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(54) Title: IMPROVED FOAMING CARTRIDGES, PUMPS, REFILL UNITS, AND FOAM DISPENSERS USING THE SAME

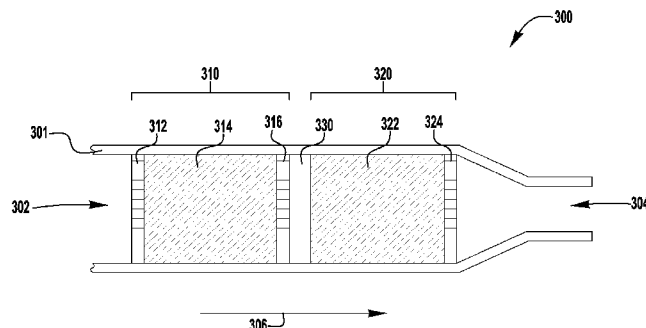


FIG. 3

(57) Abstract: An exemplary foam cartridge for a foam pump includes a housing having an inner diameter, a first foaming stage disposed within the housing, and a second foaming stage disposed within the housing. The first foaming stage is spaced apart from the second foaming stage. The first foaming stage has at least two different types of mix media, and the second foaming stage has at least two different types of mix media.

**IMPROVED FOAMING CARTRIDGES, PUMPS, REFILL UNITS,
AND FOAM DISPENSERS USING THE SAME
RELATED APPLICATIONS**

[0001] This application This application claims priority to and the benefits of U.S. Non-Provisional Application serial No. 62/192,837, filed on July 15, 2015 and titled IMPROVED FOAMING CARTRIDGES, PUMPS, REFILL UNITS, AND FOAM DISPENSERS USING THE SAME, and which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present invention relates generally to foam pumps, refill units for foam dispensers, and foam dispenser systems, and more particularly to foam pumps, refill units, and foam dispensers having an improved foam cartridge.

BACKGROUND OF THE INVENTION

[0003] Liquid dispenser systems, such as liquid soap and sanitizer dispensers, provide a user with a predetermined amount of liquid upon actuation of the dispenser. In addition, it is sometimes desirable to dispense the liquid in the form of foam by, for example, injecting air into the liquid to create a foamy mixture of liquid and air bubbles. Some liquids, such as, for example, alcohol-based liquids are difficult to foam and require enhanced mixing. Pumps for generating foam may form the foam by pumping a liquid and air mixture through a foam cartridge. Prior foam pumps and foam cartridges are disclosed in U.S. Published Patent Application No. 2014/0054323 filed on March 9, 2013 and entitled Horizontal Pumps, Refill Units and Foam Dispensers

with Integral Air Compressors, U.S. Patent No. 8,955,718 filed on March 18, 2013 and entitled Foam Pumps with Lost Motion and Adjustable Output Foam Pumps, U.S. Patent No. 8,763,863 filed on July 3, 2013 and entitled Bifurcated Foam Pump, Dispensers, and Refill Units, and U.S. Patent No. 7,850,049 filed on January 24, 2008 and entitled Foam Pump with Improved Piston Structure, all of which are incorporated herein by reference in their entirety.

SUMMARY

Exemplary embodiments of foam dispensers, refill units for foam dispensers, and foam cartridges are disclosed herein. An exemplary foam cartridge for a foam pump includes a housing having an inner diameter, a first foaming stage disposed within the housing, and a second foaming stage disposed within the housing. The first foaming stage is spaced apart from the second foaming stage. The first foaming stage has at least two different types of mix media, and the second foaming stage has at least two different types of mix media.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0004] These and other features and advantages of the present invention will become better understood with regard to the following description and accompanying drawings in which:
- [0005] Figure 1 is a cross-section of an exemplary dispenser having a refill unit;
- [0006] Figure 2 is a cross-section of a foam pump of an exemplary dispenser and refill unit; and
- [0007] Figure 3 is a cross-section of an exemplary foam cartridge.

DETAILED DESCRIPTION

[0008] Figure 1 illustrates an exemplary embodiment of a foam dispenser 100. The cross-section of Figure 1 is taken through the housing 102 to show a foam pump 120 with a foaming outlet portion 130, a container 116, and an actuator 140. The dispenser 100 includes a disposable refill unit 110. The disposable refill unit 110 includes the container 116, foam pump 120, and foaming outlet portion 130. The dispenser 100 may be a wall-mounted system, a counter-mounted system, an un-mounted portable system movable from place to place, or any other kind of dispenser system.

[0009] The container 116 forms a liquid reservoir that contains a supply of dispensable foamable liquid within the disposable refill unit 110. In various embodiments, the contained liquid could be for example a sanitizer, a cleanser, a disinfectant, or some other dispensable liquid. In the exemplary disposable refill unit 110, the container 116 is a collapsible container and can be made of thin plastic or a flexible bag-like material. In other embodiments, the container 116 may be a non-collapsible container and can be made with, for example, a thicker plastic than its collapsible counterpart. A non-collapsing container usually includes a vent (not shown) to vent the container.

[0010] The container 116 may advantageously be refillable, replaceable or both refillable and replaceable. In the event the liquid stored in the container 116 of the installed disposable refill unit 110 runs out, or the installed refill unit 110 otherwise has a failure, the installed refill unit 110 may be removed from the dispenser 100. The empty or failed disposable refill unit 110 may then be replaced with a new disposable refill unit 110. The refill unit 110 may be secured within the dispenser 100 by any means, such as, for example, a releasable locking mechanism, a quarter turn connection, a threaded connection, a flange and fastener

connection, a clamped connection, or any other reusable connection.

[0011] The refill unit 110 includes foam pump 120 that is in fluid communication with the container 116. The foam pump 120 may be secured to the container 116 by any means, such as, for example, a threaded connection, a welded connection, a quarter turn connection, a snap fit connection, a clamp connection, a flange and fastener connection, or the like. The foam pump 120 pumps liquid and air through a foaming outlet portion to dispense rich foam at the outlet nozzle 134 of the pump.

[0012] The foam pump 120 is generically illustrated because there are many different kinds of foam pumps which may be employed in dispenser 100. For example, the foam pump disclosed in U.S. Published Patent Application No. 2014/0367419 filed on June 13, 2004 and entitled Foam Cartridges, Pumps, Refill Units And Foam Dispensers Utilizing the Same and U.S. Patent No. 8,272,539 filed on December 3, 2008 and entitled Angled Slot Foam Dispenser, which are incorporated by reference in their entirety, may be used in dispenser 100.

[0013] In one embodiment, air and liquid pumps of the foam pump 120 are enclosed within a pump housing 121. In one other embodiment, the foam pump 120 includes separate air and liquid pumps. In this embodiment, the liquid pump and air pump may both be part of the refill unit 110. In other embodiments, the liquid pump may be part of the refill unit 110 and may be disposed of upon depletion of the liquid from the container 116, while the air pump (not shown) may be attached to the dispenser 100 and is not disposed. The concept of having a foam pump that has a liquid pump portion separable from an air pump portion may be referred to as a "split pump" shown and described in U.S. Patent No. 8,763,863 filed on July 3, 2013 and entitled Bifurcated

Foam Pump, Dispensers, and Refill Units which is incorporated herein in its entirety.

[0014] The foaming outlet 130 is in fluid communication with the premix chamber 122 of the foam pump 120. Foaming media 132 are retained within the foaming outlet 130. The foaming media 132 generates foam from any foamable liquid. Some embodiments are especially well suited for enhanced foaming of foamable liquids containing alcohol. For example, the foaming media 132 is longer than prior foam cartridges and includes multiple spaced apart foaming stages (See Figs. 2, 3) that generate rich foam. In some embodiments the foam is generated at increased actuation speeds and pressures.

[0015] Dispenser 100 contains one or more actuators 140. As used herein, actuator or actuating members or mechanism includes one or more parts that cause the dispenser 100 to move liquid, air and/or foam.

[0016] Actuator 140 is generically illustrated because there are many different kinds of pump actuators which may be employed in dispenser 100. Actuator 140 of dispenser 100 may be any type of actuator, such as a manual lever, a manual pull bar, a manual push bar, a manual rotatable crank, an electrically activated actuator or other means for actuating foam pump 120, which may include one or both of a liquid pump portion and an air pump portion. Electronic actuators may additionally include a sensor (not shown) to provide for a hands-free dispenser system with touchless operation

[0017] During operation of the dispenser 100, liquid is drawn in from the container 116 by the foam pump 120 through a liquid inlet 126 and pumped into premix chamber 122. Simultaneously, air is drawn into the foam pump 120 through an air inlet 124 and is pumped into the premix chamber 122 to mix with the liquid. The

air and liquid mixture is forced through the foaming media 132 in the foaming outlet portion 130 to dispense rich foam from the outlet nozzle 134. The foaming media 132 includes two foaming stages that each include a combination of at least two mix medias that generate high quality foam, such as, for example, screens, porous members, sponges, baffles, or the like. An aperture 115 in a bottom plate 103 of the housing 102 allows foam dispensed from the nozzle 126 to exit the housing 102 for use by the user.

[0018] Figure 2 illustrates an exemplary embodiment of a foam dispenser 200 that includes a foam pump 230 attached to a container 212 to form an exemplary refill unit 210. Foamable liquid is stored in the container 212 and is combined with air in the foam pump 230 to create rich foam that is dispensed from a pump outlet 227. In the illustrated embodiment, foam pump 230 includes a piston pump with liquid and air chambers that are actuated simultaneously when the pump 230 is actuated. The foam pump 230 may be any kind of pump, however, suitable for pumping and mixing liquid and air to create foam.

[0019] The interior of the container 212 forms a reservoir 220 for holding foamable liquid. A neck 214 of the container 212 is received within a collar 238 of the foam pump 230. In the illustrated embodiment, the container 212 is secured to the foam pump 230 with a threaded connection, but the container 212 can be secured to the foam pump 230 by any means, such as, for example, a snap fit connection, a friction fit connection, a quarter turn connection, a flange and fastener connection, a clamped connection, or the like (A one-time connection would actually be preferred).

[0020] The foam pump 230 includes a pump housing 231, a piston assembly 240, a foaming outlet 260, and a spring 241. The pump housing 231 includes an annular outer housing 232, an annular inner housing 234, an end cap 236, and the collar 238. The end

cap 236 of the pump housing 231 is disposed proximate the container and forms a closed end of the annular outer and inner housings 232, 234. The piston assembly 240 includes a piston body 242, an outer bore 243, an inner piston body 244, an inner bore 245, an outlet portion 246, and an outlet bore 247. In the illustrated embodiment, the inner piston body 244 is shown as a separate component, though it may be formed integrally as part of the piston body 242. The spring 241 engages a shoulder 248 on the interior of the pump outlet portion 246 of the piston assembly 240 and the interior of the end cap 238 of the pump housing 231.

[0021] The pump housing 231 and piston assembly 240 form a cylindrical liquid pump chamber 222 and an annular air pump chamber 224. The liquid pump chamber 222 is formed at least in part by the inner annular housing 234, the end cap 236, and the inner piston body 244. The air pump chamber 224 is formed at least in part by the annular outer housing 232, the end cap 236, the piston body 242, and the outer bore 243. The central bore 245 encloses a premix chamber 226. A liquid pump inlet 221 in the end cap 236 is in fluid communication with the reservoir 220 and the liquid pump chamber 222. A liquid pump outlet 223 is in fluid communication with the liquid pump chamber 222 and the premix chamber 226. An aperture 225 places the air pump chamber 224 in fluid communication with the premix chamber 226. The pump outlet portion 246 and foaming outlet 260 form a pump outlet 227 that is in fluid communication with the premix chamber 226 and the atmosphere.

[0022] The piston assembly 240 slideably engages the pump housing 231. Movement of the piston 240 within the housing 231 between charged and discharged states causes the volume of the liquid and air pump chambers 222, 224 to expand and contract. The piston 240 may be actuated manually or by an actuator. As used herein, actuator or actuating members or mechanism includes one or

more parts that cause the dispenser 200 to move liquid, air or foam. Upward actuation of the piston 240 moves the piston 240 from the charged state to the discharged state, compressing the spring 241. When the upward actuation force is removed, the spring 241 moves the piston 240 back to the charged state, expanding the liquid and air chambers 222, 224 thereby charging the pump 230. The piston 240 may be moved by any means, such as, for example, by use of an electric actuator, a mechanical actuator, a pneumatic actuator, or the like.

[0023] The annular air pump chamber 224 is larger in volume than the cylindrical liquid pump chamber 222. Thus, actuation of the piston 240 pumps a larger volume of air than liquid through the foam pump 230. Adjusting the dimensions, for example, the diameter, of the air and liquid pump chambers 224, 222 allows the ratio of the flow rate of air to liquid to be adjusted. The air flow rate may be, for example, between about one and about twenty times the liquid flow rate, and preferably about ten times the liquid flow rate.

[0024] A liquid inlet valve 250 is disposed in the liquid inlet 221 of the end cap 236 of the pump housing 231. The liquid inlet valve 250 is a one-way valve that is oriented such that it allows flow into, and prevents flow out of, the liquid pump chamber 222 through the liquid pump inlet 221. A liquid outlet valve 252 is disposed at the end of the inner piston body 244. The liquid outlet valve 252 is a one-way valve that is oriented such that it allows flow out of, and prevents flow into, the liquid pump chamber 222 through the liquid pump outlet 223. In some embodiments, liquid inlet and outlet valves 250, 252 can be any kind of one-way valves, such as ball and spring valves, wiper valves, poppet valves, flapper valves, umbrella valves, slit valves, mushroom valves, duck bill valves, or the like.

[0025] A liquid pump seal 254 on the inner piston body 244 seals against the inner pump housing 234 to prevent liquid from leaking out of the liquid pump chamber 222 during charging and discharging of the pump 230. The liquid pump seal 254 is illustrated as an integrally molded wiper seal, but may be any kind of suitable seal, such as, for example, an o-ring or an elastomeric washer.

[0026] An air pump seal 256 on the piston body 242 seals against the outer pump housing 232. The air pump seal 256 seals the air pump chamber 224 during the discharging actuation cycle, but allows air to enter the air pump chamber 224 during the charging cycle. The air pump seal 256, therefore, operates as a one-way valve that is oriented such that it allows air flow into, and prevents flow out of, the air pump chamber 224. In some other embodiments, the foam pump 230 may include a separate one-way air inlet valve (not shown) fluidly connecting the air pump chamber 224 to the atmosphere. The air pump seal 256 in an embodiment that includes a separate one-way air inlet valve (not shown) can be any suitable seal, such as, for example, an O-ring, an elastomeric washer, an integrally molded wiper seal, or a lubricant, such as, for example, grease.

[0027] The foaming outlet 260 attaches to the outlet portion 246 of the piston assembly 240 and includes a central bore 264 in fluid communication with the outlet bore 247 that together form the pump outlet 227. A nozzle 262 of the foaming outlet 260 allows foam generated in the foaming outlet 260 to be dispensed to the user. The foaming outlet 260 may be secured to the piston body 240 by any means, such as, for example, a quarter turn connection, a flange and fastener connection, a clamped connection, a friction fit connection, or the like. In some embodiments, the foaming outlet 260 may be welded or glued to the piston body 240, or may be formed integrally with the piston body 240.

- [0028] A foaming cartridge 270 comprising a first foaming media 272 and a second foaming media 274 is retained within the pump outlet 227. Each of the first and second foaming stages 272, 274 include a combination of at least two mix medias, such as a combination of at least two of the following: screens, porous members, sponges, baffles, or the like. The first and second foaming stages 272, 274 are separated by a gap 276. In some embodiments the gap is approximately equal to about 10% to about 50% of the interior diameter of the pump outlet 227.
- [0029] A dust cap 280 attaches to the pump housing 230 to conceal and protect outlet portion of the dispenser 200 and is removed prior to installing refill unit 210 in the dispenser 200.
- [0030] During operation of the dispenser 200, the piston assembly 240 of the foam pump 230 is moved by the spring 241 from a discharged to a charged position. Foamable liquid flows from the reservoir 220 through the liquid pump inlet 221 and liquid pump inlet valve 250 into the liquid pump chamber 222 as the liquid pump chamber 222 expands. Simultaneously, air flows into the air pump chamber 224 through the air pump chamber seal 256. When the dispenser 200 is actuated, the piston 240 is moved from the charged to discharged position, forcing liquid out of the liquid pump chamber 222 through the liquid pump outlet valve 252 and liquid pump outlet 223 into the premix chamber 226. Simultaneously, air is forced out of air pump chamber 224 through the aperture 225 and into the premix chamber 226 to mix with the foamable liquid. The air and liquid mixture in the premix chamber 226 flows out of the premix chamber 226 and through the foam cartridge 270 to generate rich foam at the pump outlet 227.
- [0031] The dispenser 200 is actuated at high speeds and pressures to generate rich foam in a short time. The actuator (not shown)

moves the piston at approximately 1.5 to 4 inches per second. When actuated at this high speed, the dispenser 200 generates about 5 ml to about 19.5 ml of foam in about 0.2 to about 0.5 seconds. After pumping and before the air and liquid mixture flows through the foaming cartridge, the pressures in the air and liquid mixture range from about 4 psig to about 12 psig. Unlike the foam cartridge 260, prior foam cartridges are unable to generate rich, uniform foam at these flow rates and pressures from foamable liquid containing alcohol.

[0032] Figure 3 is an enlarged cross-sectional view of an exemplary foam cartridge 300 located in a foaming outlet 301 of foam dispenser 200. The foaming outlet 301 is simplified in Figure 3 to more clearly show the components of the foam cartridge 300. The foam cartridge 300 includes a first foaming stage 310 and a second foaming stage 320 separated by a gap 330. A mixture of air and liquid enters the foam cartridge 300 at an inlet 302 and is dispensed as rich foam from an outlet 304 moving in a flow direction 306. The first foaming stage 310 includes a coarse screen 312, a sponge 314, and a fine screen 316. The second foaming stage 320 includes a sponge 322 and a fine screen 324. The coarse screen 312 may be filter media having about 40 to about 80 threads per inch. The fine screens 316, 324 may be filter media having about 80 to about 200 threads per inch. The sponges 314, 322 may be porous media having about 10 pores per inch to about 100 pores per inch.

[0033] Foam cartridge 300 provides an enhanced mixing of air and liquid and is particularly useful for hard to foam liquids, such as liquids containing alcohol and those dispensed from high pressure, high velocity foam pumps. Increased actuation speed decreases the time required to dispense a volume of foam into the hands of the user and increases the pressure and velocity of the air and liquid inside the pump. For example, a high dispenser speed of 1.5 to 4

inches per second results in pressures in the air and liquid mixture ranging from about 4 psig to about 12 psig. A pump actuating at this speed can dispense about 5 ml to about 19.5 ml in about 0.2 to about 0.5 seconds. Reducing the time to dispense foam is particularly important in the medical profession, where the time of medical professionals is in high demand and comes at a considerable cost.

[0034] Each stage 310, 320 of the foam cartridge reduces the pressure of the air and liquid mixture exiting a foam pump, allowing more stable bubbles to be formed at the outlet 304 of the cartridge 300 when a foamable liquid containing alcohol is used. Reducing the pressure of the liquid and air mixture enhances formation of rich foam from an alcohol-based foamable liquid because bubbles formed in an alcohol-based foamable liquid have lower surface tension and therefore cannot maintain bubbles at the same pressures as bubbles formed in a soap-based liquid.

[0035] An air and liquid mixture entering the first foaming stage 310 passes through the coarse screen 312 to make the size of bubbles in the mixture more uniform. The bubbles then pass through the sponge 314 where they are continually reformed. The fine screen 316 reduces and refines the size of the bubbles. The gap 330 between the first and second foaming stages 310, 320 allows bubbles exiting the fine screen 316 to fully form before entering the second stage 320. The gap 330 may be about 10% of the inner diameter of the foam cartridge 300, or may be between about 10% to about 50% of the inner diameter of the foam cartridge 300. The bubbles formed by the first foaming stage 310 flow through the second foaming stage 320 where they are continuously reformed by the sponge 322. Lastly, the fine screen 324 ensures the bubbles exiting the foam cartridge 300 are small and uniform in size and are dispensed from the foam cartridge 300 as rich foam.

[0036] While the above discussed embodiments show and describe wall mounted and above counter mounted dispensers, the foam cartridge works very well with counter mount dispensers. An exemplary embodiment is shown and described in U.S. Patent No. 8,544,698 filed on March 26, 2007 and entitled Foam Dispenser with Stationary Dispense Tube which is incorporated herein in its entirety.

[0037] While the present invention has been illustrated by the description of embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Moreover, elements described with one embodiment may be readily adapted for use with other embodiments. Therefore, the invention, in its broader aspects, is not limited to the specific details, the representative apparatus and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of the applicants' general inventive concept.

CLAIMS

What is claimed is:

1. A foam cartridge for a foam pump comprising:
 - a housing having an inner diameter;
 - a first foaming stage disposed within the housing;
 - the first foaming stage having at least two different types of mix media; and
 - a second foaming stage disposed within the housing;
 - the second foaming stage having at least two different types of mix media;
 - wherein the second foaming stage is spaced apart from the first foaming stage.
2. The foam cartridge of claim 1 wherein:
 - the housing comprises a first portion and second portion;
 - the first foaming stage is disposed within the first portion and
 - the second foaming stage is disposed within the second portion.
3. The foam cartridge of claim 1 wherein the second foaming stage is spaced apart from the first foaming stage by about 10% of the inner diameter of the housing to about 50% of the inner diameter of the housing.
4. The foam cartridge of claim 1 wherein:
 - the first foaming stage comprises at least two mix media selected from a coarse screen, a sponge, and a fine screen; and

the second foaming stage comprises at least two mix media selected from a course screen, a sponge, and a fine screen.

5. The foam cartridge of claim 4 wherein the course screen has about 40 to about 80 threads per inch, the fine screen has about 80 to about 200 threads per inch, and the sponge has about 10 to about 100 pores per inch.
6. The foam cartridge of claim 1, wherein the mix media comprise at least one fine screen and one course screen.
7. A refill unit for a foam dispenser comprising:
 - a container for holding foamable liquid;
 - a liquid pump;
 - an air pump;
 - an outlet nozzle; and
 - a foam cartridge having:
 - a first foaming stage having two or more different types of mix media; and
 - a second foaming stage having two or more different types of mix media;wherein the second foaming stage is spaced apart from the first foaming stage.
8. The refill unit of claim 7 wherein the second foaming stage is spaced apart from the first foaming stage by about 10% of the outer diameter of the first foaming stage to about 50% of the outer diameter of the first foaming stage.
9. The refill unit of claim 7 wherein:

the first foaming stage comprises at least two mix media selected from a coarse screen, a sponge, and a fine screen; and

the second foaming stage comprises at least two mix media selected from a coarse screen, a sponge, and a fine screen.

10. A foam dispenser comprising:

a housing;

a refill unit installed in the dispenser, the refill unit comprising a container and a pump secured to the container;

wherein the pump includes an outlet nozzle and a foaming cartridge, the foaming cartridge includes:

a first foaming stage having two or more different types of mix media; and

a second foaming stage having two or more different types of mix media;

wherein the second foaming stage is spaced apart from the first foaming stage.

11. The foam dispenser of claim 10, wherein the dispenser is a wall mounted dispenser.

12. The foam dispenser of claim 10, wherein the dispenser is a counter mounted dispenser.

13. A foam dispensing system comprising:

a dispenser housing having an actuator for causing the dispensing of foam and a holder for receiving a refill unit;

a refill unit having a container and a pump secured to the container, the refill unit further comprising:

a first foaming stage having two or more different types of mix media; and

a second foaming stage having two or more different types of mix media;

wherein the second foaming stage is spaced apart from the first foaming stage.

14. A foam cartridge for a foam pump comprising:

a housing;

a first mix media;

a second mix media; and

a third mix media;

wherein at least two mix media are different.

15. The foam cartridge of claim 14, wherein the first and third mix media are screens.

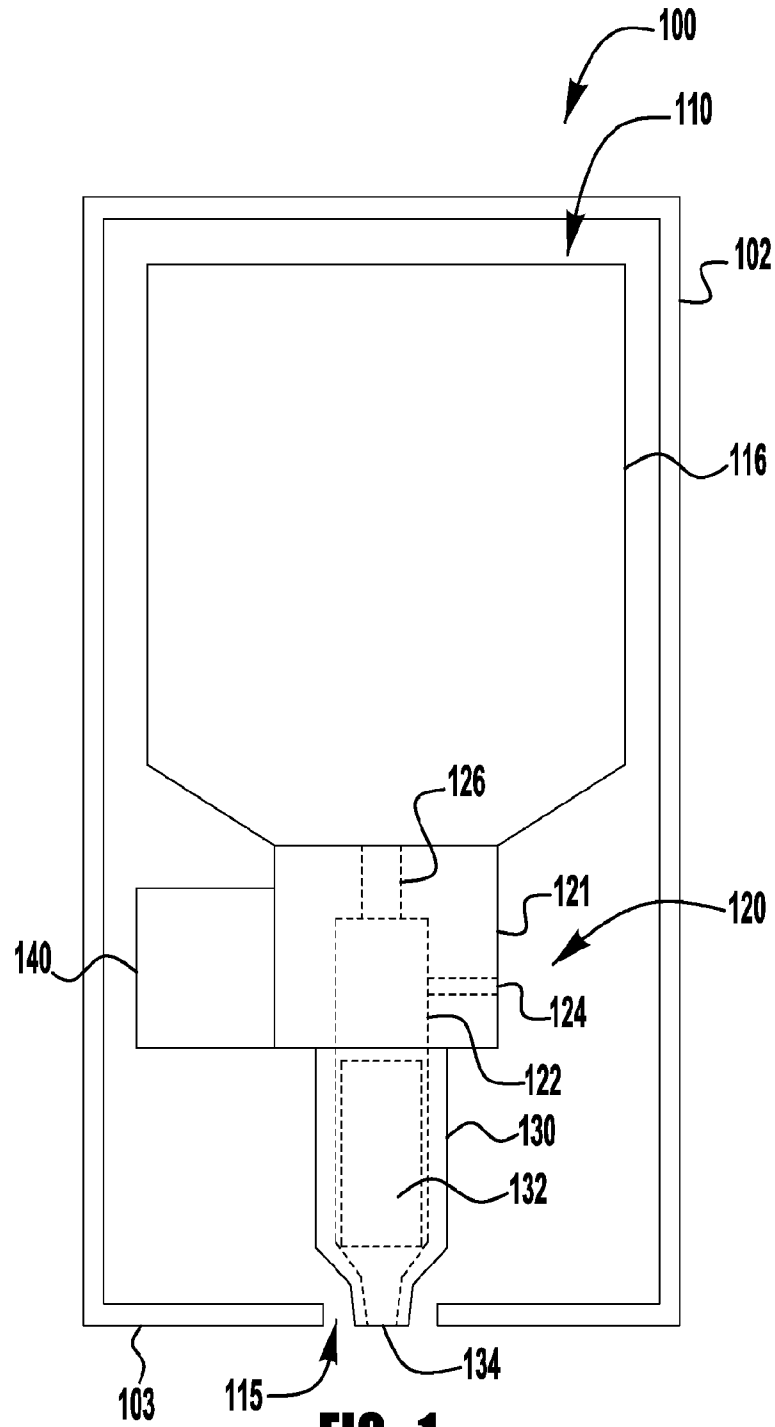
16. The foam cartridge of claim 14, wherein the second mix media is a sponge.

17. The foam cartridge of claim 14, comprising a fourth mix media.

18. The foam cartridge of claim 17, wherein the fourth mix media is a sponge.

19. The foam cartridge of claim 14, comprising a fifth mix media.

20. The foam cartridge of claim 19, wherein the fifth mix media is a screen.



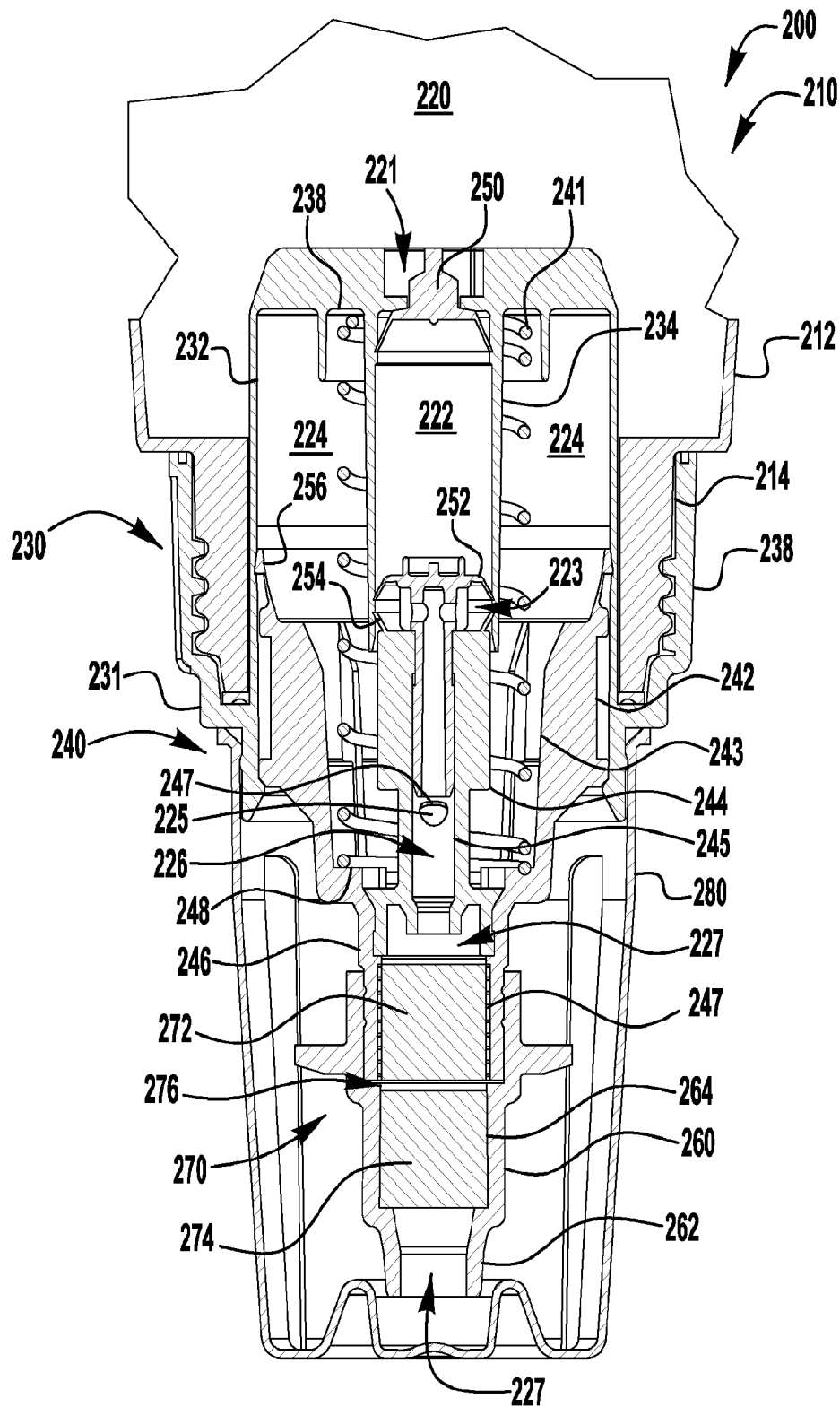


FIG. 2

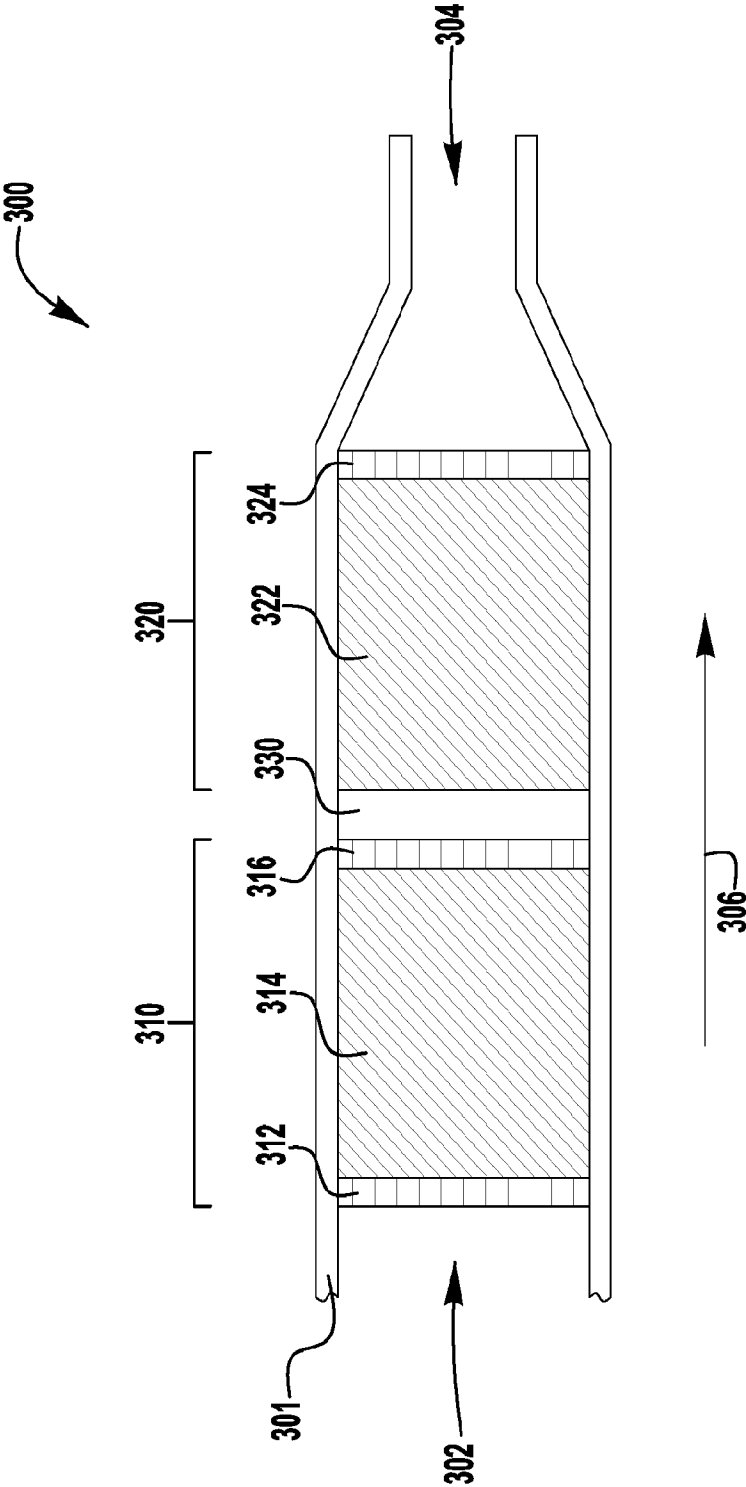


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/042403

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47K10/16 B05B7/00 A47K5/14
ADD.

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)
A47K 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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/241137 A1 (WILLIS DANIEL M [US] ET AL) 18 October 2007 (2007-10-18) paragraph [0027] - paragraph [0029]; figures 3,4 -----	1-6, 14-20
X	US 2010/051642 A1 (WONG YIN MAN JOHN [HK] ET AL) 4 March 2010 (2010-03-04) paragraph [0024] - paragraph [0025]; figure 2 -----	1,2, 14-20
X	US 2014/061246 A1 (MCNULTY JOHN J [US] ET AL) 6 March 2014 (2014-03-06) paragraph [0062]; figure 6 -----	1-6, 14-20
A	US 2012/160879 A1 (CIAVARELLA NICK E [US] ET AL) 28 June 2012 (2012-06-28) paragraphs [0022], [0027]; figures 1,4 -----	1,14



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" 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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

6 September 2016

Date of mailing of the international search report

04/11/2016

Name and mailing address of the ISA/

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Authorized officer

Zuurveld, Gerben

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/042403

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
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:
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).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ 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.:
4. ☒ 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.:

1-6, 14-20

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.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2016/042403

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FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-6, 14-20

a foam cartridge

2. claims: 7-9

a refill unit

3. claims: 10-12

a dispenser with a housing, refill unit and pump

4. claim: 13

a dispenser with a housing having an actuator for causing
the dispensing
