Title: CAP WITH SPRAY PUMP

Abstract: The invention realizes a cap with spray pump (1) of a container (C) holding a liquid to be sprayed under the form of foam and comprising: at least one hollow body (3), enclosing an air-liquid mixing chamber (4); a first piston (8) sliding in said at least one hollow body (3); a second piston (12) sliding in said first piston (8), its inside having at least one tubular chamber (13) that connects with at least one spraying duct (14) for said foam towards the outside and at least one connecting duct (15) to said mixing chamber (4); elastic devices (16) inserted between at least one of said pistons (8, 12) and said at least one hollow body (3); first valve devices (17) fitted downstream to said first air suction duct (5) and said suction duct (7) for said liquid; means of filtering (18) mounted upstream and/or downstream of said tubular chamber to favour the formation of said foam during spraying. Said valve devices (17) comprise a first cut-off system (19) suited to close said suction inlet (6) when said first piston (8) is aligned with said suction inlet (6).
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
CAP WITH SPRAY PUMP
The invention concerns a cap with spray pump for soap or liquid detergent in general, removably coupled to a container, especially suited to spraying liquids under the form of foam.

It is known that to obtain the formation of foam from a liquid detergent, contained in a container, it has to be mixed with air and then filtered through suitable filter elements to favour the formation of foam on spraying.

For this purpose containers are fitted with caps with special hand operated spray pumps, which comprise a hollow body enclosing an air-liquid mixing chamber having a suction duct for the air and a suction duct for the liquid.

In particular the air required to create the foam is sucked up from inside the container through a duct having its suction inlet set above the liquid surface while the suction duct for the liquid consists of a tube immersed in the actual liquid.

A piston slidingly coupled in the hollow body sucks the liquid and the air simultaneously to mix them before making them pass through a filter that transforms them into foam.

The inside of the piston also has a duct connecting with the outside that allows the foam to be sprayed.

Elastic devices, usually consisting of metal coil springs, inserted between the hollow body and the piston, guarantee that the latter springs back into its idle position.

Valve devices normally consisting of metal ball bearings fitted downstream to the suction ducts and the duct connecting with the outside, control both the air and liquid flows that are channelled into the mixing chamber and the spray of foam.

The operation of the spray pumps basically comprise a first stage of spraying the foam and a second stage for preparing the actual foam, which correspond to the compression and suction stages respectively of the piston.

In practise the user, by pressing the piston, simultaneously loads the elastic devices, compresses the fluid contained in the air-liquid mixing chamber and opens the duct connecting with the outside, spraying the foam.

The elastic recoil of the piston generates a depression inside the mixing chamber, which opens the liquid and air suction ducts mixing them and priming the pump for the subsequent spray.
An additional duct opening to the outside restores the pressure inside the container.
The first inconvenience in the type of products described above is that for the spray pump to work well, the liquid to be sprayed must never block the air suction channel, which thereby limits the quantity of liquid that can be contained in the actual container.
To partly overcome this kind of inconvenience known technology produces spray pumps with an air suction duct having a suction inlet set next to the neck of the container, thereby permitting to raise the level of liquid inside the container.
The first inconvenience of this kind of solution is that while filling the container and during transport, the liquid may reach this suction inlet, blocking the air suction channel.
This impairs the proper functioning of the pump which, if operated, does not generate foam but merely sprays liquid.
Another inconvenience fundamentally tied to the small section of the air suction duct arises from the difficulty in freeing the actual duct blocked by liquid.
In effect this condition makes it necessary to make a series of several sprays which do not produce the desired foam.
An additional inconvenience is that the cap cannot be fully recycled, because of the metal ball bearings and coil spring.
Another inconvenience is tied to the configuration of the valve devices and arises from the unintentional spraying of foam or liquid when the container is compressed.
The scope of this invention is to overcome the aforesaid inconveniences.
In particular a first scope of this invention is to produce a cap with spray pump for spraying a liquid under the form of foam that always obtains an optimum spray of foam.
An additional scope is to produce a cap that allows to close the container hermetically preventing accidental sprays of liquid when the container is compressed.
Another scope of the invention is to produce a cap made in every part from recyclable plastic.
An additional scope is to produce a pump having a high performance when
compared to known caps, in terms of quality of foam sprayed.

Last but not least, a scope of the invention is to produce a cap having a simple, inexpensive construction.

Said scopes are achieved by a cap with spray pump provided with means for the removable coupling to the neck of a container holding the liquid to be sprayed under the form of foam that, in accordance with the main claim comprises:

- at least one hollow body enclosing an air-liquid mixing chamber, having at least one first air suction duct with the suction inlet set next to the neck of said container and at least one suction duct for said liquid at least partly immersed in the actual liquid;

- a first piston in said at least one hollow body, sliding from a lower dead centre at the bottom of said chamber to an upper dead centre at said suction inlet, to compress/decompress the fluid held in said mixing chamber;

- a second sliding piston in said first piston, its inside having at least one tubular chamber that connects with at least one spraying duct for said foam and at least one duct connected to said mixing chamber;

- elastic devices inserted between at least one of said pistons and said at least one hollow cylindrical body;

- valve devices fitted downstream to said air and liquid suction ducts;

- means of filtering mounted upstream and/or downstream of said tubular chamber to favour the formation of said foam during the spraying;

which is characterised in that said valve devices comprise cut-off systems suited to close said suction inlet when said first piston is aligned with said suction inlet.

An advantage of the invention is that it provides an optimum spray and the creation of foam right from the first time it is used.

Another advantage of the invention is that it produces a cap with spray pump that can be fully recycled.

Yet another advantage of the invention is that it allows the container to be closed hermetically, thereby preventing liquid from being accidentally sprayed from the actual container, even under form of foam.

Another advantage of the invention is that it allows to fill the container completely guaranteeing the pump sprays foam properly.
The aforesaid scopes and advantages shall be better explained during the description of a preferred form of execution of the invention given as a guideline but not a limitation and illustrated in the attached diagrams, where:

- fig. 1 illustrates a section of the cap with spray pump invention applied to a container;
- fig. 2 shows an enlarged detail of the cap with pump in fig. 1;
- fig.'s 3 and 4 illustrate a view and section respectively of a valve element of the cap invention;
- fig. 5 illustrates a magnified view of a filter element of the cap in fig. 1;
- fig. 6 shows a section of the detail in fig. 5;
- fig.'s 7 and 8 show two different stages in the operation of the cap invention.

The cap with spray pump under this invention is illustrated in fig. 1, where it is generally indicated by 1, and is provided with means for a removable coupling 2 to neck O of a container C containing a liquid L to be sprayed under the form of foam.

It comprises a hollow body 3 enclosing an air-liquid mixing chamber 4 having a first air suction duct 5, shown in detail in fig. 2, with the suction inlet 6 set next to the neck O of the container C and a suction duct 7 for liquid L at least partially immersed in the actual liquid L.

A first piston 8 is slidingly coupled to the hollow body 3 and moves from a lower dead centre 9 at the bottom 10 of the mixing chamber 4 to an upper dead centre 11 aligned with the suction inlet 6.

A second piston 12 is slidingly coupled to the first piston 8, and its inside has a tubular chamber 13 connecting with the outside by a spray duct 14 for the foam and with the mixing chamber 4 through a connecting duct 15.

Elastic devices, generally indicated by 16, inserted between the two pistons 8 and 12 and the hollow body 3 make the movement of pistons 8 and 12 yield flexibly inside the mixing chamber 4.

Valve devices, generally indicated by 17, are fitted downstream to the air suction duct 5 and the liquid suction duct 7, while means of filtering 18a and 18b are mounted upstream and downstream respectively to the tubular chamber 13 and are suited to favouring the formation of foam when it is sprayed.

The invention prescribes that the valve devices 17 comprise first cut-off
system, generally indicated by 19, suited to closing the suction inlet 6 when the first piston 8 is aligned with the actual suction inlet 6.

In particular the first cut-off system 19 consists of a section of the ringed surface of the first piston 8 against the hollow body 3.

With regards to the elastic devices 16, these consist of a bellows spring 20 made of plastic, which preferably has a tapering cylinder shape but may, according to another form of execution, have other shapes such as for instance a cylindrical shape.

The bellows spring 20 also has spiral ribbing 21 around its perimeter that guarantees its elastic properties.

The cap 1 also comprises, as can be seen in fig. 2, a second air suction duct 22 connected with the outside of the container C, suited to maintaining the inside pressure of the container C equal to atmospheric pressure. This second duct 22 has an inlet 23 positioned inside the container C and next to the neck O of the container itself.

The valve devices 17 also comprise second and third cut-off systems 24 and 23a, again best seen in fig. 2, suited to closing the connecting duct 15 and the inlet 23 respectively, when the first piston 8 is aligned with the suction inlet 6.

The valve devices 17 also have a valve element 27 placed next to the bottom 10 of the mixing chamber 4 suited to individually closing/opening the air suction duct 5 and the liquid suction duct 7 respectively, during the compression/suction stage, illustrated in fig.'s 7 and 8.

In particular the second cut-off system 24, as seen in fig. 2, consists of a ringed surface of the first piston 8 against the second piston 12, while the valve element 27, detailed in fig.'s 3 and 4, comprises a basically flat main body 28 with a series of flexible spokes 29 that branch off from its perimeter set against the hollow body 3.

With regards to the means of filtering 18, illustrated in detail in fig.'s 5 and 6, these consist of a perforated lamina 26.

In practise the user, as illustrated in fig. 7, operates the spray pump by exerting a pressure P downward on the second piston 12 loading the bellows spring 20. By doing this, the second piston 12 slides vertically inside the first piston 8 until the connecting duct 15 is opened, allowing a passage for the foam that is found inside the air-liquid mixing chamber 4 within the tubular chamber 13 and opening the suction inlet 6 and the inlet 23.
The movement of the second piston 12 takes with it the first piston 8, compressing the air-liquid mix contained in the chamber 4, which, blocked by the valve devices 27, rises inside the tubular chamber 13 until it reaches the second filter element 18b and finally the spray duct 14 allowing the foam S to be released.

When the second piston 12 reaches the lower dead centre 9, as illustrated in fig. 8, it is released by the user, thereby allowing its elastic recoil obtained by releasing the bellows spring 20.

The second piston 12 is pushed by the bellows spring 20 and slides inside the first piston 8 so it closes the connecting duct 15, until it draws with it the first piston 8.

The depression that is then created inside the air-liquid mixing chamber 4 raises the main body 28 of the valve element 27 thereby opening the suction ducts 7 of liquid L and the first air suction duct 5.

The air and liquid now mixed reach the first filter element 18a mounted downstream to the two suction ducts 5 and 7, generating the foam that is collected inside the air-liquid mixing chamber 4.

Finally, the second piston 12 reaches the upper dead centre 11, as illustrated in fig. 1, closing the suction inlet 6 and the inlet 23, thereby making the container and air-liquid mixing chamber 4 fully airtight and preparing the spray pump for a subsequent spray.

It is important to observe how the air suction duct 22 allows the pressure inside the container C to be restored.

This offers the advantage that any compression on the container prevents liquid L from being released out of container C.

It should also be noted that when the first piston 8 closes the suction inlet 6 this guarantees that the duct supplying air towards the air-liquid mixing chamber 4 is always kept free and therefore ready for subsequent sprays.

However the invention has been described with reference to the attached diagrams, it may undergo changes in construction falling under the claims and therefore protected by this patent.
CLAIMS

1) Cap with spray pump (1) provided with means for the removable coupling (2) to the neck (O) of a container (C) holding a liquid to be sprayed under the form of foam and comprising:

- at least one hollow body (3), enclosing an air-liquid mixing chamber (4), having at least one first air suction duct (5) with the suction inlet (6) set next to the neck (O) of said container (C) and at least one suction duct (7) for said liquid (L) at least partly immersed in the actual liquid (L);

- a first piston (8) sliding in said at least one hollow body (3), from a lower dead centre (9) aligned with the bottom (10) of said mixing chamber (4) to an upper dead centre (11) aligned with said suction inlet (6) to compress/decompress the fluid (F) in said mixing chamber (4);

- a second piston (12) sliding in said first piston (8), its inside having at least one tubular chamber (13) that connects with at least one spraying duct (14) for said foam towards the outside and at least one connecting duct (15) to said mixing chamber (4);

- elastic devices (16) inserted between at least one of said pistons (8, 12) and said at least one hollow body (3);

- first valve devices (17) fitted downstream to said first air suction duct (5) and said suction duct (7) for said liquid;

- means of filtering (18a e 18b) mounted upstream and/or downstream of said tubular chamber to favour the formation of said foam during spraying;

characterised in that said valve devices (17) comprise a first cut-off system (19) suited to close said suction inlet (6) when said first piston (8) is aligned with said suction inlet (6).

2) Cap (1) according to claim 1) characterised in that said first cut-off system (19) consists of the ringed surface (20) of said first piston (8) against said hollow body (3).

3) Cap (1) according to claim 1) characterised in that said elastic devices (16) consist of a bellows spring (20) made in plastic.

4) Cap (1) according to claim 3) characterised in that said bellows spring (20) has a tapering cylinder shape.

5) Cap (1) according to claim 3) characterised in that said bellows spring (20) is cylindrical.

6) Cap (1) according to claim 3) or 4) or 5) characterised in that said
bellows spring (20) has at least one spiral ribbing (21) around its perimeter.

7) Cap (1) according to claim 1) **characterised in that** said valve devices (17) comprise a second cut-off system (24) suited to close said connecting duct (15) to said mixing chamber (4) when said first piston (8) is aligned with said suction inlet.

8) Cap (1) according to claim 7) **characterised in that** said second cut-off system (24) consists of the ringed surface against said second piston (12) of said first piston (8).

9) Cap (1) according to claim 1) **characterised in that** it comprises at least one second air suction duct (22) connecting with the outside of said container (C) and having an inlet (23) inside the container (C) and next to the neck (O) of said container (C).

10) Cap (1) according to claim 9) **characterised in that** said valve devices (17) comprise a third cut-out system (23a) suited to close said delivery duct (23) when said first piston (8) is aligned with said suction inlet (6).

11) Cap (1) according to claim 10) **characterised in that** said third cut-off system (23a) consists of the ringed surface (23b) against said hollow body (3) of said first piston (8).

12) Cap (1) according to claim 1) **characterised in that** said means of filtering (18a, 18b) consists of a perforated lamina (26).

13) Cap (1) according to claim 1) **characterised in that** said valve devices (17) comprise a valve element (27) set next to the bottom (10) of said mixing chamber (4) suited to close individually said air suction duct (5) and said liquid suction duct (7).

14) Cap (1) according to claim 13) **characterised in that** said valve element (27) comprises a basically flat main body (28) with a series of flexible spokes (29) that branch off from its perimeter.
# INTERNATIONAL SEARCH REPORT

**INTERNATIONAL SEARCH REPORT**

### A. CLASSIFICATION OF SUBJECT MATTER

| IPC 7    | 805B11/00  | 805B7/00 |

According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

| IPC 7    | 805B |

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database consulted during the international search (name of database and, where practical, search terms used)

EPO-Internal, PAJ

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 5 443 569 A (UEHIRA SHOJI ET AL) 22 August 1995 (1995-08-22) column 5, line 57-65</td>
<td>1,2,7-14</td>
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<tr>
<td>A</td>
<td>US 5 443 569 A (UEHIRA SHOJI ET AL) 22 August 1995 (1995-08-22) column 6, line 6-14</td>
<td>1,2,7-14</td>
</tr>
<tr>
<td>A</td>
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<td>1,2,7-14</td>
</tr>
<tr>
<td>A</td>
<td>US 5 443 569 A (UEHIRA SHOJI ET AL) 22 August 1995 (1995-08-22) column 7, line 4-15</td>
<td>1,2,7-14</td>
</tr>
<tr>
<td>A</td>
<td>US 5 443 569 A (UEHIRA SHOJI ET AL) 22 August 1995 (1995-08-22) column 7, line 31-48</td>
<td>1,2,7-14</td>
</tr>
<tr>
<td>A</td>
<td>US 5 443 569 A (UEHIRA SHOJI ET AL) 22 August 1995 (1995-08-22) column 8, line 52-55</td>
<td>1,2,7-14</td>
</tr>
<tr>
<td>A</td>
<td>US 5 443 569 A (UEHIRA SHOJI ET AL) 22 August 1995 (1995-08-22) column 9, line 23-27</td>
<td>1,2,7-14</td>
</tr>
<tr>
<td>A</td>
<td>US 5 443 569 A (UEHIRA SHOJI ET AL) 22 August 1995 (1995-08-22) column 10, line 10-15 column 13, line 47-52; figures 1,3,5</td>
<td>1,2,7-14</td>
</tr>
<tr>
<td>A</td>
<td>WO 98 37978 A (SANTAGIULIANA EVANS ; TAPLAST SRL (IT)) 3 September 1998 (1998-09-03) page 2, line 10-21 page 3, line 10-22; figure 1</td>
<td>1-11</td>
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**Further documents are listed in the continuation of box C.**

**Patent family members are listed in annex.**

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**Date of the actual completion of the international search**

6 March 2001

**Date of mailing of the international search report**

21/03/2001

**Name and mailing address of the ISA**

European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 661 epo nl, Fax (+31-70) 340-3016

**Authorized officer**

Busto, M

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<th>Relevant to claim No.</th>
</tr>
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<tr>
<td>A</td>
<td>WO 96 28257 A (SANTAGIULIANA EVANS ; TAPLAST SRL (IT)) 19 September 1996 (1996-09-19) page 3, line 13-27; figures 2,4,6</td>
<td>3-6</td>
</tr>
<tr>
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<td>US 5443569 A</td>
<td>22-08-1995</td>
<td>AU 663434 B</td>
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<td>AU 5644294 A</td>
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<td>CA 2117054 A</td>
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<td>DE 69405124 T</td>
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<td>EP 0613728 A</td>
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<tr>
<td>WO 9837978 A</td>
<td>03-09-1998</td>
<td>IT V1970035 A</td>
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<td>EP 0963256 A</td>
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<tr>
<td></td>
<td></td>
<td>JP 2000516184 T</td>
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<tr>
<td>JP 09187691 A</td>
<td>22-07-1997</td>
<td>NONE</td>
</tr>
<tr>
<td>JP 10099740 A</td>
<td>21-04-1998</td>
<td>NONE</td>
</tr>
<tr>
<td>WO 9628257 A</td>
<td>19-09-1996</td>
<td>IT V1950037 A</td>
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<tr>
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<td>CA 2189997 A</td>
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