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## (54) NEBULIZER FOR LIQUIDS

ZERSTÄUBER FÜR FLÜSSIGKEITEN

VAPORISATEUR POUR LIQUIDES

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<b>DE-A- 4 332 869</b>	<b>FR-A- 2 402 088</b>
<b>US-A- 5 025 958</b>	

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## Description

**[0001]** The invention refers to a nebulizer for liquids, perfumes and similar products, particularly suitable for temporary application to recipients containing the liquid to be delivered. A nebulizer according to preamble of claim 1 is known from US-A-5025958.

**[0002]** As known, liquids, and in particular perfumes and similar products, can be nebulized by increasing the pressure of the liquid to be delivered by passing it through a nozzle equipped with holes gauged in relation to the density of the liquid to be delivered and the degree of nebulization to be obtained.

**[0003]** To do this, special devices, called "nebulizers", are used which are temporarily applied to the recipients containing the liquid to be nebulized and are activated manually by the user.

**[0004]** These nebulizers generally include a hollow body with a compression chamber for the liquid communicating with a suction duct inserted in said liquid, whose opening/closing is controlled by means of valves. A sealed piston in a sliding configuration coupled to the hollow body that moves in a contrasting manner with the elastic means, compresses and sucks the liquid contained in the compression chamber.

**[0005]** Internally, the sealed piston is equipped with a tubular chamber that communicates on one side with the compression chamber and on the other, through a choke, with a delivery duct for the liquid equipped with a nozzle.

**[0006]** A stopper plug, sliding elastically inside the tubular chamber, opens/closes the choke and allows the liquid to flow.

**[0007]** From an operative viewpoint, the user, by activating the piston, closes the valves, loads the elastic means and compresses the liquid contained in the compression chamber, gradually increasing its pressure.

**[0008]** The pressure is discharged on the stopper plug until the choke opens, allowing the pressurised liquid to reach the nozzle.

**[0009]** After completing the delivery operation, the elastic means returns the piston to the initial position, generating a vacuum within the compression chamber, opening the valves and sucking the liquid, preparing the nebulizer for the next delivery operation.

**[0010]** The main problem with the nebulizers as described is that the elastic means used to make the movement of the sealed piston and the stopper plug smoother, consists of metallic helical springs. This makes it difficult to recycle the nebulizer because the metallic parts must first be separated from the plastic parts.

**[0011]** The need for such a separation significantly increases the cost of the entire recycling process and sometimes making it economically unfeasible.

**[0012]** On the other hand, replacing the metallic springs with various types of elastic, non-metallic materials creates some problems since, as known, metallic springs have a response curve that is almost linear, as

illustrated in fig. 1, while similar elastic non-metallic elements have a non-linear and asymmetrical response curve, as shown in fig. 2.

**[0013]** Furthermore, such elastic elements have a compression curve R that is different from the expansion curve D, thus significantly increasing the complexity in creating elements with characteristics that are similar to those of the metallic helical springs.

**[0014]** In particular, to obtain an elastic force with the required intensity D during the expansion phase, the user must generate a greater force R during the compression phase.

**[0015]** The purpose of this invention is to solve the aforementioned problems.

**[0016]** In particular, the purpose of this invention is to build an all-plastic nebulizer.

**[0017]** The previously mentioned purposes can be achieved by a nebulizer for liquids equipped with a cap to be coupled to the neck of a recipient containing the liquid to be delivered, that in accordance with the main claim includes:

- at least one hollow body, that at the top consists of a compression chamber for said liquid;
- at least one suction duct for said liquid at least partially immersed in said liquid, communicating with said compression chamber;
- valves installed downstream from said liquid suction duct to close/open said suction duct;
- a first sealed piston coupled in a sliding configuration to said hollow body, equipped internally with a tubular chamber that communicates through a communication duct with said compression chamber and by means of a choke with a liquid delivery channel, and said delivery channel being equipped with a nozzle to nebulize said pressurised liquid;
- a stopper plug sliding inside said tubular chamber that moves in a contrasting manner with a first set of elastic means to close/open said choke characterized in that:
- a second set of elastic means is installed between said cap for coupling to the neck and the pump actuator;

**[0018]** The advantage of this invention is that it reduces the number of elements comprising the nebulizer with respect to the known types.

**[0019]** Another advantage of the invention is that it improves the nebulization of the liquid with respect to the known types of nebulizers.

**[0020]** The aforementioned purposes and advantages will be highlighted in greater detail in the description of a preferred version provided as a non-limiting example and represented in the drawings where:

- fig. 1 represents a Cartesian diagram of the com-

- pressure/force generated by a known type of metallic helical spring;
- fig. 2 represents the elastic response of an elastic element similar to the element shown in fig. 1, built with an elastomer material;
- fig. 3 represents a partial cross-section of a nebulizer, the subject of this invention, applied to a recipient;
- figs. 4 and 5 represent executive arrangements of an item of the nebulizer shown in fig. 3;
- fig. 6 represents a layout of an element comprising the nebulizer shown in fig. 1;
- fig. 7 represents a cross-section of the element shown in fig. 6;
- fig. 8 represents the nebulizer shown in fig. 3 during an operating phase;
- fig. 9 represents the nebulizer shown in fig. 3 during another operating phase;
- fig. 10 represents the nebulizer shown in fig. 3 during a subsequent operating phase;
- fig. 11 represents an arrangement of the nebulizer shown in fig. 3;
- figs. 12 and 13 represent a cross-section of the operating phases of the nebulizer shown in fig. 11;
- fig. 14 represents an executive arrangement of the nebulizer of the invention.

**[0021]** The nebulizer described in this invention, particularly suitable for perfumes and similar products, is represented in fig. 3 where it is indicated overall with 1 at neck O of a recipient C containing a liquid L to be delivered and includes a hollow body 3 that at the top consists of a liquid compression chamber 4 which communicates with the interior of the recipient C, through a suction duct 5 immersed in the liquid L.

**[0022]** Valves, indicated overall with 6, are installed downstream of the suction duct 5 and are used to open/close it during the various operating phases of the nebulizer 1.

**[0023]** The first sealed piston 7 is coupled in a sliding configuration to the hollow body 3 and is equipped internally with a tubular chamber 8 which, through a passage way 9, communicates with the compression chamber 4 and by means of a choke 10, communicates with a delivery channel 11 for the liquid L with a nozzle 12 to nebulize said liquid L.

**[0024]** A stopper plug 13 is coupled in a sliding configuration to the interior of the tubular chamber 8 and moves in a contrasting manner with the first set of elastic means 14 to open/dose the choke 10.

**[0025]** A second set of elastic means 15 installed between the hollow body 3 and the sealed piston 7 is loaded during the liquid L compression phase and, once delivery has been completed, allows the sealed piston 7 to return to the resting position with an elastic movement.

**[0026]** According to this invention, the first set of elastic means 14 must be built with non-metallic elastic ma-

terials, for instance elastomers, such as thermoplastic rubber.

**[0027]** It is important to note that, thanks to the geometry of the elastic element, different elastic responses can be obtained. In fact, it basically has a cylindrical shape but, based on another executive arrangement, can also be spherical 14a, as shown in figs. 4 and 5.

**[0028]** In particular in the executive arrangement shown in fig. 5, a spherical elastomer element 14a is shown which is placed in contact with the sealed piston 7 by means of a projection 16 for which a sudden elastic yield can be obtained at the critical force. As a consequence, there is an almost step-like elastic response.

**[0029]** In fact, the points of contact between the elastomer 14a and the tubular chamber 8, combined with the geometric shape of the elastomer, help to determine the development of the elastic response curve.

**[0030]** For what concerns the second set of elastic means 15, it consists of a compression spring 17 made with plastic material having, in the preferred version, a truncated conic shape but that, according to additional shapes, can also be, for example, cylindrical.

**[0031]** Finally, it should be noted that the perimeter of the compression spring 17 has a spiral ribbing 18 that guarantees the necessary elastic performances at said spring.

**[0032]** For what concerns the valves 6, they include a valve element installed near the bottom of the compression chamber 4, represented in detail in figs. 6 and 7, designed to close/open the suction duct 5 of the liquid L.

**[0033]** It consists substantially of a main flat body 20 that on the exterior has projecting elastic spokes 21 that are coplanar to it in what is basically a spiral shape.

**[0034]** From an operative viewpoint, the user loads the compression spring 17, as shown in fig. 8, by exerting pressure P on the first sealed piston 7 and pushes the main body 20 against the walls of the compression chamber 4. The main body 20 closes the suction duct 5, allowing the piston 7 to compress the liquid L inside the compression chamber 4.

**[0035]** The pressure, increasing gradually, is discharged through the communication duct 9 on the stopper plug 13 that, in turn, compresses the elastomer 14.

**[0036]** When the pressure of the liquid L inside the compression chamber 4 exerts a force on the stopper plug that is slightly greater than the critical force, the elastomer 14 contracts and the stopper plug 13 slides vertically toward the bottom, opening the choke 10 and thus allowing the pressurised liquid L to reach the nozzle 12, as can be seen in the detail shown in fig. 8.

**[0037]** After the first sealed piston 7 reaches the bottom of the compression chamber 4, as can be seen in fig. 9, it is released by the user, thus terminating the delivery phase.

**[0038]** Once delivery has been completed, as shown in detail in fig. 10, the compression spring 17 returns the sealed piston 7 to its initial position, generating a vacu-

um inside the compression chamber 4.

**[0039]** This vacuum lifts the main body 20 and opens the suction duct 5, allowing the liquid L to flow within the compression chamber 4 and preparing the nebulizer 1 for the next delivery operation.

**[0040]** Tests performed have indicated that the elastic response of the elastomer element 14, as previously mentioned, is very close to the step and thus the choke 10 opens and closes rapidly and allows nebulizer 1 operation to approach the ideal operating condition.

**[0041]** An executive arrangement of the nebulizer that is the subject of the invention indicated with 100 is shown in detail in fig. 11 and differs from the previous one owing to the different construction of the valves 6 designed to open/close the suction duct 5 for the liquid L.

**[0042]** In particular, such valves 6 consist of a second sealed piston 23 that is solidly joined to the first sealed piston 7, coupled in a sliding configuration to a suction chamber 22 built along the extension of the compression chamber 4, installed between the latter and the suction duct 5 for the liquid L.

**[0043]** Figures 12 and 13 demonstrate the similar operating phases of the executive arrangement of the nebulizer of fig. 11.

**[0044]** Another executive arrangement, represented in fig. 14, and indicated overall with 101, shows how the suction duct 5 for the liquid L can be closed during the compression phase by using a diaphragm 24 that adhering to the stem 25 of the second sealed piston 23, guarantees the seal necessary for compression and suction of the liquid L.

**[0045]** Any invention described with reference to the attached figures may be subject to constructive changes that fall within the claims and thus is protected by this patent.

## Claims

1. Nebulizer (1, 100, 101) for liquids equipped with a cap for coupling (2) to the neck (O) of a recipient (C) that contains said liquid (L) to be delivered, including:
  - at least one hollow body (3), that at the top consists of a compression chamber (4) for said liquid (L);
  - at least one suction duct (5) for said liquid at least partially immersed in said liquid (L), communicating with said compression chamber (4);
  - valves (6) installed downstream of said suction duct (5) for the liquid (L) to close/open said suction duct (5);
  - a first sealed piston (7) coupled in a sliding configuration to said hollow body (3), equipped internally with a tubular chamber (8) that communicates through a communication duct (9) with said compression chamber (4) and by means

of a choke (10) with a delivery channel (11) for the liquid (L), and said delivery channel (11) being equipped with a nozzle (12) to nebulize said pressurised liquid (L);

- 5        - a stopper plug (13) sliding inside said tubular chamber (8) that moves in a contrasting manner with a first set of elastic means (14) to close/open said choke (10); **characterized in that:**
- 10      - a second set of elastic means (15) is installed between said cap (2) for coupling to the neck and the pump actuator; and **in that** said first set of elastic means (14) is built with non-metallic materials.

15      2. Nebulizer (1, 100, 101) according to claim 1) **characterised by the fact** that said non-metallic materials are elastomers.

20      3. Nebulizer (1, 100, 101) according to claim 1) **characterised by the fact** that said elastic means (15) consist of a compression spring (17) made with plastic material.

25      4. Nebulizer (1, 100, 101) according to claim 3) **characterised by the fact** that said compression spring (17) has a truncated conic shape.

30      5. Nebulizer (1, 100, 101) according to claim 3) **characterised by the fact** that said compression spring (17) has a cylindrical shape.

35      6. Nebulizer (1, 100, 101) according to claim 3) or 4) or 5) **characterised by the fact** that said compression spring (17) has at least one spiral ribbing (18) along the perimeter.

40      7. Nebulizer (1) according to claim 1) **characterised by the fact** that said valves (6) include a valve element installed in proximity to the bottom of said compression chamber (4) and designed to close said suction duct (5) for the liquid (L).

45      8. Nebulizer (1) according to claim 7) **characterised by the fact** that said valve element includes what is substantially a main flat body (20) equipped with projecting elastic spokes (21) which substantially are coplanar to it.

50      9. Nebulizer (1) according to claim 8) **characterised by the fact** that said elastic spokes (21) have a spiral shape.

55      10. Nebulizer (100, 101) according to claim 1) **characterised by the fact** that said hollow body (3) consists at the bottom of a suction chamber (22) built along the extension of said compression chamber (4), installed between the latter and said suction duct (5) for the liquid (L).

11. Nebulizer (100, 101) according to claim 10) **characterised by the fact** that said valves (6) consist of a second sealed piston (23) coupled in a sliding configuration to said suction chamber (22) and solidly joined to said first sealed piston (7).
12. Nebulizer (101) according to claim 11) **characterised by the fact** that said valves (6) consist of a diaphragm (24) solidly joined to the compression chamber (4) that adheres to the stem (25) of a second sealed piston (23) coupled in a sliding configuration to said suction chamber (22) solidly joined to said first sealed piston (7) when said nebulizer (1) is activated.

#### Patentansprüche

1. Zerstäuber (1, 100, 101) für Flüssigkeiten, versehen mit einer Kappe zum Anschluss (2) an den Hals (O) eines mit der abzugebenden Flüssigkeit (L) gefüllten Behälters (C), Folgendes umfassend:
- wenigstens einen Hohlkörper (3), der an der Oberseite aus einer Druckkammer (4) für die Flüssigkeit (L) besteht;
  - wenigstens eine zumindest teilweise in die Flüssigkeit (L) eingetauchte und mit der Druckkammer (4) kommunizierende Saugleitung (5) für die Flüssigkeit;
  - Ventile (6) stromabwärts der Saugleitung (5) für die Flüssigkeit (L), um die Saugleitung (5) zu schließen/zu öffnen;
  - einen ersten, dichten Kolben (7), gleitend gekuppelt an den Hohlkörper (3), innen versehen mit einer röhrenförmigen Kammer (8), die über eine Verbindungsleitung (9) mit der Druckkammer (4) kommuniziert sowie über eine Drossel (10) mit einem Spenderkanal (11) für die Flüssigkeit (L), wobei dieser Spenderkanal (11) eine Düse (12) aufweist, um die verdichtete Flüssigkeit (L) zu zerstäuben;
  - einen Verschlussstopfen (13), der in der röhrenförmigen Kammer (8) gleitet und sich zum ersten Satz elastischer Mittel (14) entgegengesetzt bewegt, um die Drossel (10) zu öffnen/zuschließen,

**dadurch gekennzeichnet, dass** ein zweiter Satz elastischer Mittel (15) zwischen der Kappe (2) zum Anschluss an den Hals und das Pumpenbetätigungsglied installiert ist, und dadurch, dass der erste Satz elastischer Mittel (14) aus nicht metallischen Materialien gefertigt sind.

2. Zerstäuber (1, 100, 101) nach Patentanspruch 1), **dadurch gekennzeichnet, dass** diese nicht metallischen Materialien Elastomere sind.

3. Zerstäuber (1, 100, 101) nach Patentanspruch 1), **dadurch gekennzeichnet, dass** die elastischen Mittel (15) aus einer Druckfeder (17) aus Kunststoff bestehen.
- 5
4. Zerstäuber (1, 100, 101) nach Patentanspruch 3), **dadurch gekennzeichnet, dass** die Druckfeder (17) kegelstumpfförmig ist.
- 10
5. Zerstäuber (1, 100, 101) nach Patentanspruch 3), **dadurch gekennzeichnet, dass** die Druckfeder (17) zylindrisch geformt ist.
- 15
6. Zerstäuber (1, 100, 101) nach Patentanspruch 3) oder 4) oder 5), **dadurch gekennzeichnet, dass** die Druckfeder (17) außen wenigstens eine Spirallinie (18) aufweist.
- 20
7. Zerstäuber (1) nach Patentanspruch 1), **dadurch gekennzeichnet, dass** die Ventile (6) ein Ventilelement umfassen, das in der Nähe des Bodens der Druckkammer (4) installiert und geeignet ist, die Saugleitung (5) für die Flüssigkeit (L) zu schließen.
- 25
8. Zerstäuber (1) nach Patentanspruch 7), **dadurch gekennzeichnet, dass** das Ventilelement einen im Wesentlichen flachen Hauptkörper (20) umfasst, der mit herausragenden, elastischen Speichen (21) versehen ist, die im Wesentlichen koplanar zu ihm sind.
- 30
9. Zerstäuber (1) nach Patentanspruch 8), **dadurch gekennzeichnet, dass** die elastischen Speichen (21) spiralförmig sind.
- 35
10. Zerstäuber (100, 101) nach Patentanspruch 1), **dadurch gekennzeichnet, dass** der Hohlkörper (3) am Boden aus einer Saugkammer (22) besteht, die an der Verlängerung der Druckkammer (4) entlang angeordnet und zwischen letzterer und der Saugleitung (5) für die Flüssigkeit (L) angeordnet ist.
- 40
11. Zerstäuber (100, 101) nach Patentanspruch 10), **dadurch gekennzeichnet, dass** die Ventile (6) aus einem zweiten, dichten Kolben (23) bestehen, der gleitend zur Saugkammer (22) angebracht und fest mit dem ersten, dichten Kolben (7) verbunden ist.
- 45
12. Zerstäuber (101) nach Patentanspruch 11), **dadurch gekennzeichnet, dass** die Ventile (6) aus einer Membran (24) bestehen, die fest mit der Druckkammer (4) verbunden ist und am Schaft (25) eines zweiten, dichten Kolbens (23) haftet, wenn der Zerstäuber (1) betätigt wird, wobei der Kolben gleitend an der Saugkammer (22) gekuppelt und fest mit dem ersten, dichten Kolben (7) verbunden ist.
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**Revendications**

1. Pulvérisateur (1, 100, 101) pour liquides équipé d'un capuchon pour l'accouplement (2) au goulot (O) d'un récipient (C) qui contient ledit liquide (L) devant être distribué, comprenant:

- au moins un corps creux (3) qui, dans sa partie supérieure, se compose d'une chambre de compression (4) pour ledit liquide (L);
- au moins un tuyau d'aspiration (5) pour ledit liquide au moins partiellement immergé dans ledit liquide (L) communiquant avec ladite chambre de compression (4);
- des soupapes (6) installées en aval dudit tuyau d'aspiration (5) pour le liquide (L) pour l'ouverture/fermeture dudit tuyau d'aspiration (5);
- un premier piston étanche (7) couplé d'une manière coulissante audit corps creux (3), équipé dans la partie intérieure d'une chambre tubulaire (8) qui communique à travers un tuyau de communication (9) avec ladite chambre de compression (4) et au moyen d'un étrangleur (10) avec un canal de refoulement (11) pour le liquide (L), et ledit canal de refoulement (11) étant équipé d'une buse (12) pour pulvériser ledit liquide pressurisé (L);
- un bouchon de fermeture (13) coulissant à l'intérieur de ladite chambre tubulaire (8) qui bouge d'une manière contrastante avec un premier groupe de moyens élastiques (14) pour l'ouverture/fermeture dudit étrangleur (10) ;

**caractérisé en ce que** un deuxième groupe de moyens élastiques (15) est installé entre ledit capuchon (2) pour l'accouplement au goulot et à l'actuateur de pompe et en ce que ledit premier groupe de moyens élastiques (14) est réalisé en matériaux non métalliques.

2. Pulvérisateur (1, 100, 101) selon la revendication 1) **caractérisé en ce que** lesdits matériaux non métalliques sont des élastomères.

3. Pulvérisateur (1, 100, 101) selon la revendication 1) **caractérisé en ce que** lesdits moyens élastiques (15) se composent d'un ressort de compression (17) réalisé en matériel plastique.

4. Pulvérisateur (1, 100, 101) selon la revendication 3) **caractérisé en ce que** ledit ressort de compression (17) a une forme à troc de cône.

5. Pulvérisateur (1, 100, 101) selon la revendication 3) **caractérisé en ce que** ledit ressort de compression (17) a une forme cylindrique.

6. Pulvérisateur (1, 100, 101) selon la revendication

3), 4) ou 5) **caractérisé en ce que** ledit ressort de compression (17) a au moins une nervure en spirale (18) le long du périmètre.

5 7. Pulvérisateur (1) selon la revendication 1) **caractérisé en ce que** lesdites soupapes (6) comprennent un élément de valve installé près du fond de ladite chambre de compression (4) et conçu pour fermer ledit tuyau d'aspiration (5) pour le liquide (L).

10 8. Pulvérisateur (1) selon la revendication 7) **caractérisé en ce que** ledit élément de valve comprend un corps principal essentiellement plan (20) équipé de rayons élastiques saillants (21) qui sont essentiellement coplanaires par rapport à celui-ci.

15 9. Pulvérisateur (1) selon la revendication 8) **caractérisé en ce que** lesdits rayons élastiques (21) sont en forme de spirale.

20 10. Pulvérisateur (100, 101) selon la revendication 1) **caractérisé en ce que** ledit corps creux (3) se compose, dans sa partie inférieure, d'une chambre d'aspiration (22) réalisée le long de l'extension de ladite chambre de compression (4) et installée entre cette dernière et ledit tuyau d'aspiration (5) pour le liquide (L).

25 11. Pulvérisateur (100, 101) selon la revendication 10) **caractérisé en ce que** lesdites soupapes (6) se composent d'un deuxième piston étanche (23) couplé d'une manière coulissante à ladite chambre d'aspiration (22) et fixé solidairement audit premier piston étanche (7).

30 12. Pulvérisateur (101) selon la revendication 11) **caractérisé en ce que** lesdites soupapes (6) se composent d'un diaphragme (24) fixé solidairement à la chambre de compression (4) qui adhère à la tige (25) d'un deuxième piston étanche (23) couplé d'une manière coulissante à ladite chambre d'aspiration (22) et relié solidairement audit premier piston étanche (7) quand ledit pulvérisateur (1) est actionné.

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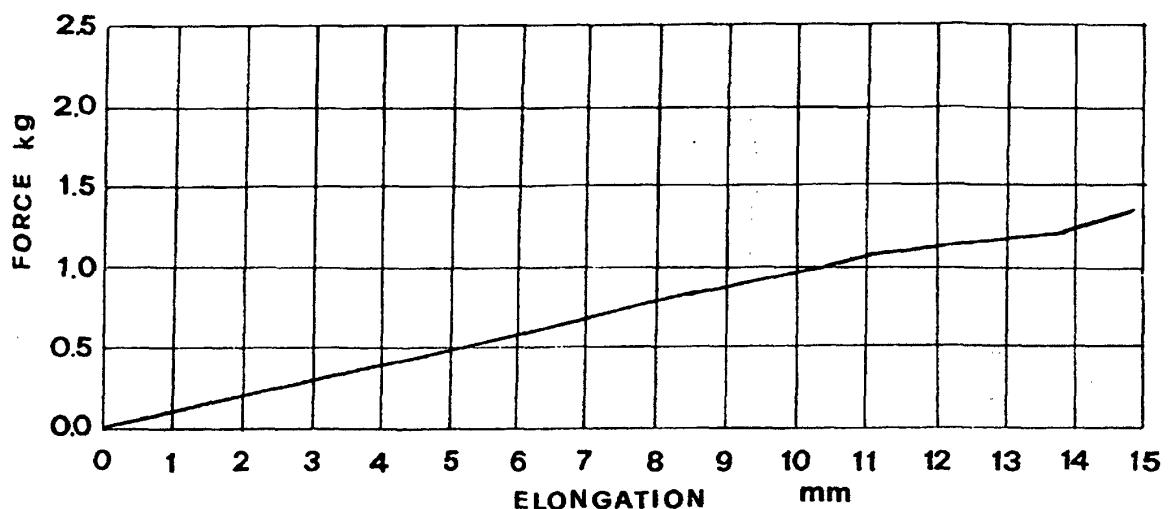


FIG.1

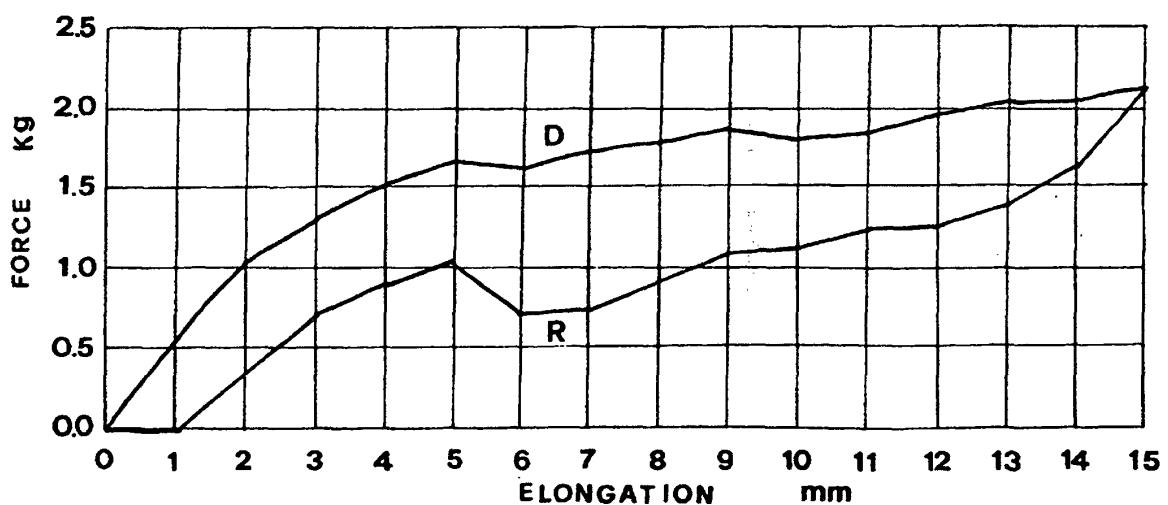


FIG.2

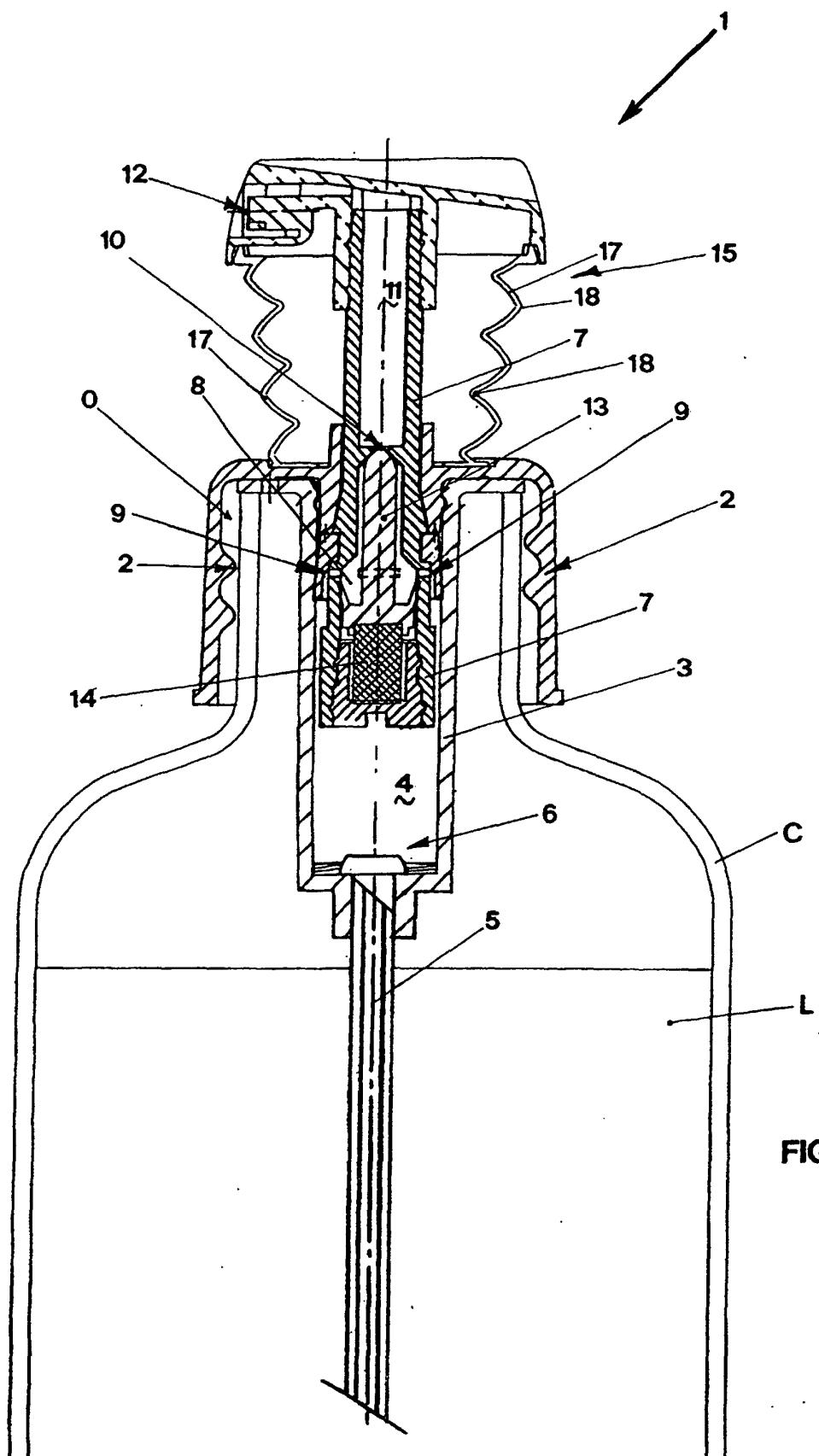


FIG.3

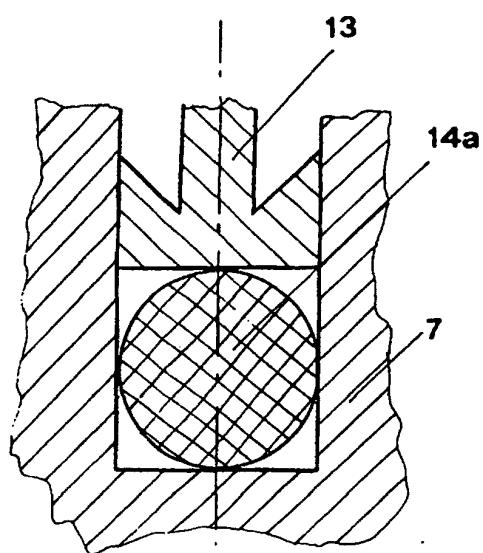


FIG.4

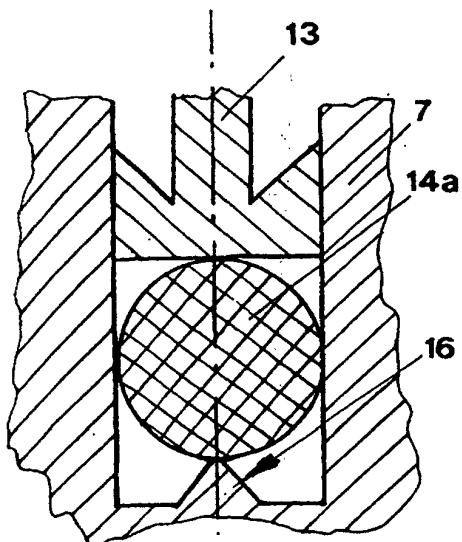


FIG.5

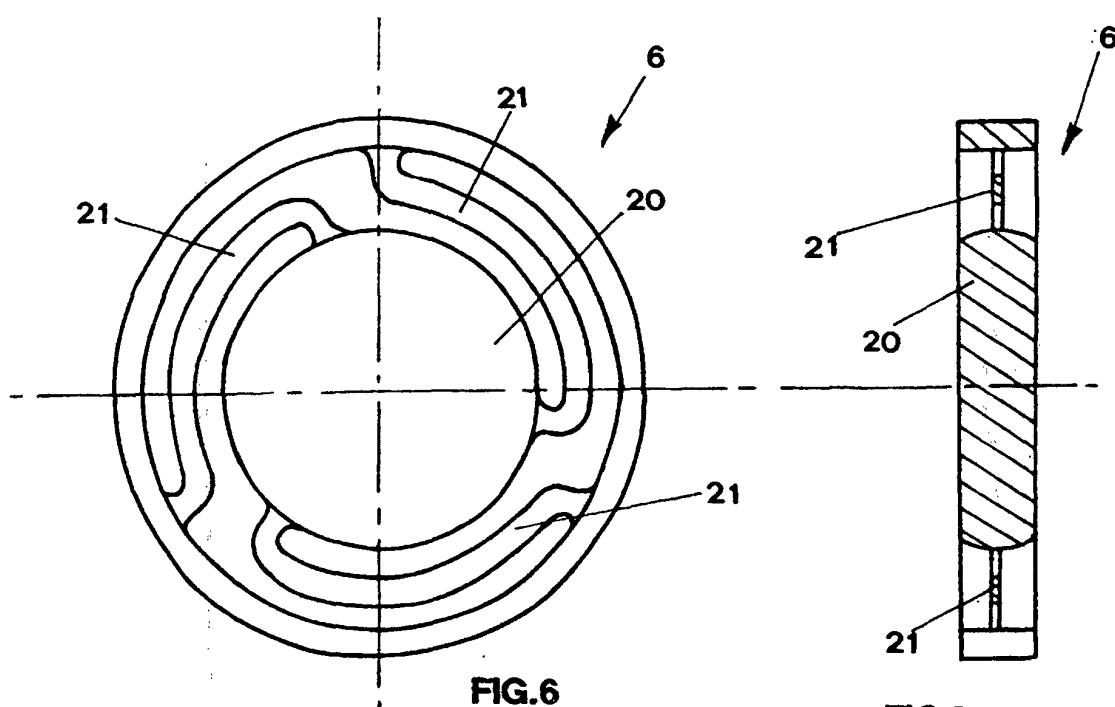


FIG.6

FIG.7

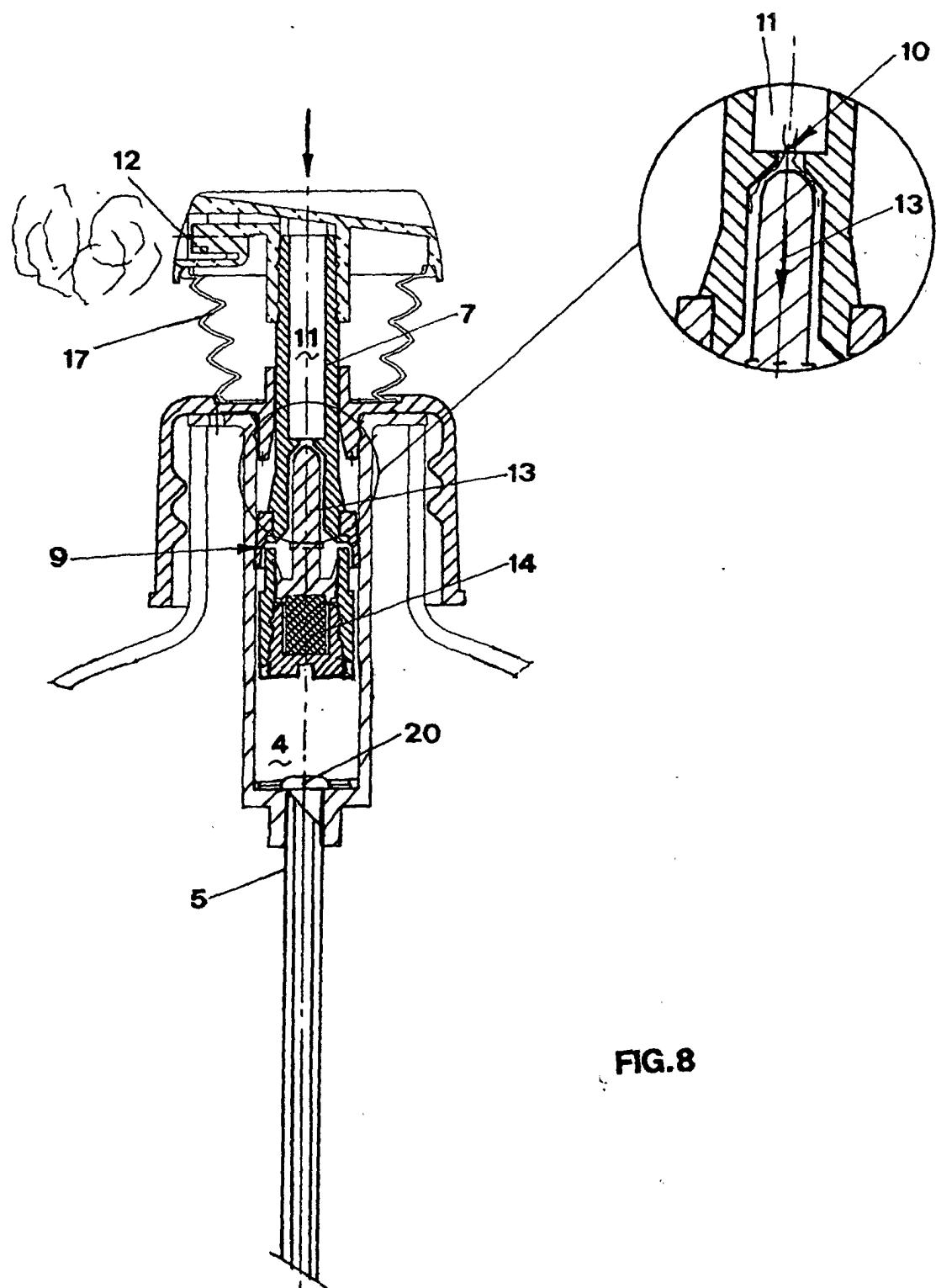
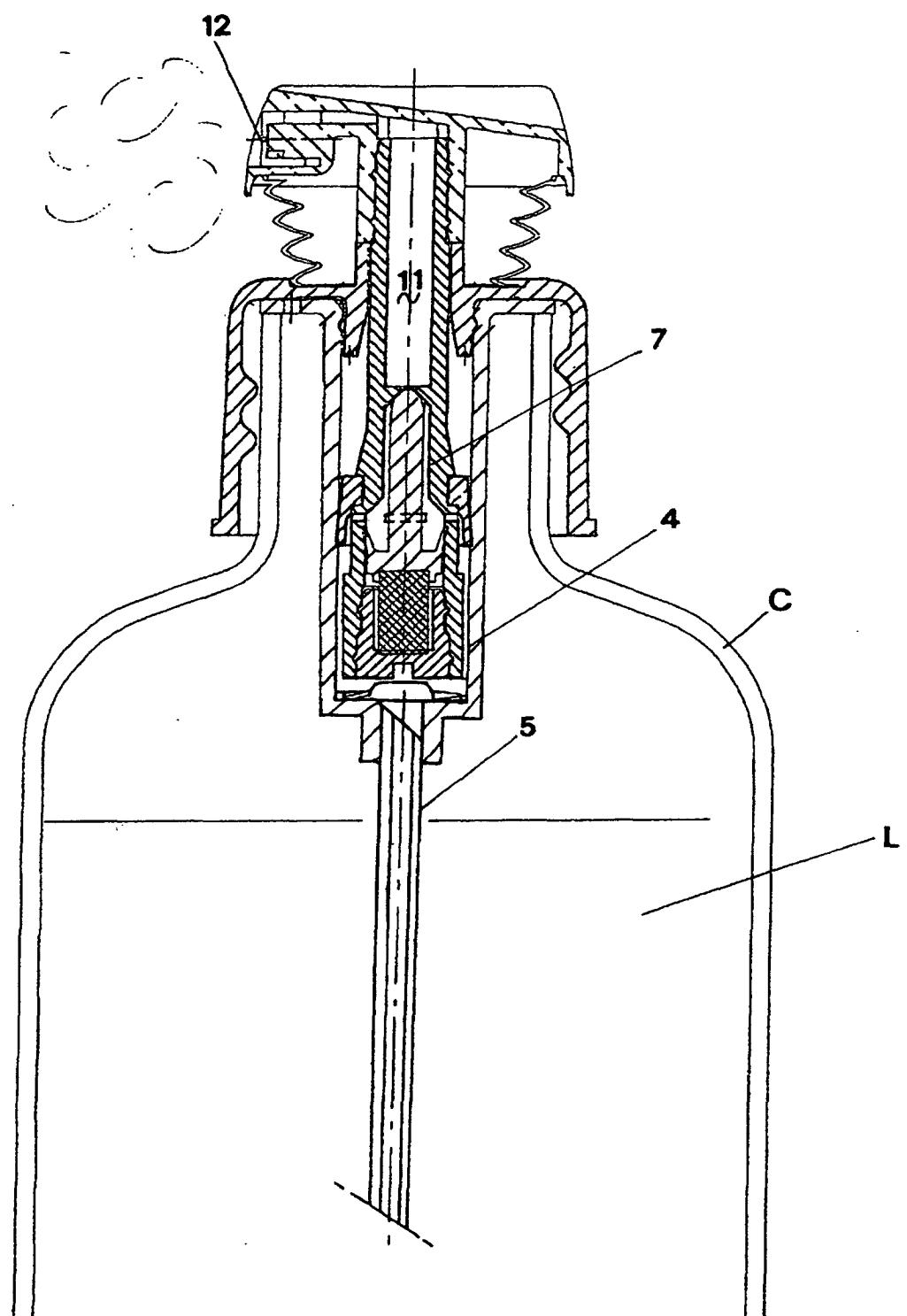


FIG.8



**FIG.9**

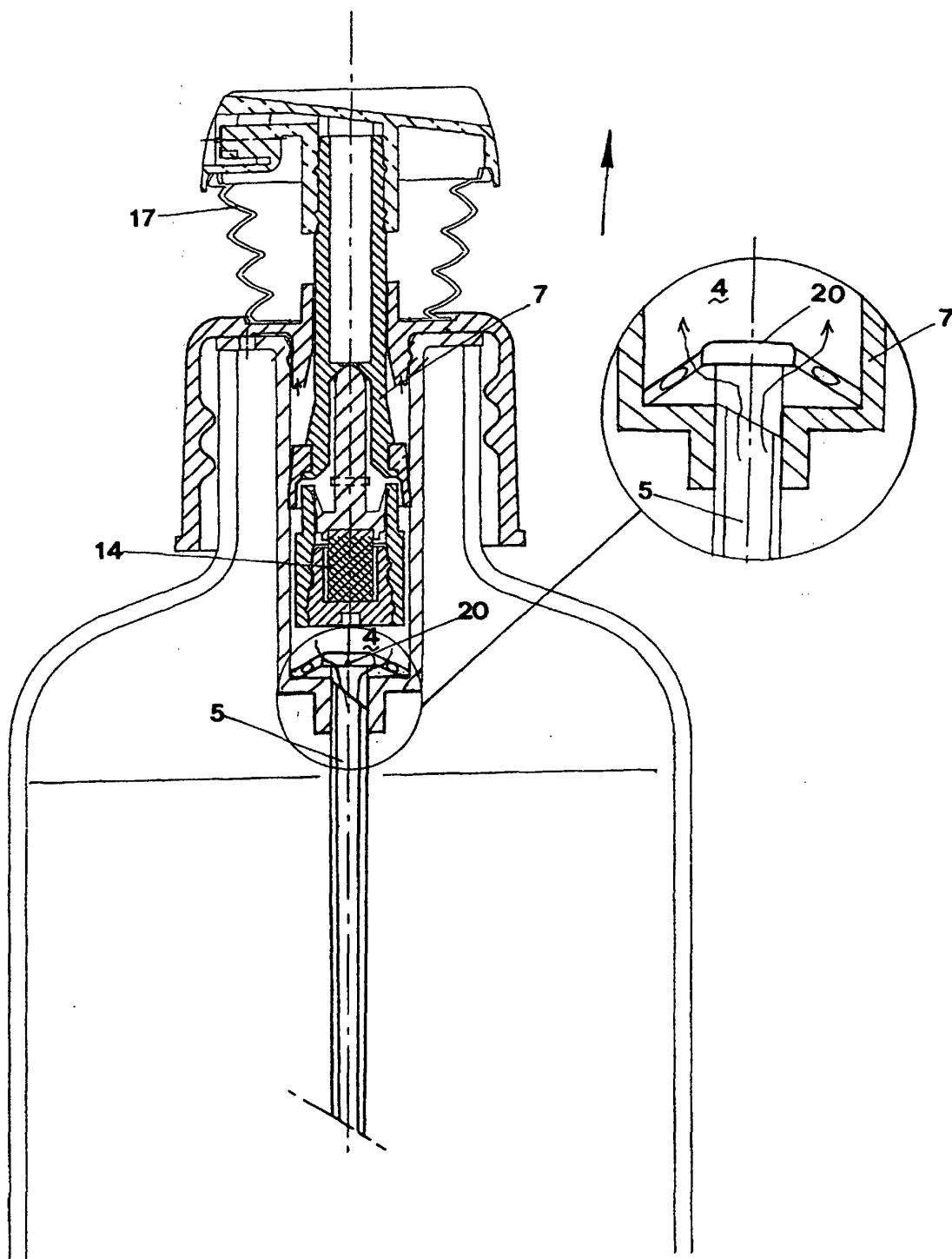


FIG.10

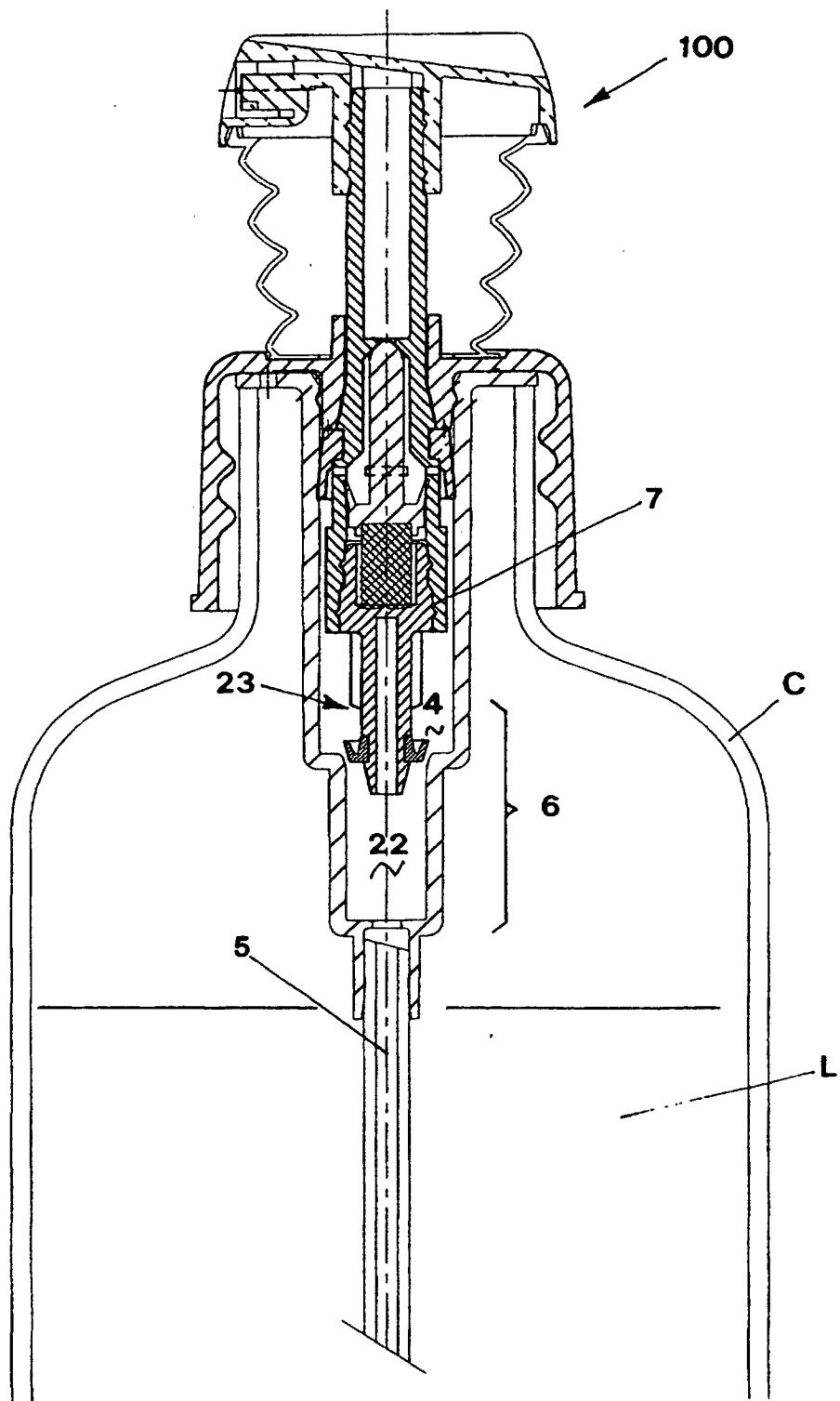
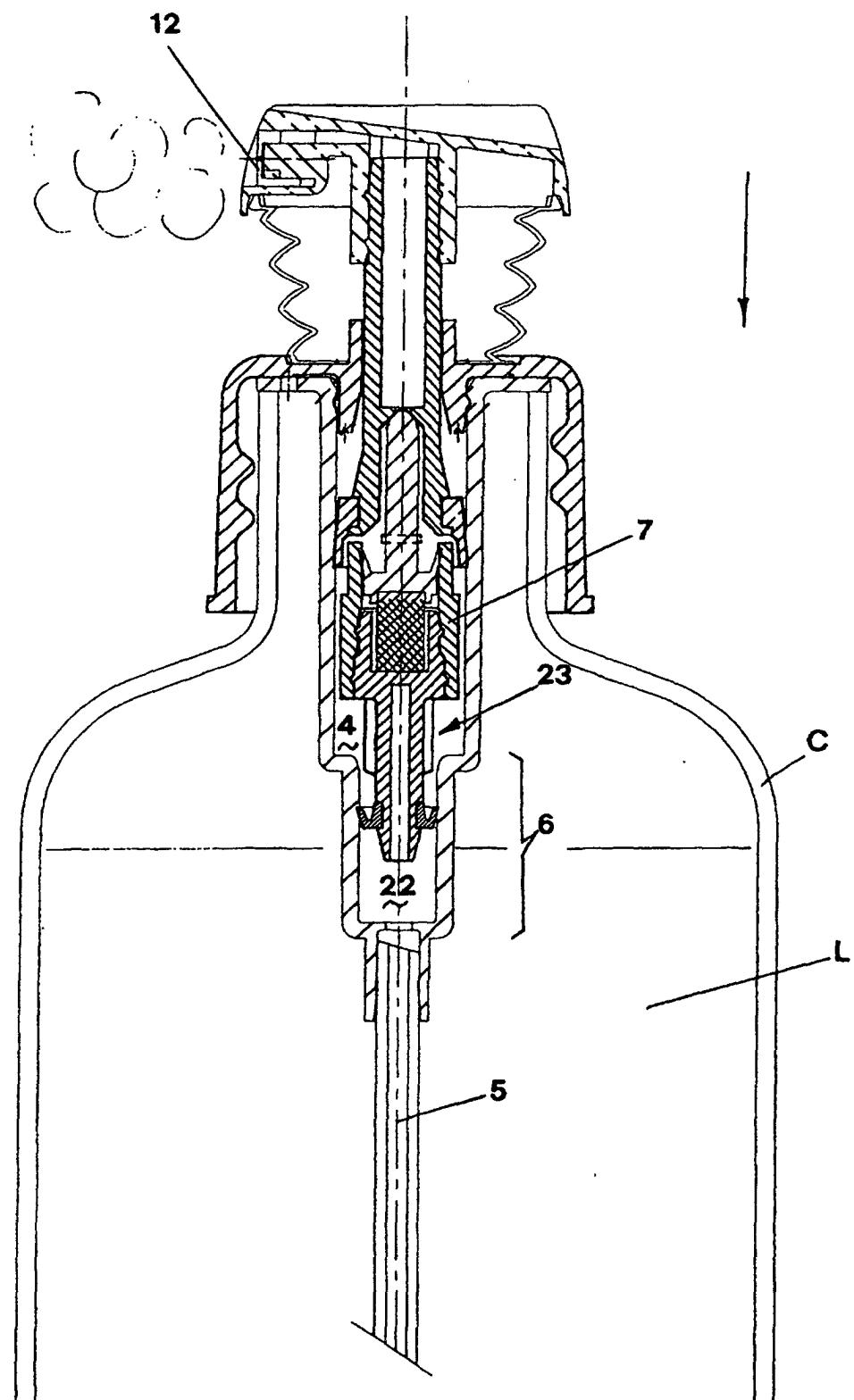


FIG. 11



**FIG.12**

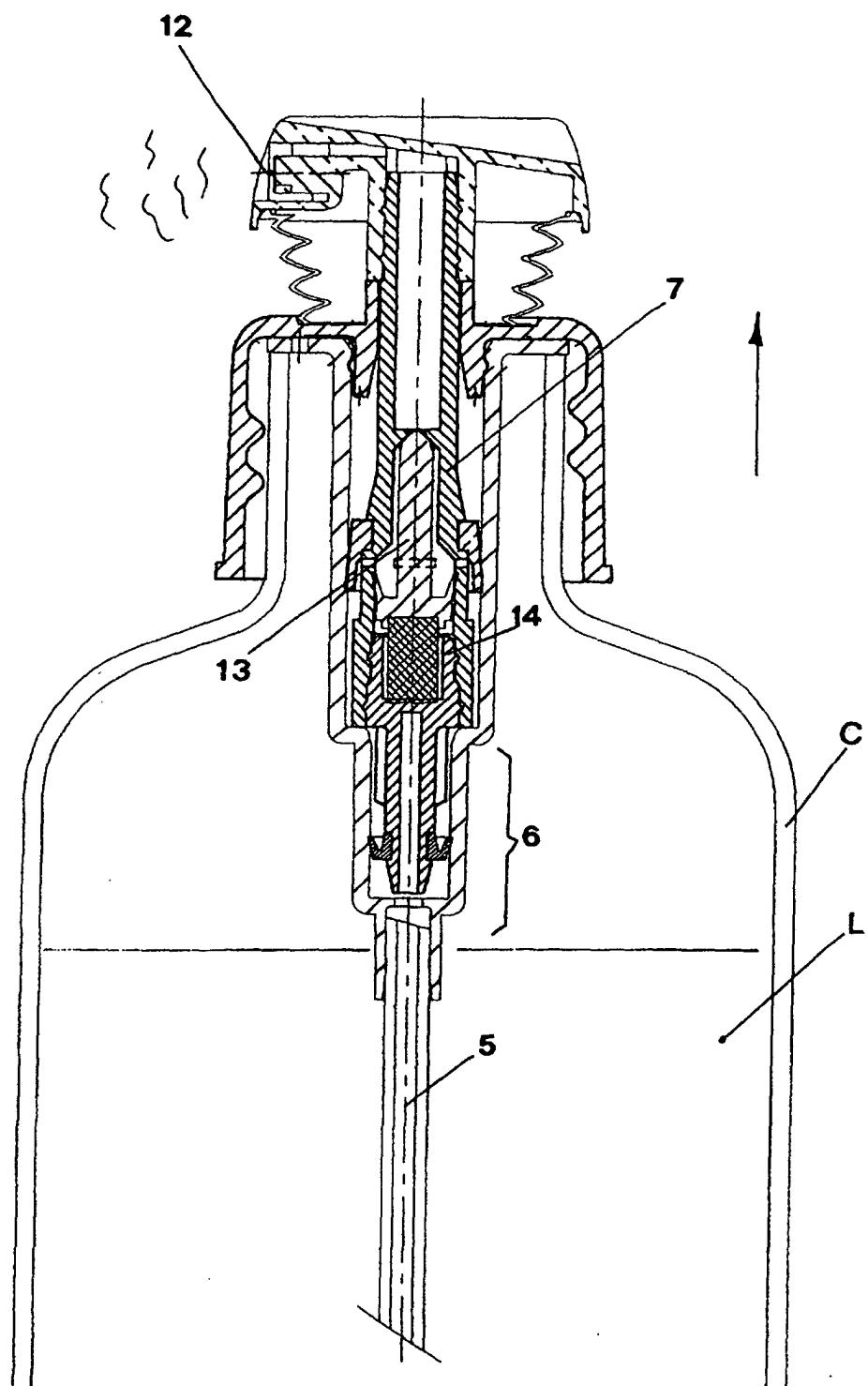


FIG.13

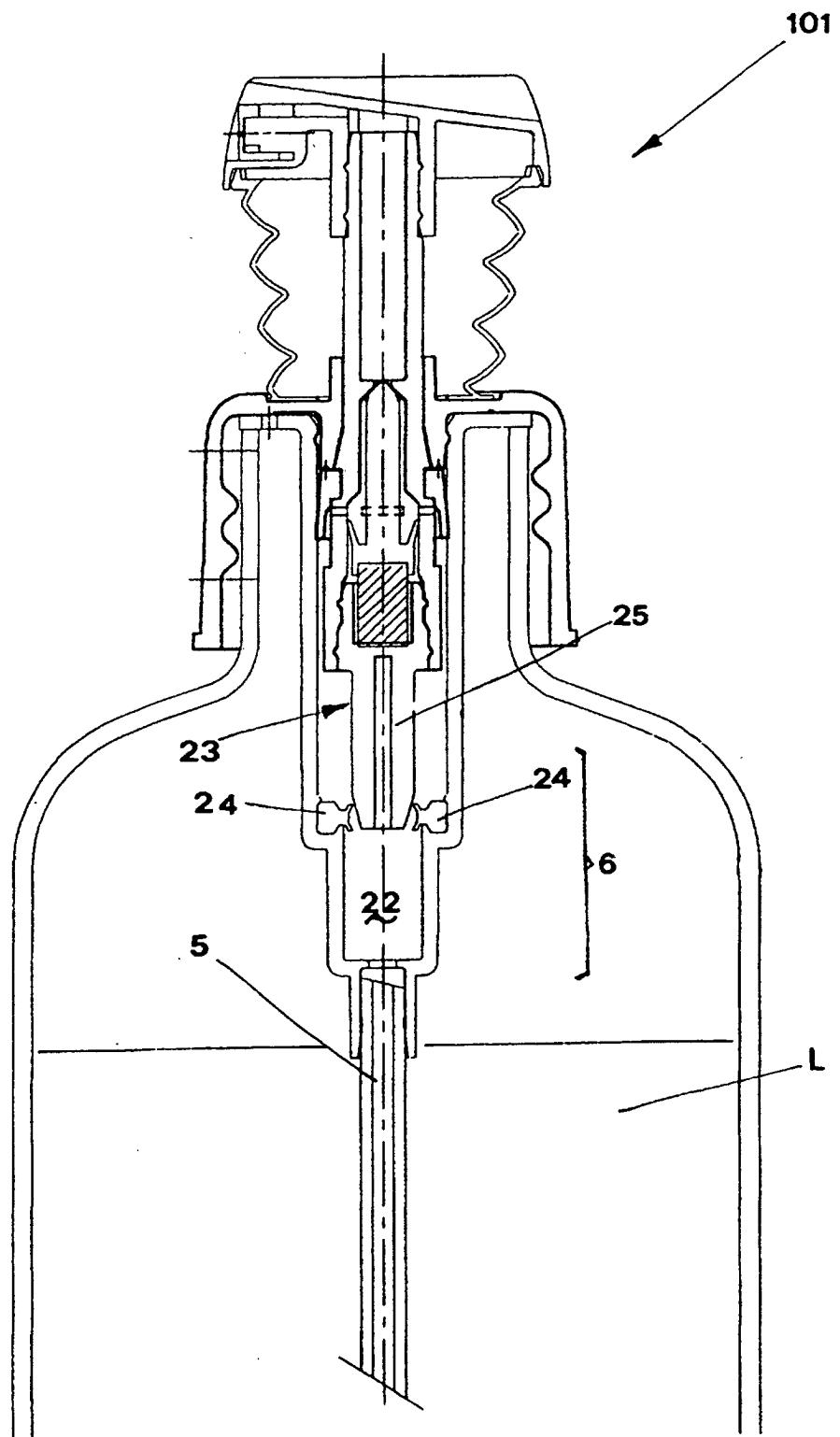


FIG.14