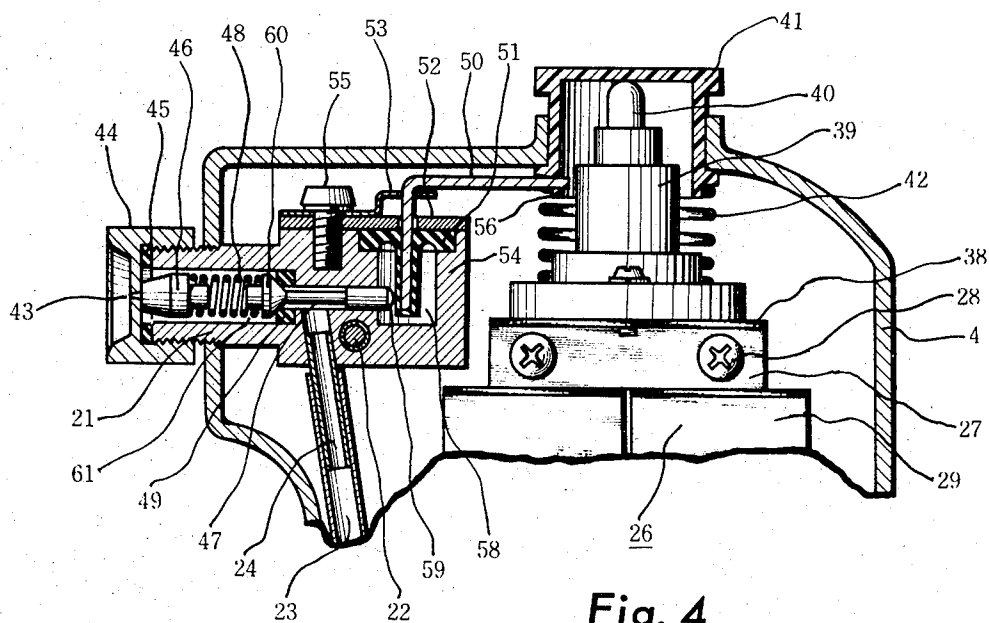


Fig. 4

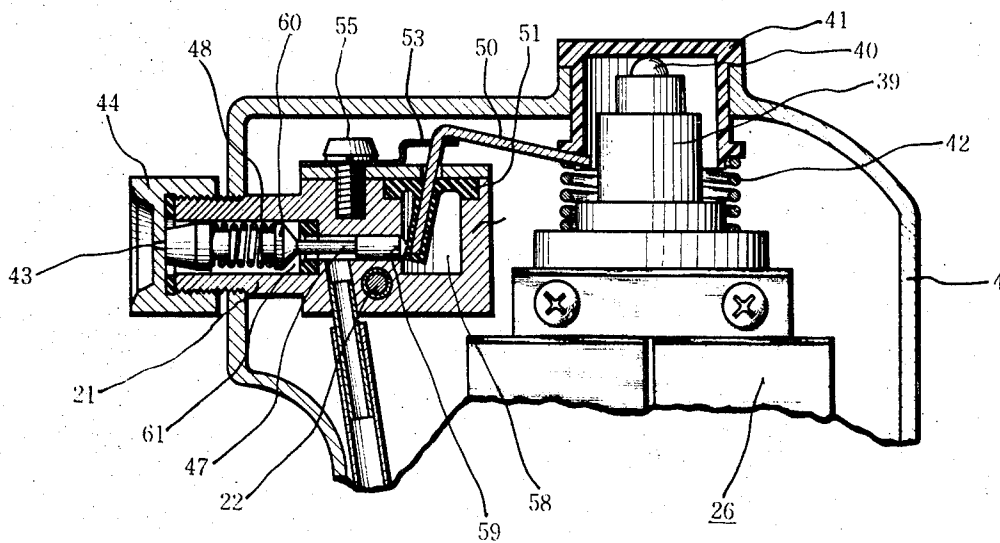


Fig. 5

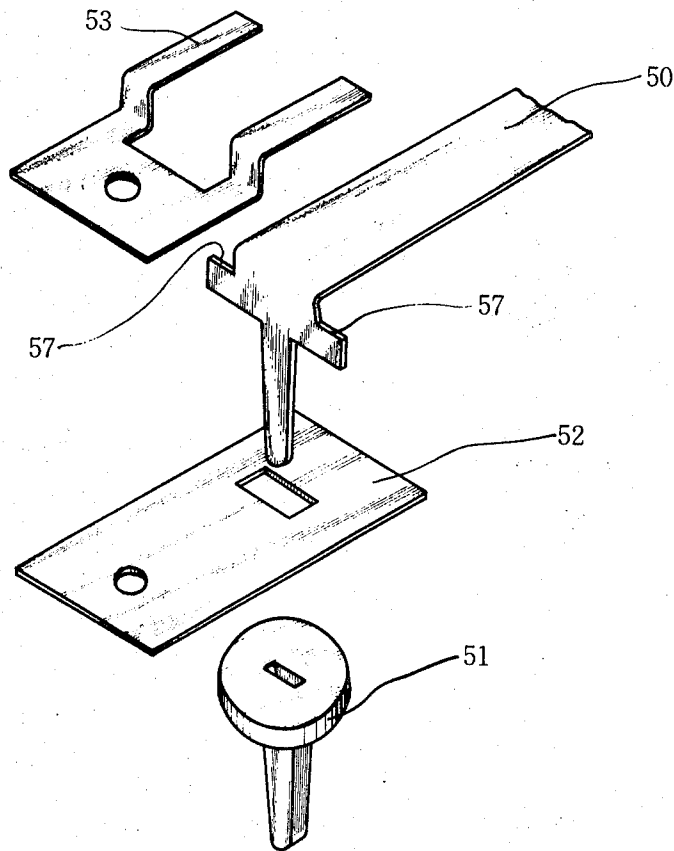


Fig. 6

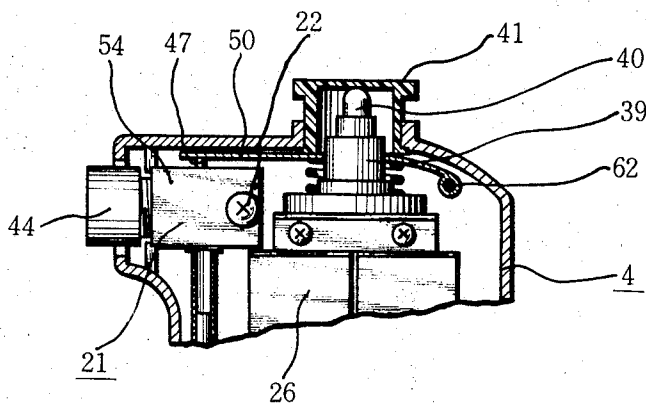


Fig. 7

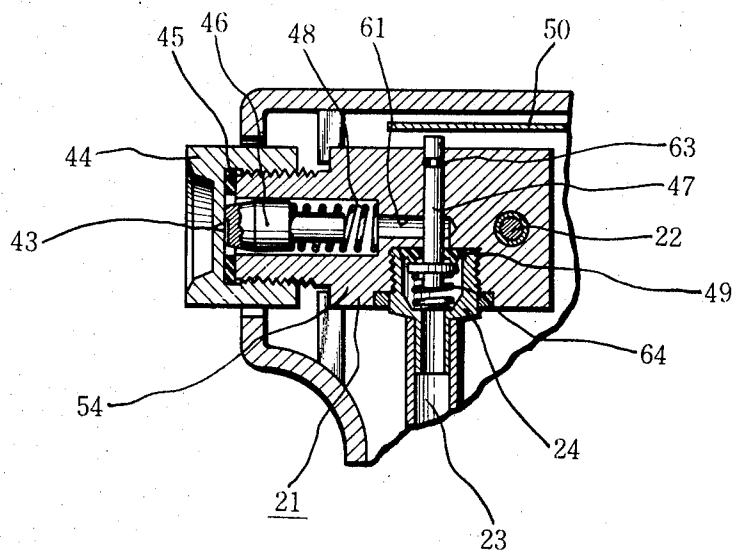


Fig. 8

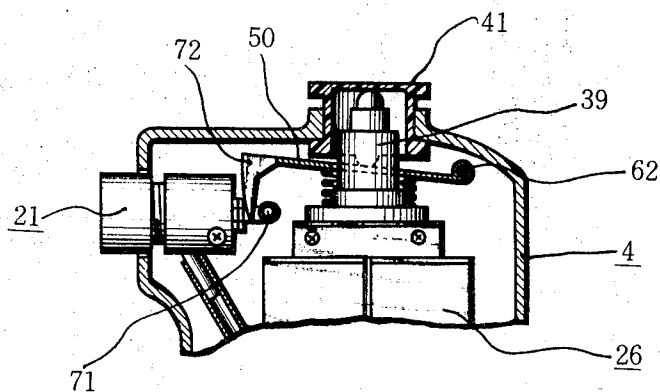


Fig. 9

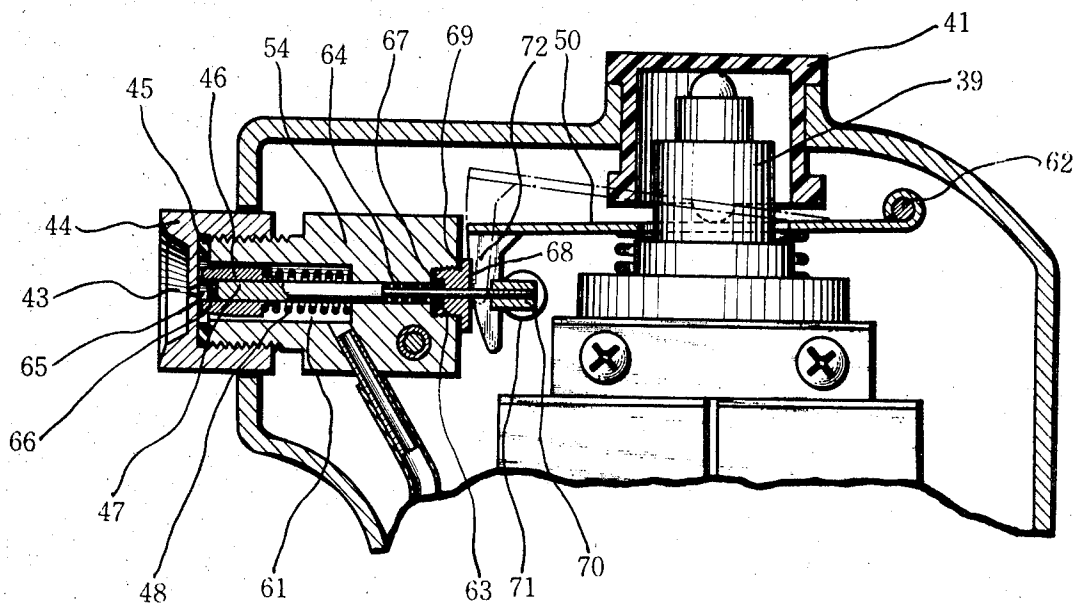


Fig. 10

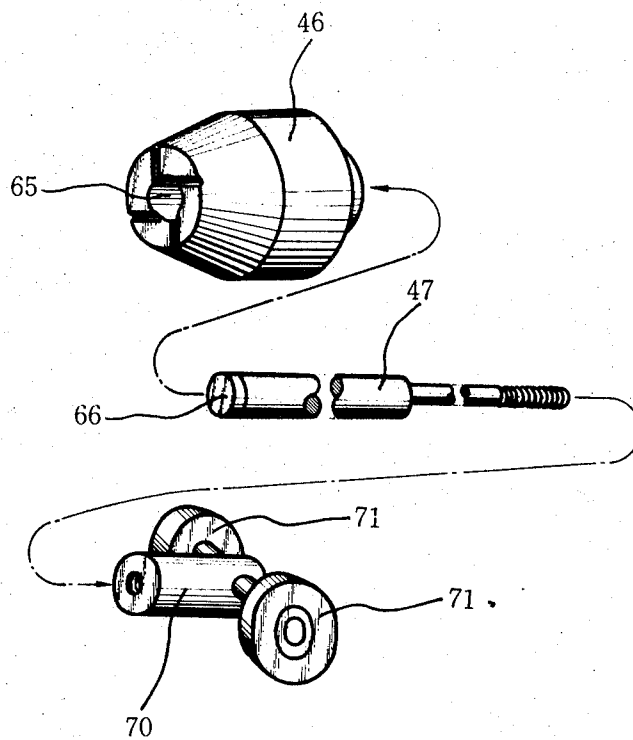


Fig. 11

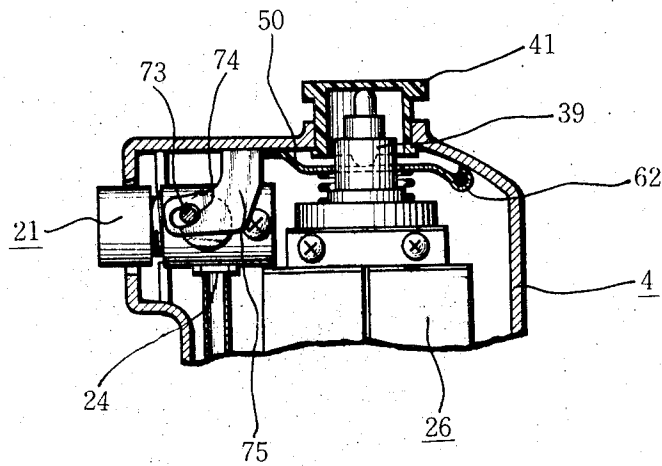
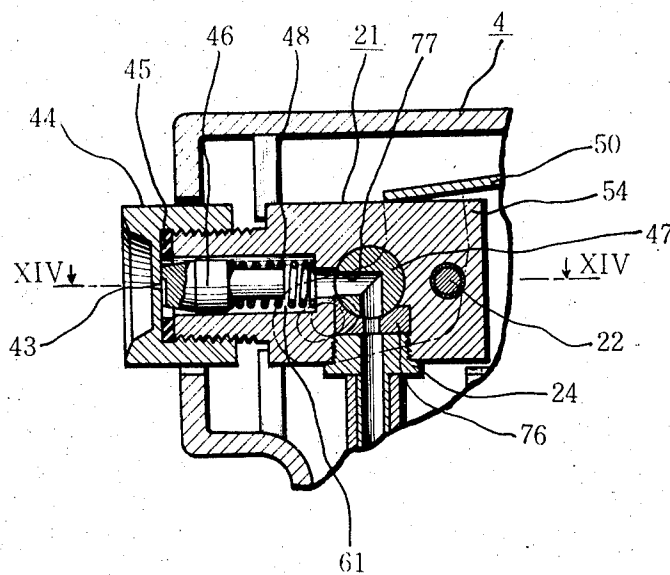


Fig. 12



SHEET 9 OF 9

Fig. 13

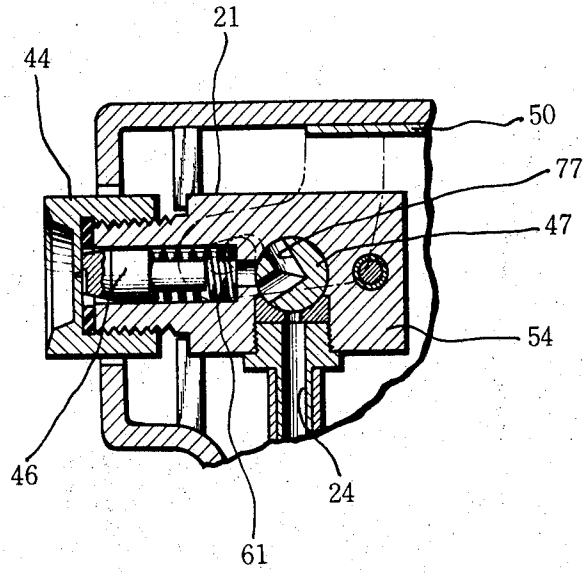
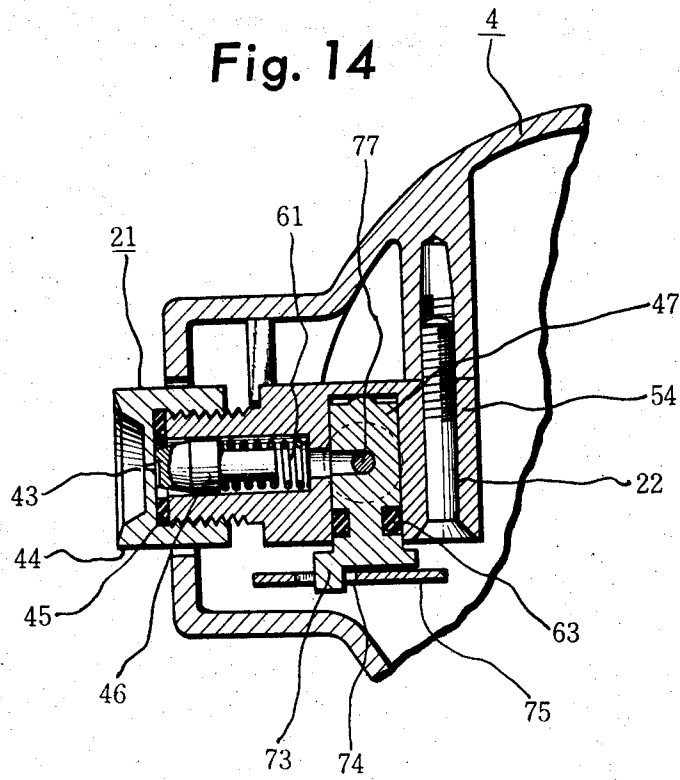


Fig. 14



1 ELECTRIC SPRAYER

This invention relates to electric sprayers and more particularly to an electric sprayer having means to prevent leakage from the nozzle jet when the sprayer is turned off.

BACKGROUND OF THE INVENTION

In an electric sprayer having an airtight container for spraying liquid and an electric pump for pumping liquid to a nozzle for spraying, liquid flows out whenever any pressure is placed on the liquid. This causes leakage of liquid from the nozzle jet, thereby staining the nozzle, sprayer or flooring where the sprayer is placed. This happens when: (a) a sprayer is filled with liquid in a low-temperature atmosphere such as in the early morning or in winter and brought into a heated room, thereby causing a rise in pressure inside the container and expansion of liquid; and (b) a sprayer is inverted with the nozzle part pointing downwardly. Particularly in the case of alcoholic liquids, such as those used in hair sprayers for hairdressing purposes, changes in pressure within the container resulting from varied outside temperatures is substantial.

Therefore, the main object of this invention is to provide a sprayer wherein the above-mentioned drawbacks are alleviated.

The main feature of this invention is the provision of a valve system opening and closing the liquid passage leading to the jet of the nozzle, the valve system being operated by means of an on/off switch of the sprayer.

SUMMARY OF THE INVENTION

According to this invention, an electric sprayer includes a valve system which opens and closes the passage for the liquid within the nozzle. The valve system is connected to the on/off switch of the sprayer so that when the switch is on, the valve system opens to let liquid flow, and when the switch is off the valve system closes to bar the flow of the liquid to the nozzle. The valve system includes a valve and biasing means to maintain the valve normally closed.

DESCRIPTION OF DRAWINGS

FIG. 1 shows a longitudinal sectional view of one embodiment of an electric sprayer according to this invention.

FIG. 2 shows a section along the line II-II of the embodiment shown in FIG. 1.

FIG. 3 shows an enlarged side view of the valve system connected to the switch of the embodiment shown in FIG. 1.

FIG. 4 is an enlarged sectional view of the system shown in FIG. 3 with the switch turned on.

FIG. 5 is a broken oblique projection of connecting part of the valve system and the switch of the embodiment shown in FIG. 1.

FIG. 6 is a longitudinal sectional view showing the main part of an electric sprayer according to a second embodiment of this invention.

FIG. 7 is an enlarged sectional view of a nozzle of this embodiment shown in FIG. 6.

FIG. 8 is a longitudinal sectional view of the main part of a third embodiment of this invention.

FIG. 9 is an enlarged sectional view of a nozzle of the third embodiment according to this invention.

FIG. 10 is a broken oblique projection of the valve system of the third embodiment of this invention.

FIG. 11 is a longitudinal sectional view of a fourth embodiment of this invention.

FIG. 12 shows an enlarged sectional view of a nozzle with an open valve system of the embodiment shown in FIG. 11.

FIG. 13 is an enlarged sectional view of the nozzle with a closed valve system.

FIG. 14 is a sectional view along line XIV-XIV of the embodiment shown in FIG. 12.

Although the above embodiments use the electromagnetic vibrating motor as a power source, this can be replaced with an electric motor wherein rotation is converted into a

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reciprocating motion by means of an eccentric cam system, thereby imparting a vertical motion to a piston. Any other type of power source may also be used.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1 and 2, a sprayer according to this invention includes a lower widemouthed container 1 made of aluminum, glass, or plastics, for containing liquid. Container 1 has a groove 2 cut around the outer circumference of an opening thereof. A cover 3 is provided which fits tightly over the groove 2 to keep the lower case 1 airtight and an upper part 4 which is fixed to the cover 3 by bolt 5, or the like. The upper part 4 consists of two portions cut vertically, each having detents 6 formed on the sides thereof for easy handling. A pump 7 is supported by a support frame 8 attached to the cover 3 and projects into the upper case 4, the pump 7 being inserted into the lower container 1 when the upper part and the lower container 4, 1, respectively, are connected. The pump 7 consists of a cylindrically shaped main part 9 (see FIG. 1) with an outlet 10 formed on the side, a packing 11 inserted within the main part in such a way as to maintain the opening of the main part 9 airtight, a piston rod 12, the lower end of which pierces the packing 11 in such a way as to allow free vertical motion of rod 12 and to keep it watertight and the upper end of which extends into said upper case 4. A valve rod 13 having an opening 14 for liquid is screwed into the lower end of the main part 9, a packing 15 being inserted between the valve rod 13 and the lower end of said main part 9. A ball 16 opens and closes said opening 14 of the valve 13 as the piston rod 12 moves vertically, a press plate 17 being provided for preventing the ball 16 from jumping out. A compression spring 18 is inserted between the press plate 17 and the packing 11. A bellows 19 is inserted between the cover 3 and piston rod 12 to allow the piston rod 12 to pierce through the cover 3 and have a free vertical motion while keeping the container airtight.

A liquid tube 20 has one end connected to the outlet 10 of said pump 7; the other end extends into the upper case 4. A nozzle 21 is fixed to the upper case 4 by a bolt 22 projecting sideways of the upper case 4. A detailed description of this portion of the system appears hereinbelow.

A connecting tube 23 connects a liquid guide tube 24 with the upper end of the tube 20. A supporting frame 25, in the form of reversed T is secured to the upper part of said cover 3 and to the upper case 4 by bolt 5.

A driving means 26 which imparts a reciprocating vertical motion to the piston rod 12 consists of an U-shaped fixed iron core 27 which is secured to the support frame 25 by a bolt 28, an accelerated magnetic coil 29 coiled around the foot of said iron core 27, a movable iron core 30 corresponding to magnetic poles 31, 31 of the fixed iron core 27, a driving lever 32 holding movable iron core 30 and fixed to said supporting frame 25 by a pin 33 or the like which provides a revolving axis allowing free swinging motion. A transmitting lever 34 forms one body with the driving lever 32 and two compression springs 35, 35 are inserted on either side of said driving lever 32 and between said supporting frame 25, supporting the driving lever 32 in such a way as to place the mobile iron core 30 inclined toward one side of the magnetic poles 31, 31 of the fixed iron core 27. An adjustable screw 36 is provided for adjusting the force providing by compression springs 35, 35 and the vibration width of the driving lever 32. The upper end of said piston rod 12 is fixed rotatably by a pin 37 to the transmission lever 34. A switchplate 38 is fixed by a bolt 28 to the upper part of the fixed iron core 27 and a switch 39 is attached to the plate 38. The switch 39 closes only while a projection 40 is being pressed, sending or cutting off the current to the accelerated magnetic coil 29 of the driving means 26. A push-button 41 projects on the top part of the upper case 4 and comes in contact with the projection 40 of the switch 39, and is biased upwardly by a spring 42.

FIGS. 3 and 4 illustrate a nozzle 21 consisting of a mouthpiece 44 including a jet 43, a gasket 45, a spinner 46, a

valve rod 47 and a spring 48 which presses the spinner 46 and the valve rod 47 in opposite directions. The nozzle 21 further includes an elastic valve seat 49, a valve-operating lever 50 to push the valve rod 47, a seal 51 made of such elastic materials as rubber or soft plastics, a pressure plate 52 for the seal 51, a supporting plate 53 which supports the valve operating lever 50, and a main part 54 for housing the above nozzle parts except for the support plate 53 and the pressure plate 52. The support plate 53 and seal press plate 52 are fixed to the main part 54 by a bolt 55.

The valve-operating lever 50 is L-shaped as shown in more detail in FIG. 5. One end of lever 50 is inserted in a notch formed with the press button 41 (see FIGS. 3 and 4), and is biased upwardly by pushbutton spring 42. Projections 57, 57 on the right and left of lever 50 are sandwiched between the seal pressing plate 52 and supporting plate 53 to form a pivot (or hinge) with the projections 57 in the center at the pivot point. The other end of lever 50 is covered by the seal 51 and inserted within a detent 58 in the main part 54. The seal 51 prevents leakage of liquid from the detent 58. The detent 58 is wide enough to accommodate one end of the valve-operating lever 50 covered with the seal 51 to move therein as illustrated by FIG. 4. One end 59 of the valve rod 47 projects into the detent 58 so as to allow movement of the valve rod 47 in accordance with the movement of the operating lever 50. Head 60 of the valve rod 47 and the valve seat 49 are provided approximately midway between the liquid passage 61 from liquid guide tube 24 to the jet 43 of the nozzle mouth piece 44. When the pushbutton 41 is not depressed, as is shown in FIG. 3, the head 60 of the valve rod 47 is biased tightly toward the valve seat 49 by means of the spring 48 to prevent liquid leakage from the tube 24 with the rise of liquid pressure.

Operational modes are now described for the above embodiment. When sprayer is not in use and pushbutton 41 is not pressed, as illustrated in FIG. 3, the head 60 of the valve rod 47 is biased tightly against the valve seat 49, thereby closing the passage for liquid 61 and preventing leakage from the jet 43 even when the pressure within container 1 increases by virtue of a temperature rise or the inversion of the sprayer.

The sprayer is operated by pressing the pushbutton 41, as indicated in FIG. 4. This closes switch 39 and causes revolving (or pivoting) of the valve operating lever 50 about the projections 57, pressing one end of end 59 of the valve rod 47, which now moves against the resistance of the strength of the spring 48, thereby opening the passage 61 by moving head part 60 away from the valve seat 49. Closing switch 39 causes electric current to be supplied to the accelerated magnetic coil 29 of the driving system 26. When the driving system 26 begins to operate, driving lever 32 swings to the right and left about the revolving axis 33 in the center, so that transmitting lever 34 moves vertically and the piston 12 is operated with a vertical reciprocating motion. By this reciprocating motion of the piston rod 12, liquid in the lower case 1 is pumped through the mouth 14 of the pump 7 and is transmitted by pressure through the opening 10, tube 20, connecting tube 23 to the liquid guide tube 24 and finally through the liquid passage 61 of the nozzle main part 54 and is sprayed out through the jet 43 of the mouthpiece 44.

When pressure is removed from the pushbutton 41, pushbutton 41 goes back to the condition shown in FIG. 3, thereby opening the switch 39 and stopping the driving system 26. Simultaneously, the valve-operating lever 50 goes back to the condition shown in FIG. 3 and the liquid passage 61 is again closed. In the foregoing description, a valve system comprising a valve rod 47 and a valve seat 49 for opening and closing of passage of liquid 61 of a nozzle 21 was given. However, many different types of valves can be applied to this type of system, description of which are now given. The same reference numerals are used for similar components in the following description for ease of comparison.

FIGS. 6 and 7 show a nozzle 21 having an L-shaped passage for liquid 61 formed in its main part 54. On the horizontal side of this L-shaped passage 61 are provided a nozzle mouthpiece

44, gasket 45, and a spinner 46. A valve consisting of a valve seat 49 and a valve rod 47 closing the passage 61 by adhering closely to the valve seat 49 from the side of liquid guide tube 24 is provided in the vertical part of the L-shaped passage 61. The upper end of the valve rod 47 slideably projects upwardly from the main part 54, allowing vertical motion thereof. An operating lever 50 is pivotally fixed on the upper case 4 by a pivot 62 so that pressing of a pushbutton 41 will give rotation downwardly to a valve-operating lever 50. In FIG. 7, an O-shaped sealing ring 63 is mounted on valve rod 47 to prevent leakage, and a spring 64 is mounted to bias the valve rod 47 against the valve seat 49. It should be understood that the same mode of operation according to this invention is provided by this embodiment as well as in the aforementioned one, since by depressing pushbutton 41, the lever 50 will be operated downwardly, pushing rod 47 down and opening passage 61 to allow operation of the sprayer.

Another embodiment shown in FIGS. 8-10 comprises a spinner 46 having a hole 65 through the length thereof, a valve rod 47 having a valve plate 66 made of an elastic material opening and closing a jet 43 in the nozzle mouthpiece 44. A switch 39, provided for turning the sprayer on and off is connected to the valve rod 47. In FIGS. 8-10, a spring 64 biases the valve plate 66 to the inner side of the nozzle mouthpiece 44 by imparting pressure to the valve rod 47 when the sprayer is not in use. An O-shaped sealing ring 63 is provided to prevent leakage. A seat plate 67 supports the spring 64 and O-shaped ring 63 and a fixture 68 is provided for holding the spring 64, the O-shaped ring 63, and the seat plate 67 in place. Packing 69 is provided for leakage prevention. Further provided is a tensioning member 70 adjustably fixed to the projecting end of the valve rod 47, rollers 71 rotatably secured to the tensioning member 70, and a wedge-shaped cam 72 formed on the free end of the valve operating plate 50. The cam 72 contacts the rollers 71 as shown. Valve-operating plate is pivotally mounted to case 4 by pivot pin 62 and is operated by push button 41.

In this embodiment, pressure on pushbutton 41 will press the valve-operating plate 50 downwardly, and the valve rod 47 is moved sideways in resistance to the spring 64 by the cam 72 at the edge of the operating plate 50. This separates the valve plate 66 from the jet 43 of the nozzle mouthpiece 44, thereby opening passage 61 and making spraying possible. When pressure is removed from the pushbutton 41, the valve-operating plate 50 goes back to its normal position, being pressed back by the valve rod 47 and spring 64, thereby closing the opening 43 and preventing undesired flow of the liquid.

Another embodiment shown in FIGS. 11-14 provides a cock valve 47 within a passage 61 of a nozzle 21, connecting the valve 47 with the operation of a switch push button 41 and revolving it so as to open and close the passage 61 for the liquid. In FIGS. 11-14 there is shown a pin 73 projecting eccentrically from the cock valve 47, an elongated slot 74 formed on one end of bent part 75 of the valve-operating plate 50. The pin 76 is mounted within the elongated slot 74. There are also shown in FIGS. 11-14 a packing 76, and an O-shaped ring 63 for prevention of leakage. In this embodiment, the passage 77, in the cock valve 47 is not connected with the passage in guide tube 24 when the sprayer is not in use, thus preventing the flow of liquid out of the jet 43 due to increase of the pressure within the liquid container. Pressure on the pushbutton 41 turns on the sprayer motor and lowers the valve operating plate 50, thereby pushing eccentric pin 73 of the cock valve 47 and rotating the cock valve 47, so that passage 61 is connected through by means of the passage 77 being aligned with the passage 61, thus allowing liquid to reach the jet 43.

In the embodiment shown in FIG. 11, the combination of the eccentric pin 73 and the elongated slot 74 may be replaced with the combination of a rack gear and a rack. This modification should be obvious to those ordinarily skilled in the art.

We claim:

1. In an electric sprayer having:
an airtight container;

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an electric pump system for pumping liquid from said container;
a switch controlling said pump system;
nozzle means having a passage for liquid flow therethrough and including:
a jet coupled to said passage through which said liquid is sprayed; and
a spinner member provided within said passage;
means for providing liquid flow between said pump and said nozzle; and
valve means controlled by said switch, said valve means including:

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a valve rod slidably mounted in said passage;
a valve seat mounted in said passage;
biasing means interposed between said valve rod and said spinner member for biasing said valve rod against said valve seat on the side of said valve seat adjacent said jet to close said passage, and for biasing said spinner member against said jet; and
a valve operating means connected to said switch for moving said valve rod against said biasing means to open said passage when said switch is operated to turn the prayer on.