SANITARY LIQUID REFILL APPARATUS

A sanitary liquid refill apparatus (10) comprising a refill unit (200) and a reservoir unit (100). The refill unit (200) comprises a nozzle (202) having a nozzle tip in which is formed a nozzle outlet (204) and a valve element 208 disposed within the nozzle (202). The valve element (208) is moveable between a closed position in which discharge of liquid through the nozzle outlet (204) is prevented, and an open position in which discharge of liquid through the nozzle outlet (204) is permitted. The reservoir unit (100) comprises a reservoir (102), a refill port (112) through which a sanitary liquid is delivered to the reservoir (102), and a flow restrictor (114) for restricting flow through the refill port (112). The flow restrictor (114) is arranged centrally with respect to the refill port (112) such that a periphery of the refill port (112) and the flow restrictor (114) define an annular aperture (119) for receiving the nozzle tip. The flow restrictor (114) is further arranged such that, on insertion of the nozzle tip into the refill port (112), the flow restrictor (114) moves the valve element (208) from the closed position to the open position such that the nozzle (202) and the flow restrictor (114) define a flow path through which sanitary liquid is delivered to the reservoir (102).
SANITARY LIQUID REFILL APPARATUS

FIELD OF THE INVENTION

This invention relates to a sanitary liquid refill apparatus and components thereof, and particularly, but not exclusively, relates to a soap refill apparatus and components thereof.

BACKGROUND OF THE INVENTION

Soap dispensers, such as those found in public washrooms, have to be replenished on a regular basis. Typically, a soap dispenser will have a soap reservoir which can be refilled directly by an attendant, or else will have a cartridge, pouch or similar that can be replaced.

A problem associated with soap dispensers having a soap reservoir is that it is possible for an attendant to refill the reservoir with soap that is unsuitable for use with the soap dispenser. In addition, soap reservoirs are often provided with a port through which the reservoir is filled. If left exposed, it is possible for ingress of contaminants through the port.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention there is provided a sanitary liquid refill apparatus comprising: a refill unit comprising a nozzle having a nozzle tip in which is formed a nozzle outlet, and a valve element disposed within the nozzle, the valve element being movable between a closed position in which discharge of liquid through the nozzle outlet is prevented, and an open position in which discharge of liquid through the nozzle outlet is permitted; and a reservoir unit comprising a reservoir, a refill port through which a sanitary liquid is delivered to the reservoir, and a flow restrictor for restricting flow through the refill port, the flow restrictor being arranged
centrally with respect to the refill port such that a periphery of the refill port and the flow restrictor define an annular aperture for receiving the nozzle tip, wherein the flow restrictor is arranged such that, on insertion of the nozzle tip into the refill port, the flow restrictor moves the valve element from the closed position to the open position such that the nozzle and the flow restrictor cooperate to define a flow path through which sanitary liquid is delivered to the reservoir.

A refill apparatus in accordance with the first aspect of the invention has a reservoir unit that is difficult to fill by pouring a liquid, such as liquid soap, through the refill port because flow of liquid through the refill port is inhibited by the flow restrictor. It is therefore difficult for an attendant to inadvertently refill the reservoir unit with an unsuitable type of soap poured from a conventional bottle. A flow path is defined between the nozzle and the flow restrictor when the nozzle tip of the nozzle is inserted into the refill port. The flow path may permit a relatively high flow rate of liquid from the nozzle to the reservoir unit.

The flow restrictor may be arranged to occlude at least 50 percent, preferably at least 75 percent, and more preferably at least 95 percent, of the refill port.

The flow restrictor may have a peripheral edge or a peripheral surface having a profile that corresponds to the nozzle outlet.

The nozzle outlet may be substantially circular. The profile of the peripheral edge or surface of the restrictor may be substantially circular. The diameter of the nozzle outlet may be substantially the same as the diameter of the peripheral edge or the peripheral surface of the flow restrictor.

The restrictor may comprise a head portion and a neck portion below the head portion. The head portion may be tapered towards the neck portion. The peripheral edge or surface may be provided on the head portion. The head portion and the periphery of the refill port may define the annular aperture. The flow restrictor may be arranged such
that the region of the restrictor below the peripheral edge or surface cooperates with the nozzle to define the flow path through which the sanitary liquid is delivered to the reservoir.

5 The shape of the nozzle tip may substantially correspond to the shape of the annular aperture such that insertion of the nozzle tip through the aperture substantially occludes the aperture. The nozzle may be a convergent nozzle.

A seal may be disposed at the refill port, the seal is movable between a sealing condition in which flow of liquid into the reservoir is prevented, and a non-sealing condition in which flow of liquid into the reservoir is permitted. The seal may be arranged such that insertion of the nozzle tip into the annular aperture moves the seal from the sealing condition to the non-sealing condition.

15 The nozzle tip may comprise a rim surrounding the nozzle outlet, the reservoir unit comprises a shoulder disposed below the refill port, wherein the shoulder and the restrictor define a slot for receiving the rim. The slot may have a width defined in a direction which is parallel with the plane of the refill port, the width of the slot being substantially equal to the width of the rim. The width of the rim may be not greater than 5mm, and preferably not greater than 2mm.

The seal may be disposed below the slot such that the rim is pressed against the seal to move the seal from the sealing condition to the non-sealing condition by insertion of the rim into the slot.

20 The slot may be annular, the seal may annular and arranged such that seal is secured to the restrictor.

25 The nozzle unit may comprise a nozzle insert, the valve element being slidably supported by the nozzle insert such that the valve element is displaceable with respect to
the insert between the closed position and the open position. The nozzle unit may comprise a bias which biases the valve element into the closed position.

The valve insert may comprise a venting arrangement which provides fluid communication between atmosphere and a region upstream of the nozzle outlet. The venting arrangement may comprise at least one vent flow passage extending between a vent inlet provided in an outer wall of the nozzle and a vent outlet in a central region of the valve support member. The vent outlet may be provided with a non-return valve arranged to prevent flow into the vent flow passage.

According to a second aspect of the invention there is provided a refill unit comprising a nozzle having a nozzle tip in which is formed a nozzle outlet, a valve element disposed within the nozzle, the valve element being movable between a closed position in which discharge of liquid through the nozzle outlet is prevented, and an open position in which discharge of liquid through the nozzle outlet is permitted, wherein the nozzle comprises a rim surrounding the nozzle outlet which extends forward of the nozzle outlet.

According to a third aspect of the invention there is provided a reservoir unit a reservoir unit comprising a reservoir, a refill port through which a sanitary liquid is delivered to the reservoir, and a flow restrictor for restricting flow through the refill port, the flow restrictor being arranged centrally with respect to the refill port such that a periphery of the refill port and the flow restrictor define an annular aperture for receiving a nozzle tip of a refill unit, wherein the flow restrictor is arranged such that when the nozzle tip is inserted into the annular aperture, the nozzle and the flow restrictor cooperate to define a flow path through which sanitary liquid is delivered to the reservoir.

**BRIEF DESCRIPTION OF THE DRAWINGS**

In order to better understand the present invention, and to show more clearly how the invention may be put into effect, the invention will now be described, by way of example, with reference to the following drawings:
**Figure 1** is a perspective view of a faucet comprising a reservoir unit;

**Figure 2** is a perspective view of a sanitary liquid refill apparatus;

**Figure 3** is a cross-sectional view of a first component of the sanitary liquid refill apparatus shown in **Figure 2**;

**Figure 4** is a cross-sectional view of a second component of the sanitary liquid refill apparatus shown in **Figure 2**;

**Figure 5** is a plan view of the second component shown in **Figure 4**;

**Figure 6** is a partial cross-sectional view of part of the sanitary liquid refill apparatus shown in **Figure 2** in a first condition;

**Figure 7** is a partial cross-sectional view of part of the sanitary liquid refill apparatus shown in **Figure 2** in a second condition;

**Figure 8** is a perspective view of a nozzle of the sanitary liquid refill apparatus shown in **Figure 2**; and

**Figure 9** is a top view of the nozzle shown in **Figure 8** in the axial direction of the nozzle.

**DETAILED DESCRIPTION OF THE INVENTION**

**Figure 1** shows a faucet 2 which is intended to be installed adjacent a washbasin (not shown). The faucet 2 comprises a trunk 4, a limb 6 extending away from the top of the trunk 4 and two branches 8 extending in opposite directions away from the end of the limb 6. A faucet nozzle (not shown) is provided at the end of the limb 6 between the
two branches 8. The nozzle is arranged on the underside of the limb 6 and is configured to deliver both water and soap to a user. Slots (not shown) are provided in each of the branches 8 through which air is blown for drying the hands of a user.

The faucet 2 further comprises a soap reservoir unit 100 disposed on top of the trunk 4. The soap reservoir unit 100 is in fluid communication with the faucet nozzle so that liquid soap can be delivered from the reservoir unit 100 to the nozzle on demand.

The soap reservoir unit 100 is part of a soap refill apparatus 10, which is shown in Figure 2. The soap refill apparatus 10 comprises the soap reservoir unit 100 and a refill unit 200.

The refill unit 200 will be explained with reference to Figures 2, 3, 8 and 9. The refill unit 200 comprises a nozzle 202 secured to a refill bottle 203. The nozzle 202 has a nozzle outlet 204, a nozzle insert 206 and a valve element 208 disposed within the nozzle 202. In the embodiment shown the nozzle outlet 204 is circular.

The nozzle 202 comprises a cylindrical portion 210 and a conical portion 212 in which the outlet 204 is provided. The cylindrical portion 210 and the conical portion 212 define a nozzle axis 214. The cylindrical portion 210 has a cylindrical inner surface and the conical portion 212 has a conical inner surface. The conical portion 212 is convergent in the direction of the outlet 204.

The nozzle insert 206 comprises an annular wall 216 which defines an annular cavity between the annular wall 216 and an inner surface of the nozzle 202. The nozzle insert 206 is located substantially within the cylindrical portion 210 such that a lower edge 218 of the annular wall 216 seals against the inner surface of the conical portion 212 of the nozzle 202. An upper edge 220 of the annular wall 216 is spaced away from an inner surface of the nozzle 202 thereby defining a slot between the annular wall 216 and an inner surface of the nozzle 202 for receiving the neck of the refill bottle 203. Four circumferentially spaced apertures 222 are provided in the annular wall 216. Hollow
struts 224 extend respectively between each of the apertures 222 and a central spigot 226. The central spigot 226 has a lower portion 228 which extends in the direction of the nozzle outlet 204, and a hollow upper portion 230 which extends into the refill bottle 203. The lower end of the hollow upper portion 230 is provided with four apertures 231 through which the hollow upper portion 230 is in fluid communication with each of the hollow struts 224. A non-return valve 232 in the form of a duckbill valve is fitted to the upper end of the hollow upper portion 230. The non-return valve 232 is arranged to prevent flow of liquid soap from the refill bottle 203 into the hollow upper portion 230.

The valve element 208 is in the form of a piston which is slidably supported by the lower portion 228 of the central spigot 226. The valve element 208 has a plug 234 at one end and an axially extending bore 236 provided in the other end. The bore 236 receives the lower portion 228 of the spigot 226. The valve element 208 is slidably supported by the lower portion 228 such that the valve element 208 can slide between a closed position in which the plug 234 seals against the inner surface of the nozzle 202 adjacent the nozzle outlet 204 such that flow of liquid soap through the nozzle outlet 204 is prevented, and an open position in which liquid soap can flow around the plug 234 and through the nozzle outlet 204. The inner surface of the nozzle 202 surrounding the nozzle outlet 204 therefore forms a valve seat. A biasing member in the form of a spring 238 is disposed between the plug 234 and a collar 240 formed on the central spigot 226. The spring 238 is arranged to urge the valve element 208 into the closed position by acting on the plug 234.

The nozzle 202 further comprises a rim 242 which surrounds the nozzle outlet 204. The rim 242 is in the form of an annular wall having a substantially uniform thickness. The thickness of the rim 242 is between 0.5mm and 5mm, preferably between 0.5mm and 2mm. The rim 242 extends in a direction which is parallel to the nozzle axis 214. The rim 242 extends forwards of the nozzle outlet 204. For example, the rim 242 may extend forward of the nozzle outlet 204 by a distance of between 1mm and 20mm, preferably between 5mm and 10mm. The profile of the rim 242 corresponds to the
profile of the nozzle outlet 204. In the embodiment shown, the rim 242 is circular and has an inner diameter which is the same as the diameter of the nozzle outlet 204.

An abutment surface 244, in the form of a ridge, is formed adjacent the base of the rim 242. The abutment surface 244 extends radially outwardly from the rim 242.

The cylindrical portion 210 of the nozzle 202 has retaining features 246 (shown clearly in Figure 8) which engage with corresponding retaining features 248 on the neck of the refill bottle.

The soap reservoir unit 100 will be explained with reference to Figures 1, 2, 4 and 5. The reservoir unit 100 comprises a soap reservoir 102 in the form of a cylindrical chamber. The side wall 104 of the soap reservoir 102 is made of a transparent or translucent material such as glass or a suitably transparent/translucent plastic. A base 106 of the reservoir 102 is configured to be secured to the faucet 2. An outlet port (not shown) is provided in the base 106 through which soap is discharged from the reservoir 102 during use of the faucet 2. The top of the reservoir 102 is enclosed by a cap 108 (shown in Figure 2) which, in turn, is covered by a removable glamour cap 110 (shown in Figure 1). The glamour cap 110 can be removed in order to gain access to the cap 108. In the embodiment shown, the cap 108 and the reservoir 102 are welded together. However, it will be appreciated that the cap 108 could be secured by alternative means, such as adhesive, or else the cap 108 could be formed integrally with the reservoir 102.

With reference to Figures 4 and 5, the cap 108 comprises a nozzle receiving portion 109 provided with a refill port 112 through which liquid soap is delivered to the reservoir 102. The refill port 112 is circular. A flow restrictor 114 is disposed centrally with respect to the refill port 112. The flow restrictor 114 comprises a restrictor head 116 and a restrictor neck 118. The restrictor head 116 is substantially conical, and tapers downwardly in the direction of the restrictor neck 118. The diameter of the flow restrictor 114 at the top of the restrictor head 116 is larger than the diameter of the flow restrictor 114 at the restrictor neck 118. The top surface of the restrictor head 116
extends in the same plane as the refill port 112. The upper peripheral edge of the restrictor head 116 and the peripheral edge of the refill port 112 define an annular aperture 119 (shown in Figure 5) which extends in the plane of the refill port 112. The maximum diameter of the restrictor head 116, which in the embodiment shown is at the top of the restrictor head 116, corresponds to the diameter of the nozzle outlet 204.

The nozzle receiving portion 109 has an annular shoulder 120 which is located below the refill port 112. The shoulder 120 projects radially inwardly towards the flow restrictor 114, and is substantially level with the region of the flow restrictor 114 at which the restrictor head 116 and the restrictor neck 118 meet. In the embodiment shown, the shoulder 120 has an internal diameter which corresponds to the external diameter of the rim 242 of the nozzle 202. When viewed from the top of the reservoir unit 100 (i.e. when viewed in a direction which is perpendicular to the plane in which the refill port 112 extends), the restrictor head 116 and the shoulder 120 define an annular slot 122 (shown clearly in Figure 5) which corresponds to the shape of the rim 242. The width of the annular slot 122 is defined in a direction which is parallel with the plane of the refill port 112. The width of the annular slot 122 corresponds to the thickness of the rim 242. For example, the width of the annular slot 122 may be substantially the same as the thickness of the rim 242. The upper peripheral edge of the restrictor head 116 and the shoulder 120 are spaced apart in the vertical direction thereby defining a flow path between the restrictor head 116 and the shoulder 120. The distance between the respective peripheral edges of the restrictor head 116 and the shoulder 120 is less than the distance by which the rim 242 extends forwards of the nozzle outlet 204 (i.e. the height of the rim 242).

The edge of the refill port 112 may be shaped to receive the conical portion 212 of the nozzle 202. For example, the edge of the refill port 112 may be inclined (i.e. the edge may be bevelled) at an angle which corresponds to the angle of the outer surface of the conical portion 212 of the nozzle 202.
An annular seal 124 is secured to the restrictor neck 118 at its inner peripheral edge 126. The inner peripheral edge of the annular seal 124 is secured within a circumferential groove provided in the restrictor 114. The annular seal 124 extends radially outwardly from below the restrictor head 116 underneath the shoulder 120. An upper surface of the annular seal 124 adjacent the outer circumferential edge 128 abuts a lower surface of the shoulder 120, thereby sealing the reservoir 102.

The nozzle receiving portion 109 comprises a support portion 130 which extends beneath the refill port 112. The flow restrictor 114 is secured to the support portion 130 by a screw 132.

Refilling of the soap reservoir unit 100 will be described with reference to Figures 6 and 7.

Firstly, the refill unit 200 is brought into partial engagement with the reservoir unit 100 by aligning the nozzle outlet 204 with the restrictor head 116, and inserting the nozzle 202 into the refill port 112 over the flow restrictor 114 until the valve element 208 abuts the restrictor head 116, as shown in Figure 6. It will be appreciated that Figure 6 shows the valve element 208 in the closed position and so the valve element 208 prevents flow of soap through the nozzle outlet 204 while the refill bottle 203 is inverted.

The inner surface of the rim 242 abuts the restrictor head 116 and the outer surface of the rim 242 abuts the shoulder 120. In this configuration, the rim 242 extends between the peripheral edges of the restrictor head 116 and the shoulder 120. It will be appreciated that the shape and thickness of the rim 242 exactly matches the shape and width of the annular slot 122 so that the restrictor head 116, rim 242 and shoulder 120 prevent liquid from entering the soap reservoir 102 through the refill port 112.

The refill unit 200 is then pressed downwardly so that the outer surface of the conical portion 212 of the nozzle 202 is brought into abutting engagement with the edge of the
refill port 112, as shown in Figure 7. At the same time, the rim 242 slides downwardly past the peripheral edge of the shoulder 120 and presses the outer portion of the annular seal 124 away from the lower surface of the shoulder 120. The downward motion of the nozzle 202 over the flow restrictor 114 causes the valve element 208 to be pressed by the flow restrictor 114 upwardly against the spring 238 into the open position. The plug 234 is therefore spaced away from the nozzle outlet 204. The abutment surface 244 is brought into abutting engagement with the shoulder 120. The shoulder 120 prevents the nozzle 202 from being inserted further into the refill port 112.

In the configuration shown in Figure 7, the inner surface of the nozzle 202 and a lower surface of the restrictor head 116 together define a flow passage that extends in a radially inward and downward direction. The inner surface of the rim 242 and the lower part of the restrictor head 116 and the restrictor neck 118 define a continuation of the flow passage which extends in an axial direction. Liquid soap within the refill bottle 203 flows downwardly through the nozzle 202 between the hollow struts 224, around the plug 234 and the restrictor head 116, and towards the nozzle outlet 204. The liquid soap then flows through the nozzle outlet 204 and between the inner surface of the rim 242 and the restrictor neck 118.

The pressure of the soap, either as a consequence of gravity acting on the soap or, where the refill bottle 203 is made of a resilient material, a user squeezing the refill bottle 203, forces the soap against the annular seal 124 which causes the annular seal to deflect downwardly further. The liquid soap then flows past the annular seal 124 and into the soap reservoir 102.

As soap is discharged from the refill bottle 203, it evacuates the region of the refill bottle 203 above the soap. The reduction in pressure within the refill bottle 203 causes air to be drawn into the nozzle 202 around the top edge of the nozzle 202 into the cavity between the annular wall 216 of the nozzle insert 206 and the inner surface of the cylindrical portion 210 of the nozzle 202. The air is then drawn through each of the apertures 222, along the respective hollow struts 224, hollow upper portion 230 of the
central spigot 226 and through the non-return valve 232 into the refill bottle 203. The air bubbles up through the liquid soap within the refill bottle 203 into the upper region of the refill bottle 203, thereby equalising the pressure within the refill bottle 203 with ambient pressure. The non-return valve 232 prevents flow of soap from the refill bottle 203 into the hollow upper portion 230. The venting arrangement prevents the reduction in pressure above the soap (caused by evacuation of the soap) from inhibiting flow through the nozzle 203.

Disengagement of the nozzle unit 200 from the soap reservoir unit 100 causes the valve element 208 to be return to the closed position by the spring 238 acting on the plug 234, thereby preventing further flow through the nozzle outlet 204.

The soap refill apparatus 10 enables a soap reservoir 102 having a flow restrictor that restricts soap delivery to the soap reservoir 102 to prevent contamination and refilling with unsuitable soap to be quickly and easily replenished without having to remove the reservoir from a fixture and without risk of spillage. The soap refill apparatus is of particular benefit when a large number of soap reservoirs 102 have to be replenished on a regular basis.
CLAIMS

1. A sanitary liquid refill apparatus comprising:
   a refill unit comprising a nozzle having a nozzle tip in which is formed a nozzle outlet, and a valve element disposed within the nozzle, the valve element being movable between a closed position in which discharge of liquid through the nozzle outlet is prevented, and an open position in which discharge of liquid through the nozzle outlet is permitted; and
   a reservoir unit comprising a reservoir, a refill port through which a sanitary liquid is delivered to the reservoir, and a flow restrictor for restricting flow through the refill port, the flow restrictor being arranged centrally with respect to the refill port such that a periphery of the refill port and the flow restrictor define an annular aperture for receiving the nozzle tip, wherein the flow restrictor is arranged such that, on insertion of the nozzle tip into the refill port, the flow restrictor moves the valve element from the closed position to the open position such that the nozzle and the flow restrictor cooperate to define a flow path through which sanitary liquid is delivered to the reservoir.

2. A sanitary liquid refill apparatus as claimed in claim 1, wherein the flow restrictor is arranged to occlude at least 50 percent, preferably at least 75 percent, and more preferably at least 95 percent, of the refill port.

3. A sanitary liquid refill apparatus as claimed in claim 1 or 2, wherein the flow restrictor has a peripheral edge or a peripheral surface having a profile that corresponds to the nozzle outlet.

4. A sanitary liquid refill apparatus as claimed in claim 3, wherein the nozzle outlet is substantially circular and the profile of the peripheral edge or surface of the restrictor is substantially circular, the diameter of the nozzle outlet being substantially the same as the diameter of the peripheral edge or surface of the flow restrictor.
5. A sanitary liquid refill apparatus as claimed in any one of the preceding claims, wherein the restrictor comprises a head portion and a neck portion below the head portion.

6. A sanitary liquid refill apparatus as claimed in claim 5, the head portion is tapered towards the neck portion.

7. A sanitary liquid refill apparatus as claimed in claim 5 or 6, when appendant to claims 3 or 4, wherein the peripheral edge or surface is provided on the head portion.

8. A sanitary liquid refill apparatus as claimed in claim 7, wherein flow restrictor is arranged such that the region of the restrictor below the peripheral edge or surface cooperates with the nozzle to define the flow path through which the sanitary liquid is delivered to the reservoir.

9. A sanitary liquid refill apparatus as claimed in any one of the preceding claims, wherein the shape of the nozzle tip substantially corresponds to the shape of the annular aperture such that insertion of the nozzle tip through the aperture substantially occludes the aperture.

10. A sanitary liquid refill apparatus as claimed in any one of the preceding claims, wherein the nozzle is a convergent nozzle.

11. A sanitary liquid refill apparatus as claimed in any one of the preceding claims, wherein a seal is disposed at the refill port, the seal is movable between a sealing condition in which flow of liquid into the reservoir is prevented, and a non-sealing condition in which flow of liquid into the reservoir is permitted.
12. A sanitary liquid refill apparatus as claimed in claim 11, wherein the seal is
arranged such that insertion of the nozzle tip into the annular aperture moves the
seal from the sealing condition to the non-sealing condition.

13. A sanitary liquid refill apparatus as claimed in claim 12, wherein the nozzle tip
comprises a rim surrounding the nozzle outlet, the reservoir unit comprises a
shoulder disposed below the refill port, wherein the shoulder and the restrictor
define a slot for receiving the rim.

14. A sanitary liquid refill apparatus as claimed in claim 13, wherein the slot has a
width defined in a direction which is parallel with the plane of the refill port, the
width of the slot being substantially equal to the width of the rim.

15. A sanitary liquid refill apparatus as claimed in claim 14, wherein the width of
the rim is not greater than 5mm, and preferably not greater than 2mm.

16. A sanitary liquid refill apparatus as claimed in any one of claims 13 to 15,
wherein the seal is disposed below the slot such that the rim is pressed against
the seal to move the seal from the sealing condition to the non-sealing condition
by insertion of the rim into the slot.

17. A sanitary liquid refill apparatus as claimed in any one of claims 13 to 16,
wherein the slot is annular, the seal is annular and arranged such that seal is
secured to the restrictor.

18. A refill system as claimed in any one of the preceding claims, wherein the
nozzle unit comprises a nozzle insert, the valve element being slidably supported
by the nozzle insert such that the valve element is displaceable with respect to
the insert between the closed position and the open position.
19. A refill system as claimed in claim 18, wherein the nozzle unit comprises a bias which biases the valve element into the closed position.

20. A refill system as claimed in claim 18 or 19, wherein the valve insert comprises a venting arrangement which provides fluid communication between atmosphere and a region upstream of the nozzle outlet.

21. A refill system as claimed in claim 20, wherein the venting arrangement comprises at least one vent flow passage extending between a vent inlet provided in an outer wall of the nozzle and a vent outlet in a central region of the valve support member.

22. A refill system as claimed in claim 21, wherein the vent outlet is provided with a non-return valve arranged to prevent flow into the vent flow passage.

23. A refill unit comprising a nozzle having a nozzle tip in which is formed a nozzle outlet, a valve element disposed within the nozzle, the valve element being movable between a closed position in which discharge of liquid through the nozzle outlet is prevented, and an open position in which discharge of liquid through the nozzle outlet is permitted, wherein the nozzle comprises a rim surrounding the nozzle outlet which extends forward of the nozzle outlet.

24. A reservoir unit a reservoir unit comprising a reservoir, a refill port through which a sanitary liquid is delivered to the reservoir, and a flow restrictor for restricting flow through the refill port, the flow restrictor being arranged centrally with respect to the refill port such that a periphery of the refill port and the flow restrictor define an annular aperture for receiving a nozzle tip of a refill unit, wherein the flow restrictor is arranged such that when the nozzle tip is inserted into the annular aperture, the nozzle and the flow restrictor cooperate to define a flow path through which sanitary liquid is delivered to the reservoir.
25. A sanitary liquid refill apparatus substantially as described herein with reference to, and as shown in, the accompanying drawings.

26. A refill unit substantially as described herein with reference to, and as shown in, Figures 2, 3 and 6 to 9.

27. A reservoir unit substantially as described herein with reference to, and as shown in, Figures 1, 2 and 4 to 7.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

**INV. B05B11/00**

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)
B05B

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

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<td>wo 2012/140366 AI (APTAR FRANCE SAS [FR]; BERANGER STEPHANE [FR]; MULLER PATRICK [FR]) 18 October 2012 (2012-10-18) page 10, paragraph 2 - page 11, paragraph 2; figures 1,3,7</td>
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<td>X</td>
<td>DE 84 29 005 UI (SCHRODER, ULRICH) 11 April 1985 (1985-04-11) page 4, paragraph 6 - page 7, paragraph 1; figures 2,3</td>
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<td>X</td>
<td>wo 93/21103 AI (HENKEL KGAA [DE]) 28 October 1993 (1993-10-28) page 7, paragraph 3 - page 8, paragraph 3; figures 3,4</td>
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**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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**Further documents are listed in the continuation of Box C.**

**See patent family annex.**

* Special categories of cited documents:

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*I* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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*S* document member of the same patent family

Date of the actual completion of the international search
19 September 2014

Date of mailing of the international search report
26/09/2014

Name and mailing address of the ISA
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Authorized officer
Lostetter, Yori c

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<td>US 5 598 877 A (REIDEL HERMANN [DE]) 4 February 1997 (1997-02-04) column 3, line 61 - column 4, line 25; figures 2a, 2b, 3</td>
<td>1-3, 5, 9, 10, 23, 24</td>
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<td>US 4 391 308 A (STEINER ROBERT L.) 5 July 1983 (1983-07-05) column 8, line 66 - column 10, line 29 column 13, line 62 - column 14, line 15 figures 3, 4, 15</td>
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

*Category* indicates the nature of the document or its relevance to the claim.
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<th>Box No. II</th>
<th>Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)</th>
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<td>This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:</td>
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<tr>
<td>1.</td>
<td>☐ Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:</td>
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</table>
| 2.        | ☒ Claims Nos.: 25, 27 because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:  
  see FURTHER INFORMATION sheet PCT/ISA/210 |
| 3.        | ☐ Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a). |

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<th>Observations where unity of invention is lacking (Continuation of item 3 of first sheet)</th>
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<td>This International Searching Authority found multiple inventions in this international application, as follows:</td>
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<td>1.</td>
<td>☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.</td>
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<td>2.</td>
<td>☒ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.</td>
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<td>3.</td>
<td>☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:</td>
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<tr>
<td>4.</td>
<td>☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:</td>
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**Remark on Protest**

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☒ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.
Claims 25-27 are unclear (Article 6 PCT) and were consequently not searched because they rely on references to the drawings and the description (see Rule 6.2(a) PCT).

The applicant’s attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on a matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.
<table>
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<td>US 2014041753 A1</td>
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<td>DE 4212434 A1</td>
<td>21-10-1993</td>
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<tr>
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<td>DK 0636104 T3</td>
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<td>EP 0636104 A1</td>
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<td></td>
<td>ES 2101131 T3</td>
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<td>GR 3023682 T3</td>
<td>30-09-1997</td>
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<tr>
<td></td>
<td></td>
<td>WO 9321103 A1</td>
<td>28-10-1993</td>
</tr>
<tr>
<td>US 5598877 A</td>
<td>04-02-1997</td>
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