

June 11, 1968

R. G. FEDIT ET AL

3,387,789

ATOMIZER PUMP ASSEMBLIES

Filed March 17, 1965

3 Sheets-Sheet 1

Fig. 1.

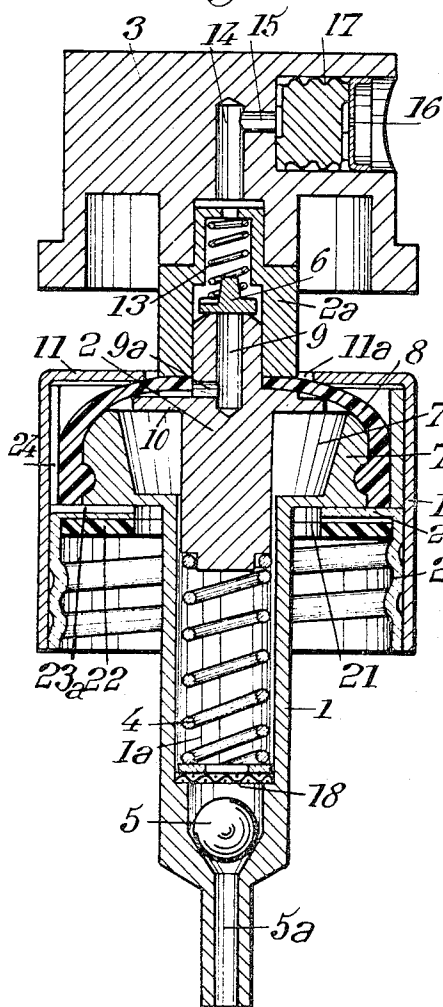
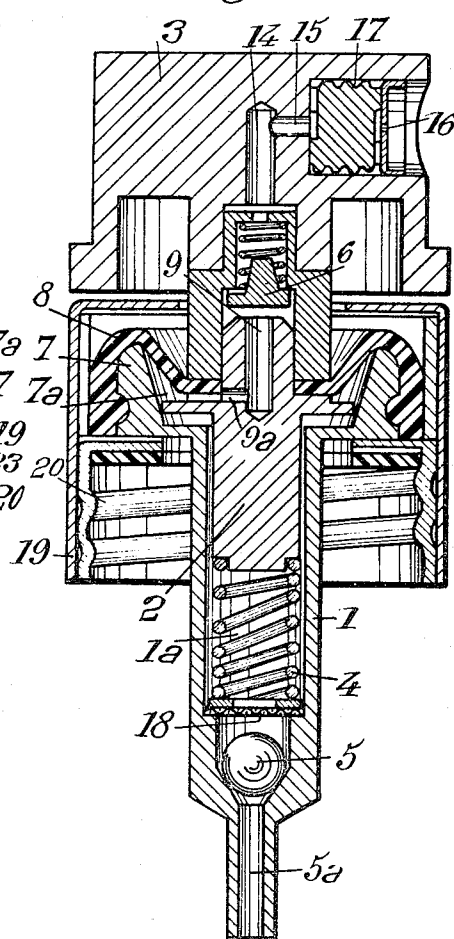


Fig. 2.



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Fig. 3.

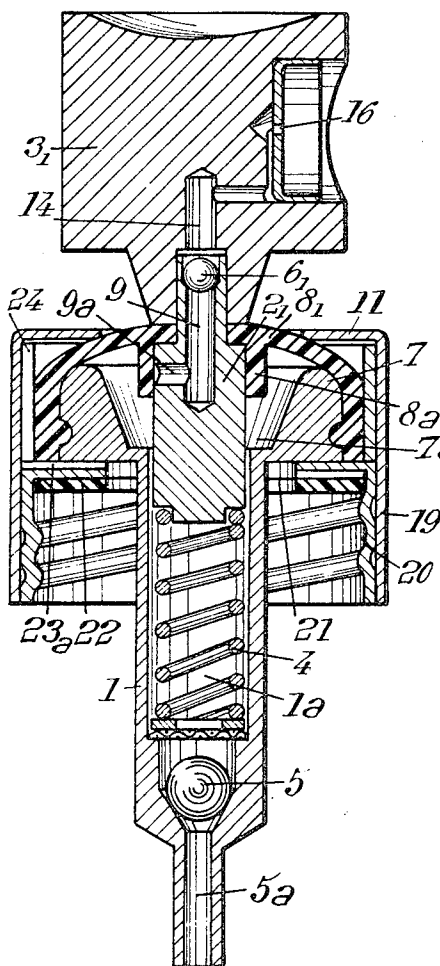
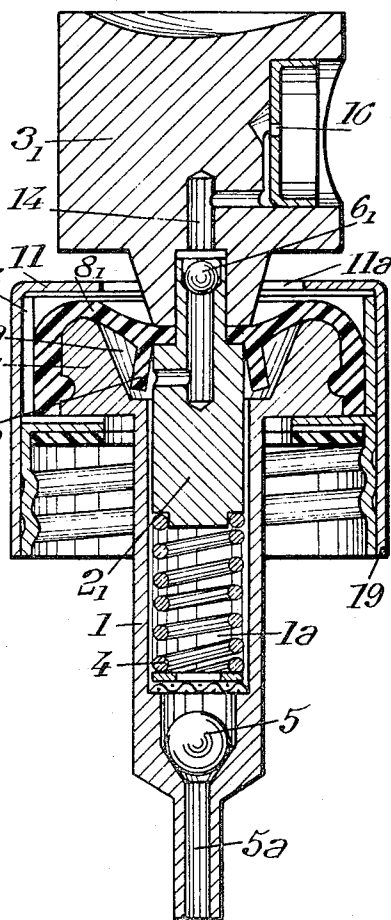


Fig. 4.



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Fig. 5.

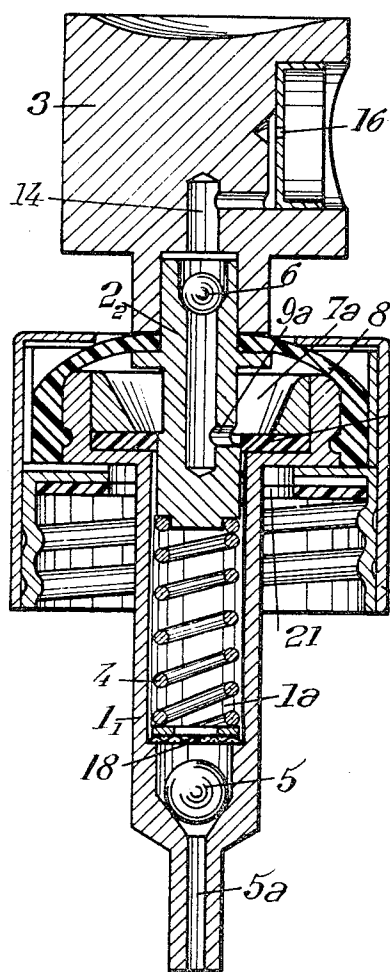
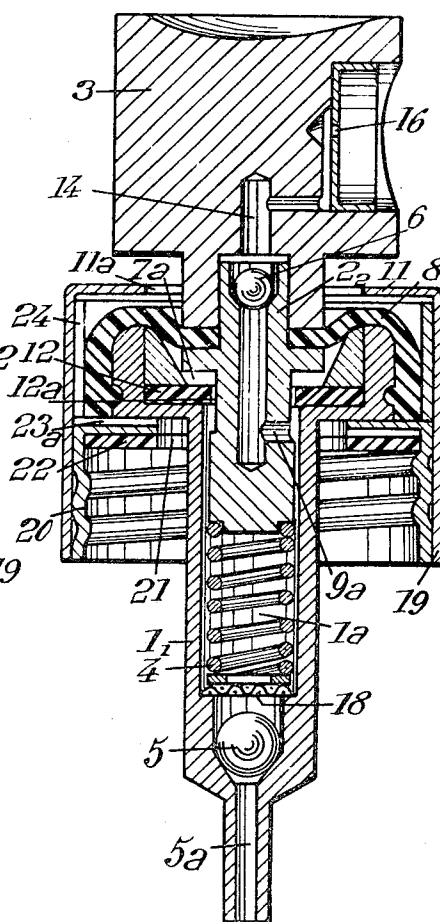


Fig. 6.



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ATOMIZER PUMP ASSEMBLIES

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5 Claims. (Cl. 239—333)

ABSTRACT OF THE DISCLOSURE

An atomizer pump to be mounted on a container of liquid to be atomized and having a plunger slidable in a cylinder. Said plunger has a liquid passage extending therethrough with a check valve at its outlet end. Said passage has its inlet end opening into the side wall of said plunger under the inner edge of a flexible fluid tight annular membrane which acts as a valve between the inside of the container and the passage.

This invention relates to liquid atomizers and particularly to atomizers driven by an alternating pump.

The present invention especially, but not exclusively, concerns atomizer pump units adapted to be operated manually by the user and to be mounted as the cap for a vessel containing the liquid to be atomized.

It is a principal object of the present invention to improve the liquid-tightness of such units when not in use.

It is another object of this invention to increase the useful life of such pumps.

Yet another object herein is to facilitate the utilization of such atomizers.

It is well known that the presently used fluid delivery valves of pumps of this type are not capable of assuring a satisfactory fluid-tightness because, in order to achieve such a fluid-tightness, the valves would have to be pressed against their seatings with too strong a restoring force, with the result that manipulation of the pump would be rendered difficult and, when at least a part of the pump work chamber wall is of elastically yieldable material, said restoring force renders inoperative the alternative pump action which only result is an alternative elastically bulging of said part.

The present invention is intended to be employed in an atomizer assembly having a pump comprising an alternating element to be operated by the user and a restoring means for returning, and maintaining, the element in its rest position. The novel concept of the invention rests in causing this element, when in its rest position, to break the communication between the pump work chamber and the pump outlet valve, and, preferably, in attaching to the wall of said chamber an element capable of yielding elastically in such a way as to ensure the reestablishment of the communication between the chamber and the valve when the alternating element is moved away from its rest position.

The present invention also consists in several other features which will be discussed in detail below.

The invention concerns not only the abovedescribed device, but also its application to containers for dispensing various types of cosmetic and medicinal liquids.

These and other objects, features and advantages of the present invention will become more readily understood from the following detailed description, when taken together with the annexed drawings, in which:

FIG. 1 shows a longitudinal cross-sectional view of one preferred embodiment of the present invention in its rest position;

FIG. 2 is a view similar to that of FIG. 1 showing that

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embodiment in its position corresponding to the end of its compression motion;

FIGS. 3 and 4 show views similar to those of FIGS. 1 and 2, respectively, of a second embodiment of the present invention; and

FIGS. 5 and 6 are correspondingly similar views of a third embodiment thereof.

Each of the illustrated embodiments of the present invention are shown, only for exemplary reasons, in the form of a unitary assembly of an atomizer pump and nozzle arrangement forming a part of a threaded cap designed to fit tightly on the top of a suitable container, such as a bottle or can, having any neck diameter, since the cap can easily be made to any size. Thus, the structure of the present invention can be used as easily in connection with wide-neck bottles as with those of the narrow-neck variety.

Referring first to the embodiment shown in FIGS. 1 and 2, it may be seen that the alternating pump is constituted by a cylinder 1 within which travels a plunger 2. A downward pressure exerted by the user on a control push button 3 urges plunger 2 in a direction to drive fluid out of the volume 1a enclosed by the lower portion of cylinder 1. This movement of plunger 2 also serves to compress a restoring spring 4, placing said spring in a condition to force plunger 2 out of volume 1a when the user releases button 3. This upward movement creates a partial vacuum in volume 1a which acts to lift ball valve 5 away from its seating and to draw liquid from tube 5a into volume 1a. Tube 5a is an immersion tube whose length is such that its lowest end rests very close to the bottom of the container to assure that all of the liquid in the container will eventually be drawn into volume 1a. The bottom of spring 4 is supported by a washer which may rest on a screen 18 serving to limit the movement of ball valve 6.

The upper end of cylinder 1 is extended by a coaxial, larger-diameter portion 7 enclosing a bowl-shaped volume 7a. Cylinder 1 and plunger 2 are also joined together by a roughly annular flexible membrane 8 which may be made of rubber or any other material having similar mechanical properties. The inner edge of membrane 8 is attached to plunger 2 by being mechanically gripped, for example, between a shoulder on the upper end of said plunger and the lower edge of a sleeve 2a of rigid material which forms an element for transmitting to plunger 2 the depression force exerted by the user on button 3. The outer edge of membrane 8 is attached to cylinder 1 by being tightly gripped between the outer circumference of portion 7 and a retaining collar.

The space 7a communicates with the space 1a through the annular passage resulting from the play existing between plunger 2 and cylinder 1. The pump work chamber is thus constituted by these two spaces and has a maximum volume when plunger 2 and membrane 8 are in their rest position, as shown in FIG. 1.

When the pump elements arrive in this rest position, the pump will have completed its intake movement and space 1a will contain a certain quantity of liquid drawn from the container.

Plunger 2 has an upper portion containing a fluid passage 9, 9a communicating with work space 7a through a radial groove in said plunger shoulder and serving as the pump outlet passage. The outlet end of this passage is covered by a one-way outlet valve 6 which is normally urged thereagainst by a spring 13.

One of the basic concepts of the present invention is to provide means which tightly closes the fluid path between work space 7a and outlet valve 6 when the pump is in its rest position, thereby assuring that the container on which the atomizer is mounted, as well as the pump work spaces, will not be subject to any fluid leakage. In the embodiment of FIGS. 1 and 2 this means is consti-

tuted by a portion of membrane 8 which bears against a disc 10 of plunger 2 when the latter is in its rest position. It should be noted that this membrane forms one boundary of the pump work space and also encloses the fluid-receiving end of passage 9, 9a. The communication between passage 9a and work space 7a is controlled by the relation between the membrane and the disc 10 which is rigidly mounted on plunger 2.

When membrane 8 bears against the outer end of disc 10, as is shown in FIG. 1, the communication is broken, while when the plunger is in any position other than its rest position, as shown in FIG. 2 for example, the manner of attachment of membrane 8 to portion 7 assures that said communication will be restored.

It should be noted that the cap containing the pump and adapted to close the container comprises an outer shell constituted by a cylindrical wall 19 and an annular top 11 in which is formed an axial opening 11a for the passage of sleeve 2a. Opening 11a is of slightly smaller diameter than disc 10; hence, top 11 serves to determine the rest position of plunger 2 and acts to force membrane 8 against disc 10, thus assuring the creation of a seal between the latter two elements.

The remainder of the cap is constituted by an insert consisting of a cylindrical lateral portion 20 having raised container-engaging threads therein, and an annular top 23 having a central opening 21 therein through which passes cylinder 1. This opening serves as the outlet end for an air passage constituted by a radial passage 23a in top 23 communicating with a longitudinal slot 24 (left side of drawings). The inlet end of this passage communicates with the outside air through opening 11a and thereby permits air to enter the container at a rate equal to the rate at which liquid is dispensed. Air may enter whenever membrane 8 is not blocking opening 11a, i.e., whenever the pump is not in its rest condition. However, with the pump in its rest position, membrane 8 acts to prevent fluid from escaping either from space 7a or from the above-described air passage. Such an arrangement for closing the air passage is described in detail in applicant's French Patent No. 1,339,657 filed on Aug. 30, 1962.

Push button 3 is rigidly mounted atop sleeve 2a and comprises a fluid outlet path consisting of a vertical passage 14 aligned with the fluid passage through sleeve 2a, a radial passage 15 communicating with passage 14, an atomizing nozzle 16, and, in the embodiment of FIGS. 1 and 2, a helical passage 17 connecting passage 15 to nozzle 16, the shape of passage 17 being chosen to give a rotation to the atomized spray.

The above-described device begins its cycle of operation in the position shown in FIG. 1, with a quantity of liquid held in volume 1a. When it is desired to produce a spray, the user depresses push button 3, thereby moving plunger 2 downward through the intermediary of sleeve 2a and against the action of restoring spring 4. The start of this downward movement deflects membrane 8 sufficiently to open both the above-described air-inlet passage and the fluid passage between volume 7a and passage 9, 9a. Both passages will remain open during the complete cycle of operation of the pump, until plunger 2 returns to its rest position.

As plunger 2 continues to descend, it reduces volume 1a, forcing liquid into volume 7a. At the same time, the downward plunger movement pulls the interior portion of membrane 8 downward in such a way as to diminish the size of volume 7a. These reductions in volume force the trapped fluid through passages 9a and 9, creating a sufficient pressure to open valve 6. Valve 6 is provided with a radial passage which assures that a fluid flow path will remain between passages 9 and 14 even if valve 6 is forced into its uppermost position, as shown in FIG. 2. The fluid is forced through passages 14, 15 and 17, being accelerated considerably in this latter passage due

to the small cross-sectional area thereof, and emerges from atomizing nozzle 16 as a fine spray.

The positions of the various elements just before reaching the end of this compression travel are shown in FIG. 2. As soon as plunger 2 reaches the end of its travel path, the pressure on the fluid drops, permitting valve 6 to close.

The push button is then released, permitting spring 4 to urge plunger 2 upward, moving both the plunger and membrane 8 back to their rest positions. As plunger 2 moves upward, a partial vacuum is created in volume 1a which causes the liquid in tube 5a to force ball 5 upward and to enter the volume. This continues until plunger 2 reaches its rest position, the fluid then remaining trapped in volume 1a in preparation for the next atomizing operation. At the same time that liquid is being drawn into volume 1a, the previously described air inlet passage is left open, thereby assuring that atmospheric pressure will be maintained in the container. As described above, this air passage will be closed when the pump elements return to their rest positions.

Turning now to FIGS. 3 and 4, there is shown a second proposed embodiment of the present invention in which elements identical with corresponding elements of FIGS. 1 and 2 are given the same reference numerals while elements which are the functional equivalents thereof are given the same number indicated. The same procedure will be followed for FIGS. 5 and 6.

The device shown in FIGS. 3 and 4, to be in its rest position and at the end of compression travel, respectively, differs from that of FIGS. 1 and 2 only in the structure of plunger 2₁, button 3₁, valve 6₁ and membrane 8₁, and in the elimination of sleeve 2a, spring 13, and helical passage 17, the latter two elements being merely optional features in any device of this type.

Plunger 2₁ is shorter than plunger 2 and does not require a disc such as disc 10. In addition, passage 9a and the lower end of passage 9 are placed in a slightly lower position than in FIG. 1. Membrane 8₁ is almost identical with membrane 8, except that the former carries a downwardly-directed tubular rubber sleeve 8a which is sufficiently co-extensive with plunger 2₁ to pass beyond passage 9a. Sleeve 8a acts, in cooperation with membrane 8₁, in such a way as to seal the end of passage 9a, thus breaking the communication between this passage and volume 7a, when the pump is in its rest position (FIG. 3) and to open passage 9a when the pump is in any other position (e.g. FIG. 4). Thus, this sleeve performs the function previously carried out by the cooperation between disc 10 and membrane 8.

Button 3₁ is formed with a hollow downwardly-directed extension into which the upper end of plunger 2₁ fits. The lower rim of this extension cooperates with a shoulder on plunger 2₁ to grip the inner edge of membrane 8₁. The top of button 3₁ has a depression which serves as a finger grip.

Valve 6₁ is in the form of a ball which is the functional equivalent of the valve 6 of FIG. 1.

Since this embodiment has been simplified by the elimination of disc 10, the rest position of the pump is determined almost completely by the contact between membrane 8₁ and top 11. For this reason, and to improve the durability of the device, membrane 8₁ may be made slightly thicker than membrane 8.

The device of FIGS. 3 and 4 functions in exactly the same way as that of FIGS. 1 and 2.

Turning now to FIGS. 5 and 6, there is shown a third embodiment of the present invention which differs from that of FIGS. 3 and 4 chiefly in the position of passages 9 and 9a and in the provision of an annular seal 12.

Seal 12 is mounted on cylinder 1₁, at the bottom of the large-diameter portion thereof, in such a way as to serve as a boundary between volume 1a and volume 7a. In order to hold seal 12 in place, this large-diameter portion may be made of two annular portions the inner one

of which is positioned after seal 12 has been put in place in such a way as to grip the outer portion of this seal.

The lower portion of plunger 2₂, up to passage 9a, has a diameter sufficient to form a fluid-tight fit with seal 12 when the pump is in its rest position. The plunger region above passage 9a has a reduced diameter which assures that passage 7a will communicate with volume 1a through space 12a when the plunger leaves its rest position. If desired, the same result could be obtained by not giving this latter region a reduced diameter, but by providing a longitudinal groove on the plunger surface extending upwardly from passage 9a.

Passage 9a is placed to be just even with, or slightly above, seal 12 when plunger 2₂ is in its highest, or rest, position.

This assures that volume 1a, and eventually volume 7a, which contain liquid to be vaporized, will be completely isolated from the atomizer outlet passages when in this position. When the plunger is depressed, passage 9a enters the lower part of cylinder 1₁, coming into direct communication with volume 1a.

The remainder of the structure and manner of operation of this embodiment is identical with that of FIGS. 3 and 4.

While several preferred embodiments of this invention have been shown and described herein, it should be obvious that many modifications and variations could be given thereto without departing from the spirit of the present invention, whose coverage should therefore be limited only by the scope of the annexed claims.

What we claim is:

1. In an atomizer pump designed to be mounted on a container of liquid to be atomized and comprising a casing formed by a top end wall and a cylindrical skirt extending downwardly from said top end wall, a cylinder carried by said casing coaxially on the inside thereof so as to extend into said container, a check valve in said cylinder opening in the upward direction, a plunger slidable in said cylinder so as to be movable between two positions, a bottom one and a top one, said top position being the rest position of said plunger, said plunger being provided with a liquid passage extending therethrough from the inside of said cylinder, a push-piece rigid with said piston slidable with respect to said casing, said push-piece being provided with a discharge nozzle in communication with said passage, a check valve in said passage adapted to open outwardly, a flexible fluidtight annular membrane having its outer edge secured in a fluidtight manner to said cylinder and its inner edge secured in a fluidtight manner to said plunger and such that, in the top position of said plunger, said membrane is applied tightly against the top end wall of said casing, means forming an air passage in said casing opening into said container, said casing end wall being provided with an aperture in communication with the atmosphere and forming the inlet of said air passage and said aperture being adapted to be tightly closed by said membrane in the top position of said plunger, and spring means be-

tween said plunger and said cylinder for urging said plunger upwardly with respect to said cylinder,

the improvement which comprises the following features:

5 said passage has its inlet end opening into the side wall of said plunger, under said membrane inner edge, and

10 resilient means fixed to said cylinder are provided to cooperate with said plunger for cutting off communication between said passage and the inside of said cylinder when said plunger is in its rest position.

2. An atomizer pump according to claim 1 wherein said resilient means consist of a portion of said membrane surrounding said inner edge thereof, said plunger including a disc located just under said passage inlet end and adapted, when said plunger is in its top position, to pinch said membrane against said casing top end wall.

3. An atomizer pump according to claim 1 wherein said resilient means consist of a downwardly extending sleeve integral with said membrane and adapted to fit on the periphery of said plunger at the height of said passage inlet end when said plunger is in its top position, thus stopping said passage, and to be deformed away from said plunger so as to clear said passage inlet end when said plunger is moved downwardly from its rest position and said membrane is correspondingly deformed.

4. An atomizer pump according to claim 1 wherein said resilient means consist of a sealing annular member of resilient material fixed at its outer edge to said cylinder and the inner edge of which is slidably applied against the periphery of said plunger, the outer wall of said plunger being shaped to fit tightly against said annular member inner edge when said plunger is in its top position and to leave a passage between itself and said annular member inner edge when said plunger is moved downwardly from said top position.

5. An atomizer pump according to claim 4 wherein the portion of said plunger below said passage inlet end has a diameter equal to that of the inner edge of said annular member, whereas the portion of said plunger above said passage inlet end has a diameter smaller than that of the inner edge of said annular member.

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