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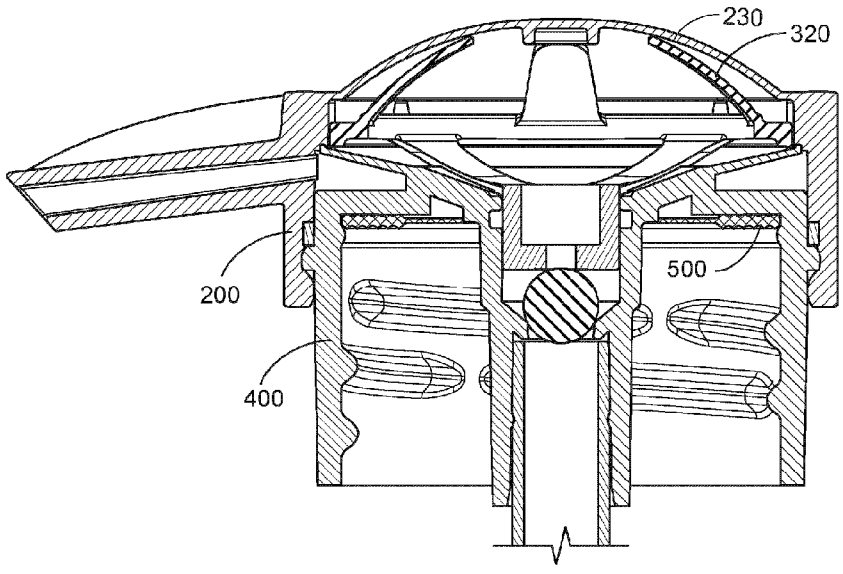

FIG. 3A

(57) **Abstract:** A pump constructed entirely from a polymeric material is described. The pump is formed from only four components all made from the same (or otherwise recyclable) polymer(s), resulting in a simple and sustainable dispenser. Further, the actuator mechanism relies only on a deformable dome integrated with the nozzle element itself, so that the nozzle move axially during actuation, although a separate axial locking mechanism is provided to avoid unwanted actuation and lose of fluid from the pump.

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TITLE

SINGLE POLYMER, DOME-ACTUATED PUMP

BACKGROUND

[0001] Containers for everyday household fluid products, such as soaps, cleaners, oils, consumable liquids, and the like, can be outfitted with dispensing pumps to improve a consumer's ability to access and use the fluid. Dispensing pumps of this type usually rely upon a reciprocating pump, driven by a compressible biasing member.

[0002] These products reach the end-use consumer via a bulk-shipment retail supply chain or by way of e-commerce (i.e., delivery to the consumer's home or business). Both supply chains require safeguards against damage and/or leakage of fluid caused by dropping the container(s), vibration, and the like. However, the e-commerce channel is particularly demanding since it is more cost effective to ship individual containers without any additional packaging. Also, because e-commerce shipping does not involve pallets or other means of confining the container to an upright position, the rotation, inversion, and jostling/vibration of the container and dispensing pump increases the likelihood that fluid can leak from the container. Despite these issues, the need for containers with dispensing pumps that can withstand the rigors of shipment also is expected to grow because of the growing popularity of on-line retailers who sell and ship individual fluid-containing products via e-commerce.

[0003] Another concern relates to sustainability. Increasingly, regulatory authorities are requiring consumer products manufacturers to use product packaging and designs that can easily be recycled. As a practical matter for businesses relying on pump dispensers, it is becoming increasingly important to design products made only from polymeric materials that can be

recycled without the need to disassemble and/or separate out metal parts and components made from difficult to recycle materials (e.g., thermosetting resins, specialized elastomers, and other materials that either cannot be recovered or that require temperatures and conditions for recycling that are incompatible with the materials used in the other parts within the design).

[0004] United States Patent Publication 2018/0318861 discloses a dispenser pump with components that can be integrally formed from the same polymer, with a deformable wall in the diaphragm body of this pump eliminates the need to rely upon a metallic biasing member. United States Patents 7,246,723; 5,924,603; and 5,673,814 also disclose similar "all plastic" type designs for dispensing pumps, except with a "bellows-style" coiled cone instead of a diaphragm body. International Patent Publication WO2020/114532; United States Patent Publication 2019/0009293; and United States Patent 9,555,428 disclose various iterations of dispensing pumps incorporating a dome-shaped actuator. All of these references are controlled by and/or commonly assigned to affiliated entities of this application and are, therefore, incorporated by reference.

[0005] Additionally, United States Patents 4,880,161; 5,5115,948; 5,271,432; 5,492,252; 5,875,936; 8,225,966; 8,365,962; and 8,573,449, along with United States Patent Publications 2009/0302064; 2012/0181305; and 2018/0297049 and European Publications EP1911526A1; EP1939111A1; and EP2300171A1, all provide further background information. However, each of these publications rely on elastomers, dome actuators of variable thickness, axially movable nozzle outlets, and/or additional actuation structures.

[0006] In view of the foregoing, a pump dispenser made from polymeric materials that are easy to recycle would be welcome. Specifically, a pump design that did not require disassembly and separation of parts into separate recycling streams is needed.

[0007] Also, a dome-actuated pump that did not axially displace the nozzle is needed and, for ease of manufacture and assembly, a dome actuator of relatively consistent thickness and made entirely from the same polymeric materials as the other pump elements would be welcome. Further still, a pump design that included a simple rotational lock to avoid unwanted actuation would also be welcomed.

SUMMARY OF INVENTION

[0008] Operation of the invention may be better understood by reference to the detailed description, drawings, claims, and abstract—all of which form part of this written disclosure. While specific aspects and embodiments are contemplated, it will be understood that persons of skill in this field will be able to adapt and/or substitute certain teachings without departing from the underlying invention. Consequently, this disclosure should not be read as unduly limiting the invention(s).

[0009] A reciprocating dispenser pump is constructed from only four polymeric pieces. A closure element is attachable to a container holding the fluid for dispensing. Venting apertures in the cap are sealed by a annular valve flap to control admission of make up air into the container after a dispensing event. A separate cap and actuator dome assembly is rotatably fitted onto the closure, so as to move between locked and dispensing positions. Finally, a biasing member is captured between the cap and the closure. The member nests within the cap so as to allow those two elements to move in concert, while a threaded engagement between the biasing member and an flow channel formed through the closure allows the cap and biasing member to move axially (by way of rotation) between a down position (closed and locked) and an up position (open and ready for dispensing).

DESCRIPTION OF THE DRAWINGS

[0010] The appended drawings form part of this specification, and any information on/in the drawings is both literally encompassed (i.e., the actual stated values) and relatively encompassed (e.g., ratios for respective dimensions of parts). In the same manner, the relative positioning and relationship of the components as shown in these drawings, as well as their function, shape, dimensions, and appearance, may all further inform certain aspects of the invention as if fully rewritten herein. Unless otherwise stated, all dimensions in the drawings are with reference to inches, and any printed information on/in the drawings form part of this written disclosure.

[0011] In the drawings and attachments, all of which are incorporated as part of this disclosure:

[0012] Figures 1A and 1B are, respectively speaking, complimentary top and bottom perspective, three dimensional views of the pump assembly according to certain aspects disclosed herein.

[0013] Figures 2A through 2E are top perspective, three dimensional views of the individual components of the pump of Figure 1A in isolation, with Fig. 2A being the cap and actuator dome; Fig. 2B being the biasing member; Fig. 2C being the closure element; Fig. 2D being the annular valve flap; and Fig. 2E being the dip tube (optional).

[0014] Figures 3A and 3B are complimentary cross sectional side views, taken from the side and back (i.e., so that the nozzle is in the background), of the pump of Fig. 1A.

[0015] Figures 4A through 4E are various views of the closure element of Fig. 2C, with Fig. 4A being a top perspective, three dimensional dual views of the element at complimentary, ninety degree intervals to highlight the annular flange and cooperating stoppers positioned along

its periphery; Fig. 4B being a bottom perspective, three dimensional view highlighting vent apertures, coupling threads, and dip tube mount; Fig. 4C being a cross sectional side view taken along a diameter that coincides with the vent apertures; and Figs. 4D and 4E being complimentary, top and bottom perspectives (respectively speaking), cross sectional views taken along a diameter that coincides with the vent apertures.

[0016] Figures 5A through 5C are various views of the biasing member of Fig. 2B, with Fig. 5A being a bottom perspective, three dimensional view of the member highlighting the engagement posts on the hollowed central base; Fig. 5B being a top perspective, three dimensional view of the member highlighting the resilient arms extending up and down from the annular support ring, as well as the radial projections on the sidewall of that support ring; and Fig. 5C being top plan view of the member.

[0017] Figures 6A through 6E are various views of the cap and actuator dome of Fig. 2A, with Fig. 6A being a bottom plan view of the cap/dome; Figs. 6B and 6C being bottom perspective, three dimensional views of the cap/dome at complimentary, ninety degree intervals to highlight the features on the inner facings of the skirt/sidewall; Fig. 6D being a top perspective, three dimensional view of the cap/dome; and Fig. 6E being a cross sectional side view of the cap/dome.

[0018] Figure 7 is a cross sectional side view of the pump of Fig. 1A with the cap/dome and spring placed in the locked position to urge the ball valve into a sealed position above the dip tube.

[0019] Figure 8 is a cross sectional side view of the pump of Fig. 1A with the dome depressed and arrows and indicating fluid flows coinciding with the actuation/dispensing function of the pump.

[0020] Figure 9 is a cross sectional side view of the pump of Fig. 1A with the dome returned to its extended position with assistance of the biasing member and indicating fluid flows coinciding with the release/priming function of the pump.

DETAILED DESCRIPTION

[0021] Specific reference is made to the appended claims, drawings, and description, all of which disclose elements of the invention. While specific embodiments are identified, it will be understood that elements from one described aspect may be combined with those from a separately identified aspect. In the same manner, a person of ordinary skill will have the requisite understanding of common processes, components, and methods, and this description is intended to encompass and disclose such common aspects even if they are not expressly identified herein.

[0022] As used herein, the words "example" and "exemplary" mean an instance, or illustration. The words "example" or "exemplary" do not indicate a key or preferred aspect or embodiment. The word "or" is intended to be inclusive rather an exclusive, unless context suggests otherwise. As an example, the phrase "A employs B or C," includes any inclusive permutation (e.g., A employs B; A employs C; or A employs both B and C). As another matter, the articles "a" and "an" are generally intended to mean "one or more" unless context suggest otherwise.

[0023] With reference to the drawings, a dispenser pump is attachable to a container neck. The pump itself includes four main parts, all of which are constructed from the same (or functionally equivalent) polymeric materials so as to simplify recycling. The four parts include a

nozzle with integral dome actuator, a biasing member with resilient articulating arms and a locking stem, a closure element, and a pair of valves including a gasket and ball or flap.

[0024] One aspect of the invention relates a dispensing pump whose components are all made from the same polymeric material. Preferably, this material is polypropylene, polyethylene, and/or a blend of these materials. Various low density forms of polyethylene may be particularly useful, as is any polymer that is comparatively easy to recover (i.e., in recycling streams) and reuse in common manufacturing process (e.g., injection or blow molding).

[0025] Further, the aspects of the invention effectively limit the number of manufactured, critical components to as little as four discrete elements: an actuator head having a flexible dome that is supported by and moves in response to a resilient biasing member positioned beneath it. A closure element ensures the pump can be rotatably sealed to a container, preferably according to any number of standardized neck finishes already used in the container and dispensing industry. Finally, valve elements—including at least an annular flap valve and, possibly/separately, a ball-type valve seated between the closure and the spring—are provided. A detachable dip tube can be used to allow for variations in the container size, although it is understood the dip tube could be integrally formed as part of the closure itself. In the same manner, the ball-valve could also be formed integrally with the closure element as a flap-style valve.

[0026] By minimizing the number of elements and forming them from a common polymeric material, it becomes possible to easily recycle the pump. Further, the container material can be matched to the dispenser components, thereby yielding an easy-to-recycle dispenser. This minimalist approach to the components also simplifies manufacturing by limiting the number of components to assemble, as well as the resins from which they are made.

[0027] Another advantage to the aspects disclosed herein related to the style of dispenser itself. In particular, some consumers may prefer a dispensing pump in which the nozzle/outlet from which fluids are dispensed remains stationary. This ensures that the user can similarly keep one hand positioned under the outlet without moving in concert with the dispensing stroke required to actuate the pump. Some users may also prefer the aesthetic look of such pumps.

[0028] A further advantage resides in the pump's ability to be sealed in the down-locked position. Reliable locking of the pump enables the pump to be shipped without the need for additional packaging or protections against leakage. In this regard, the locking mechanism here results in separate sealing faces at the dip tube in-flow and at the interface between the closure and the nozzle outlet integrally formed in the cap/dome actuator element.

[0029] Turning now to Figs. 1A through 9, pump 10 includes cap and dome actuator element 200, biasing member 300, closure element 400, and valves 500. A common dip tube 100 has a length and diameter that compliments the container (not shown) to which pump 10 is attached. Notably, the container will be a hollowed vessel, usually having a cylindrical shape with a circular, hollow tubular neck that is received in and coupled to the closure 400 by way of a threaded or other known coupling/connection.

[0030] Cap 200 has a basic cup-like shape so as to fit over and couple to the closure element 400. A polymeric biasing member 300 conforms to the dome actuator 230 portion of the cap so as to create resilient force to restore the dome to its original shape if/when it is depressed in an actuating stroke (i.e., in the vertical or axial direction). Radial projections/detents 243 on the cap 200 cooperate recesses or detents 313 on spring 300 so that these elements nest and rotated together.

[0031] The biasing member 300 is also seated atop the closure 400, with projections 311 on base 310 of biasing element 300 cooperate with features 411 (such as helical grooves, channels, or shelves) along the central duct 410 of the closure 400. Features 311, 411 couple the spring 300 to the closure 400 while allowing facilitating helically-driven axial rotation between them. As the projections 311 travel up and down, the pump 100 is toggled between locked and actuation positions. Specifically, as seen in Fig. 7, the spring 300 can be screwed down to create a sealing face created in the central duct 410 and, separately, within the dispensing duct 210 formed in nozzle 220. Conversely, as seen in Figs. 8 and 9, the spring 300 moves up and away from the closure 400 to ensure the pump 10 can dispense by actuation of the dome 230 and biasing element 300 (as well as the necessary displacement/movement of the valves 500).

[0032] The operation of the pump 10 will be better understood with reference to the various features of the components 200, 300, 400, and 500. Thus, the following discussion will focus on Figs. 2A through 6E, although it will be understood that the entire assembly of pump 10 should be considered in context and with further reference to the general state of the art.

[0033] First, cap 200 includes a nozzle 220 and a compressible dome 230. Nozzle 220 may be inclined so that dispensed fluid does not remain in and clog the duct 210, with the preferred arrangement having the duct 210 slope down and away from the dome 230.

[0034] A cylindrical skirt wall 240 extends downward beneath dome 230. Wall 240 has an inner diameter in which the spring 300 and closure 400 are received and contained. The outer surfaces of wall 240 and nozzle 220 may be contoured to create a specific aesthetic, although their inner surfaces are specifically engineered to facilitate fit and various other functions described herein.

[0035] Generally speaking, dome 230 will have a thinner wall relative to the skirt 240. Dome 230 also preferably has a consistent thickness along most of its surface, although a central feature 231, such as an circular cylindrical extension, detent, or may facilitate molding, positioning of the parts, and/or the resilient "springback" action of the dome itself. The dome 230 is integrally formed around its lower periphery 232 with the upper regions of wall 240.

[0036] A first shelf 242 is formed on the inner facing of upper region where the dome 230 transitions to the skirt 240. A plurality of radial projections or detents 243, preferably even spaced, are formed on a second shelf 244 and cooperate with corresponding features 311 on the spring 300. Shelf 242 helps to locate and position portions of the closure 400 and may include one or more axial projections or stoppers 241 that interface with other portions of closure 400 to define the range of rotational movement between these parts (both when locked down and released in the up-position). A radially projecting annular flange 246 is positioned at the lower terminal end of the wall 240 to define a channel 245 between flange 246 and shelf 244. Channel 245 sealingly receives portions of the closure 400, and the axial height of the channel 245 should cooperate with the expected amount of helically-driven axial travel caused by cooperation and engagement of features 311, 411.

[0037] Biasing member 300 includes resilient spring arms 320 extending upward and downward from ring member 330. The spring arms 320b extending downward from the ring 330 connect to a base member 310. In operation, arms 320a (and possibly/preferably 320b) are axially compressed by the downward force exerted on the adjacent dome 230. Ring 330 is fitted within the inner diameter of wall 240, with detents (or projections) 243 cooperating with features 313 positioned on the radial outer surfaces of the ring 330. Detents 243 and features 313 should

be of a number and spacing that is complimentary to secure the spring 300 and enable coordinated, rotational movement of the cap 200 and spring 300.

[0038] The lower end of the spring 300 terminates in a hollow cylindrical base 310 which defines a flow channel 312 on its inner facings. A web 315 is positioned at the lower end to engage and restrain a ball valve 520. As noted above, projections 311 serve to guide the rotational/axial movement of the spring 300 relative to the closure 400.

[0039] The extension arms 320 are preferably evenly spaced, with an equal number of arms 320a in comparison to arms 320b. However, in one aspect, the radial positioning of the arms 320a will be offset in comparison to arms 320b (e.g., see Fig. 5C). Three, four, five, or six arms 320a will preferably compliment three, four, five, or six arms 320b. The tips of arms 320a may extend upward and radially inward so as to coincide with the shape of feature 231 and/or to approximate the inner or outer diameter of extension 310. The radius of curvature in arms 320a should be approximately the same or identical to that of arms 320b, so as to impart an oval shape when viewed in cross section.

[0040] The volume beneath the dome 230 defines a pump chamber 202. As that volume expands and contracts in response to the actuation of dome 230 (along actuation force path A), suction is created to draw and expel fluid through the dip tube 100 and out of the nozzle 220 along flow path E. The underside of dome 230 accommodates the biasing member 300, with the resilient arms 320a supporting and urging the dome wall 230 upward after actuation force A is released. Thus, as the arms 320a urge the dome back to its original position by restoring force R, the expanding volume draws fluid up through the flow channel 312 along flow path S.

[0041] Closure 400 presents a cylindrical shell or skirt 420 on its outermost facing, with an annular flange 422 positioned in the upper portions of the skirt 420. The inner walls of skirt 420

include features, such as threads 421, that enable the dispenser 10 to be easily connected to a container.

[0042] Flange 422 is configured to receive and cooperate with shelf 242. More specifically, stopper 241 slides along the bottom edge of the shelf 242 and within channel 245. A locking post 423 is interposed on the flange, along with an arcuate stopper section 424. Both these elements are configured and sufficiently spaced apart to allow the stopper 241 to slide over post 423 but collide with section 424. In this manner, the spacing of the elements 423, 424 on the skirt 420 and the size and spacing of the elements 241, 242, 245 in the skirt 240 define a range of relative rotation between the closure 400 and the cap 200 (with the spring 300 moving in concert with the cap).

[0043] The cap 200 may be rotated between positions specifically configured to correspond to the helically-driven axial range of travel induced by elements 311, 411. Thus, the arcuate length of stopper 424 may coincide with the locked and unlocked positions of the dispenser 10, while the post 423 can provide tactile feedback as to when the transition from locked to unlocked has occurred. In a preferred embodiment, shelf 242 and flange 422 are formed in the horizontal plane, with the axial heights of the stopper 241, post 423, and stopper section 424 all sized to fit within channel 245. During assembly, flange 246 may flex outward so as to receive all necessary components within cap 200 and, more specifically, the inner volume defined by skirt 240.

[0044] Skirt 420 terminates in top panel 430, so that the combination of these elements presents a cup-like shape on its inner facing. One or more vent apertures 431 are provided through the panel 430 and may be sealed by valve 500 to control the flow of air through the closure and, more specifically, to allow make-up air to enter the container (not shown) sealed by the closure 400 and, more generally, the dispenser 10.

[0045] A central duct 410 is formed through panel 420 and, more specifically, is defined by hollow cylindrical extension 413. Extension 413 extends coaxially into and/or below the space defined by the inner facings of the skirt 420. The inner diameter of extension 413 is sized to receive and retain (by interference fit or other known means of coupling) the optional dip tube 100. Alternatively, the extension 413 itself can be sized to serve the purpose of the dip tube.

[0046] In addition to the features 411 noted above, the inner facings of the duct 410 also include one or more radial protrusions 414. Protrusions 414 are configured to serve as a seat for ball valve 520, which seals the inlet to the pump chamber 202 depending upon the suction forces created by dome 230/spring 300. Protrusions should be axially spaced apart from the threads 411 to ensure the ball vent 520 can be displaced upward when the dispenser is unlocked. Conversely, the protrusions 414, ball 520, and webbing 315 (or lower reaches of the central base 310) will form a seal to prevent the escape of fluid through interstices of duct 410 when the dispenser is screwed down into the locked position.

[0047] A funnel or cone-shaped extension 415 extends above the opening at the top of the duct 410, with the opening effectively serving as an inlet to pump chamber 202. The shape of the funnel 415 will cooperate with and receive biasing member 300. More specifically, the funnel 415 will abut and prevent flexion of the spring arms 320b when the dispenser 10 is locked. In the unlocked position, arms 320b could provide further resilient, restorative force after actuation of the dome 230. Significantly, the outer annular edge of funnel 415 may seal to a facing on the dome 230, skirt 240, or at the transition point of these elements 230, 240 to ensure the pump chamber 202 is sealed when the dispenser is locked, thereby blocking the duct 210 which otherwise serves as an outlet to the pump chamber 202. Gaps can be created along other portions of the interface of the funnel 415 and the dome 230/skirt 240 to enable flow of make up air M

around the funnel 415, through the vent holes 431, and into the container (when the valve 500 is properly deflected owing to negative pressure build up inside the container). To the extent the funnel 415 creates a seal/blockage of duct 210, it should be understood as a separate seal in comparison to the seal/blockage created along the duct 410.

[0048] Annular valve 500 is configure to fit inside of the skirt 420 and extends radially inward a sufficient amount to cover and seal the vent apertures 431. A groove, rib or other feature on the skirt 420 may provide an interference fit to ensure the valve 500 does not become displaced.

[0049] The valve 500 is thinner along those portions covering the vents 431. In this manner, the thinner portion will deflect downward in response to negative pressures and allow make up air to flow around the funnel 415, through the vents 431 and into the container. While the thinner portions 510 of valve 500 are shown along the inner portion of the annulus, other configurations may be possible. Also, portion 510 may extend up to and abut the extension 413, or the vents 431 could be spaced away from the extension 413 to allow for the use of a smaller valve flap 500.

[0050] The remaining features of the pump relate to its basic function. For example, a dip tube 100 ensures fluid can be drawn up from the internal volume of the container, and the length and width of the tube 100 compliments the container, as well as how it couples to its mount on closure 400. The container is configured to couple to the pump body, usually by way of a threaded connection, so that the pump engages a corresponding set of features at or proximate to the container mouth. The container itself must retain the fluid(s) to be dispensed and possess sufficient rigidity and/or venting capability to withstand the pumping motions and attendant pressure differentials created by the structures disclosed herein.

[0051] One particular advantage of the disclosed aspects relates to the appearance and functionality of the pump in comparison to more conventional dispensing pumps in which the dispenser head and nozzle are all axially displaced during actuation. Specifically, in those conventional designs, the top facing of the dispenser includes the nozzle outlet which remains fixed and immovable relative to the rest of the actuator head, causing the dispensing outlet to move axially as the fluid is being dispensed. Thus, a user must also move his/her hand in concert with the motion of the actuator head in order to capture the dispensed fluid. In contrast, the disclosed aspects insure that the nozzle outlet remains in a single location throughout the actuation and dispensing process.

[0052] Further, the integration of the movable/compressible dome 230 onto the immovable nozzle 220/sidewall 240 creates an appearance that some users find more aesthetically appealing because it does not use or expose of an extension stem (normally retracted into the pump engine and/or container). This arrangement also insures that debris will not get lodged within the internal moving parts of the pump 10 or otherwise provides an obvious means of ingress into the pump engine's components (precisely because these parts are not exposed during actuation/use).

[0053] In view of the foregoing, numerous iterations and aspects of the invention are contemplated. By way of example and not limitation, these aspects may include any functional combination of the following:

- a cap having a skirt, a flexible dome, and an outlet nozzle;
- a biasing member nested within the cap, the biasing member including an annular ring with a plurality of resilient, curved arms extending radially inward above the annular ring and a plurality of resilient, curved arms extending from the annular ring to a central base

wherein at least one engagement feature is disposed on an outer facing of the central base and at least one engagement feature is disposed on a peripheral edge of the annular ring;

- a closure element having a skirt extending downward from a top panel and a central duct with an engagement feature configured to cooperate with the at least one engagement feature on the outer facing of the central base;
- a first valve with a thinned flap sealing one or more vent holes formed in the top panel so as to allow air to selectively pass therethrough and a second valve sealing the central duct; and
- wherein the plurality of resilient curved arms above the annular ring restores the flexible dome to an original shape after actuation;
- wherein the skirt of the closure element includes an annular flange disposed on an outer facing, said annular flange interfacing with a first shelf formed on an inner facing of the skirt of the cap;
- wherein the skirt of the cap has a second shelf with engagement features configured to receive the at least one engagement feature of the annular ring;
- wherein the engagement feature on the central duct facilitates helically driven axial movement between the biasing member and the closure element;
- wherein the helically driven axial movement of the biasing member urges the closure element into a sealed and locked position relative to the biasing member and the cap;
- wherein a second valve is a ball valve positioned within the central duct;
- wherein the ball valve is locked into a sealing position by helically driven axial movement between the spring and the closure;

- wherein the annular flange of the closure includes at least one of an arcuate stopper section and a post;
- wherein the skirt of the cap includes a second shelf having at least one stopper and wherein the stopper of the cap and the arcuate stopper section and/or the post of the closure are all configured to align with locked and unlocked positions for the dispenser based upon rotation of the cap relative to the closure;
- wherein the closure includes a funnel section positioned above the top panel and fluidically connected to the central duct;
- wherein the funnel section of the closure is configured to at least partially support the resilient, curved arms extending from the annular ring to the central base of the biasing member;
- wherein a single polymeric material is used to form the cap, the closure, and the biasing member;
- wherein the single polymeric material is used to form the first valve and the second valve
- wherein a dip tube is detachably connected to the central duct of the closure; and
- wherein top facings of the closure and an underside of the flexible dome define a pump chamber with the first valve admitting make up air along a return flow path

[0054] All components should be made of materials having sufficient flexibility and structural integrity, as well as a chemically inert nature. Certain grades of polypropylene and polyethylene are particularly advantageous, especially in view of the absence of any thermosetting resins and/or different, elastomeric polymer blends. The materials should also be selected for workability, cost, and weight. Common polymers amenable to injection molding, extrusion, or other common forming processes should have particular utility.

[0055] References to coupling in this disclosure are to be understood as encompassing any of the conventional means used in this field. This may take the form of snap- or force fitting of components, although threaded connections, bead-and-groove, and slot-and-flange assemblies could be employed. Adhesive and fasteners could also be used, although such components must be judiciously selected so as to retain the recyclable nature of the assembly.

[0056] In the same manner, engagement may involve coupling or an abutting relationship. These terms, as well as any implicit or explicit reference to coupling, will should be considered in the context in which it is used, and any perceived ambiguity can potentially be resolved by referring to the drawings.

[0057] References to cylinders may mean an elongated cylinder of any variety of cross sectional shapes, although the reliance of certain components on rotational forces means that circular cross sections may be preferred. Also, the cylinders may solid, hollow, or reinforced with ribs, webbing, or other common features. To the extent hollow (or partially hollowed) cylinders are used, these interstices may form any required flowpaths or channels.

[0058] Although the present embodiments have been illustrated in the accompanying drawings and described in the foregoing detailed description, it is to be understood that the invention is not to be limited to just the embodiments disclosed, and numerous rearrangements, modifications and substitutions are also contemplated. The exemplary embodiment has been described with reference to the preferred embodiments, but further modifications and alterations encompass the preceding detailed description. These modifications and alterations also fall within the scope of the appended claims or the equivalents thereof.

CLAIMS

What is claimed is:

A. A dispenser pump substantially as described, disclosed, depicted, and/or contemplated herein.

B. Methods of making and using the pump of claim A, also as described, disclosed, depicted, and/or contemplated herein.

1. A dispenser pump made only from polymeric materials, the dispenser comprising:

a cap having a skirt, a flexible dome, and an outlet nozzle;

a biasing member nested within the cap, the biasing member including an annular ring with a plurality of resilient, curved arms extending radially inward above the annular ring and a plurality of resilient, curved arms extending from the annular ring to a central base wherein at least one engagement feature is disposed on an outer facing of the central base and at least one engagement feature is disposed on a peripheral edge of the annular ring;

a closure element having a skirt extending downward from a top panel and a central duct with an engagement feature configured to cooperate with the at least one engagement feature on the outer facing of the central base; and

a first valve with a thinned flap sealing one or more vent holes formed in the top panel so as to allow air to selectively pass therethrough and a second valve sealing the central duct; and

wherein the plurality of resilient curved arms above the annular ring restores the flexible dome to an original shape after actuation.

2. The dispenser of claim 1 wherein the skirt of the closure element includes an annular flange disposed on an outer facing, said annular flange interfacing with a first shelf formed on an inner facing of the skirt of the cap.

3. The dispenser of claim 1 wherein the skirt of the cap has a second shelf with engagement features configured to receive the at least one engagement feature of the annular ring.

4. The dispenser of claim 3 wherein the engagement feature on the central duct facilitates helically driven axial movement between the biasing member and the closure element.

5. The dispenser of claim 4 wherein the helically driven axial movement of the biasing member urges the closure element into a sealed and locked position relative to the biasing member and the cap.

6. The dispenser of claim 1 wherein a second valve is a ball valve positioned within the central duct.

7. The dispenser of claim 6 wherein the ball valve is locked into a sealing position by helically driven axial movement between the spring and the closure.

8. The dispenser of claim 2 wherein the annular flange of the closure includes at least one of an arcuate stopper section and a post.

9. The dispenser of claim 8 wherein the skirt of the cap includes a second shelf having at least one stopper and wherein the stopper of the cap and the arcuate stopper section and/or the post of the closure are all configured to align with locked and unlocked positions for the dispenser based upon rotation of the cap relative to the closure.

10. The dispenser of claim 1 wherein the closure includes a funnel section positioned above the top panel and fluidically connected to the central duct.

11. The dispenser of claim 10 wherein the funnel section of the closure is configured to at least partially support the resilient, curved arms extending from the annular ring to the central base of the biasing member.

12. The dispenser of claim 1 wherein a single polymeric material is used to form the cap, the closure, and the biasing member.

13. The dispenser of claim 12 wherein the single polymeric material is used to form the first valve and the second valve.

14. The dispenser of claim 1 wherein a dip tube is detachably connected to the central duct of the closure.

15. The dispenser of claim 1 wherein top facings of the closure and an underside of the flexible dome define a pump chamber with the first valve admitting make up air along a return flow path and the second valve expelling dispensed fluid along an expelled flow path.

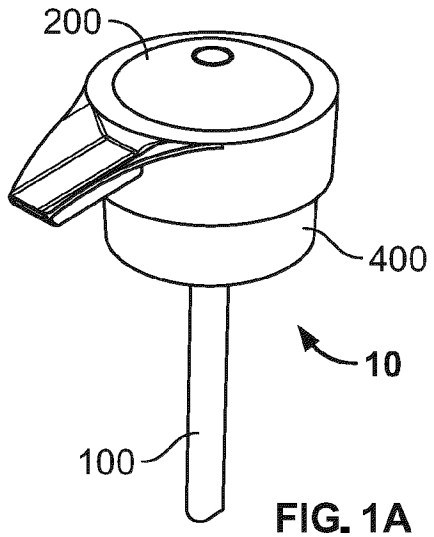

FIG. 1A

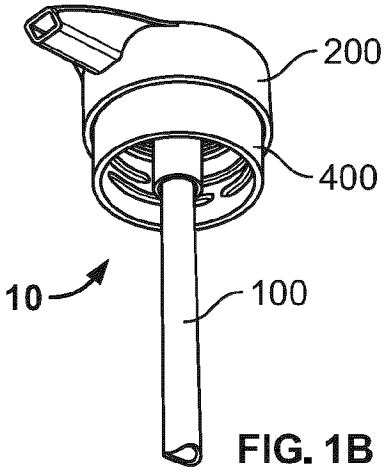

FIG. 1B

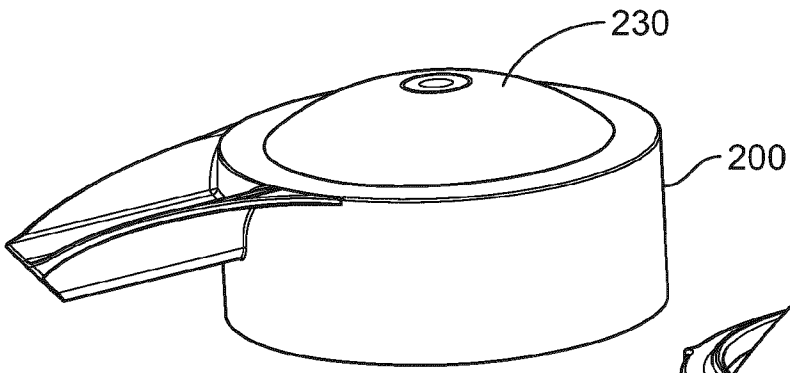

FIG. 2A

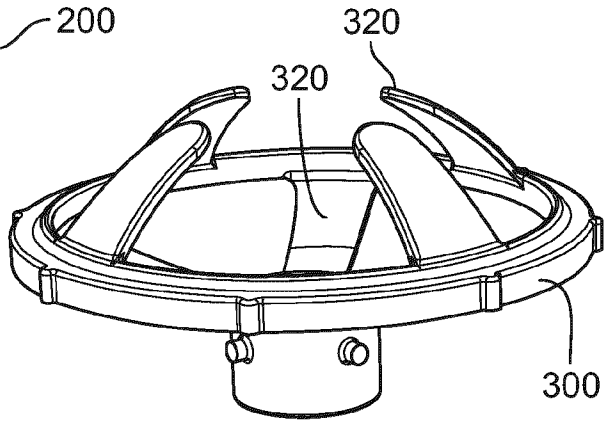

FIG. 2B

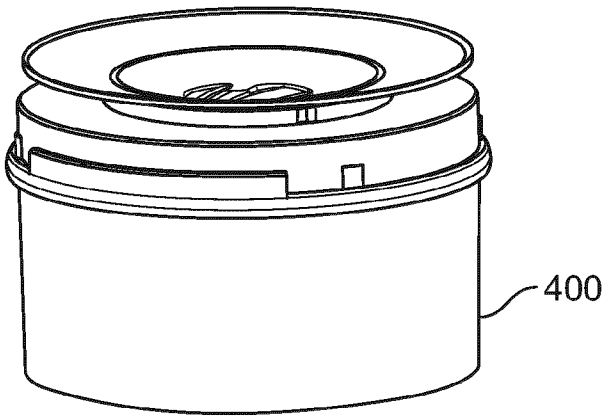

FIG. 2C

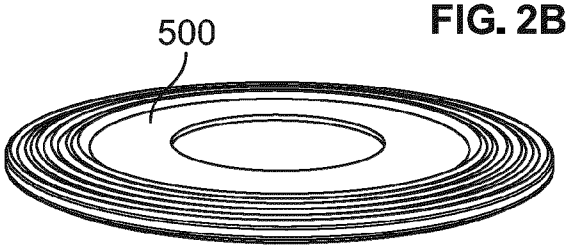

FIG. 2D

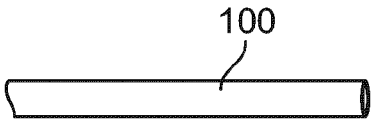

FIG. 2E

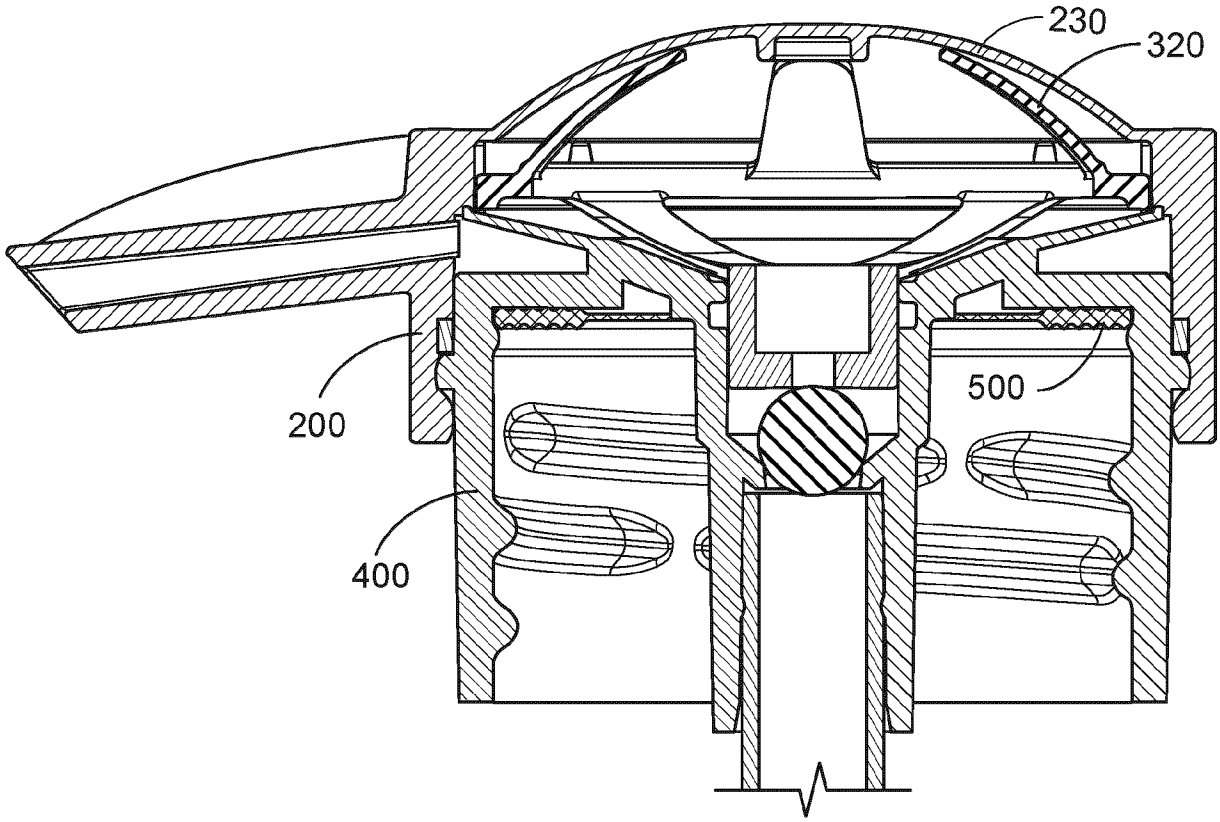

FIG. 3A

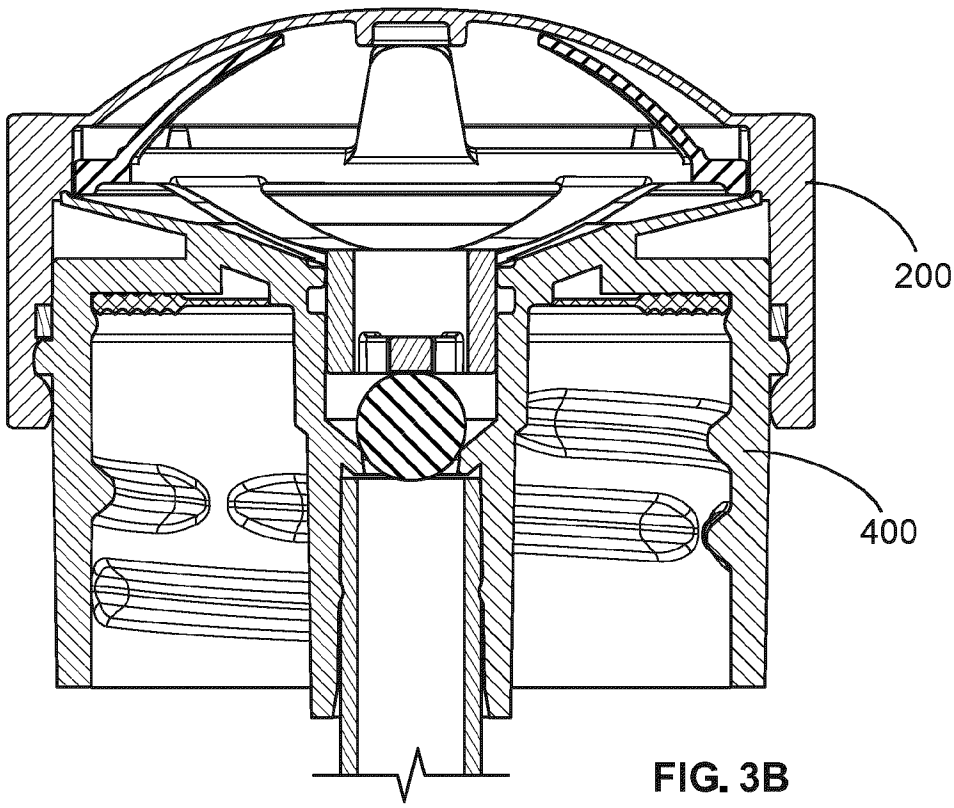

FIG. 3B

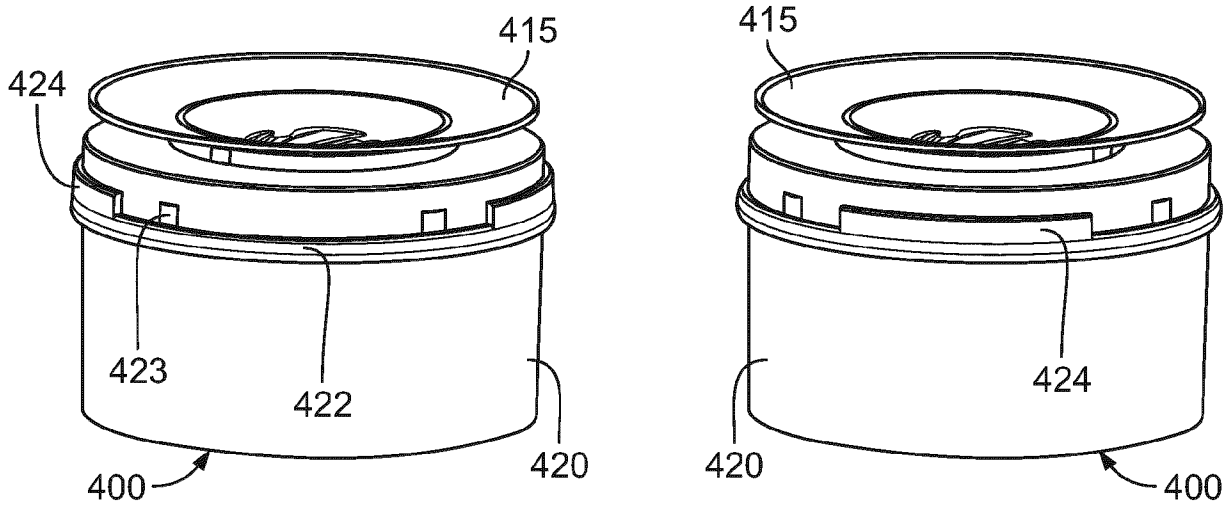

FIG. 4A

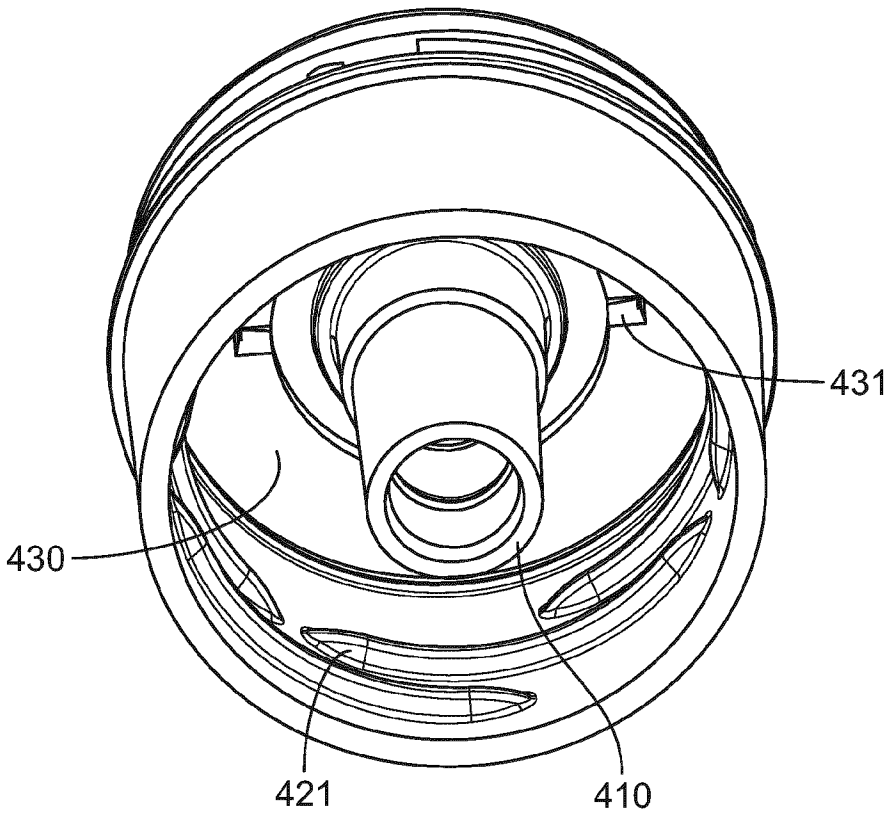

FIG. 4B

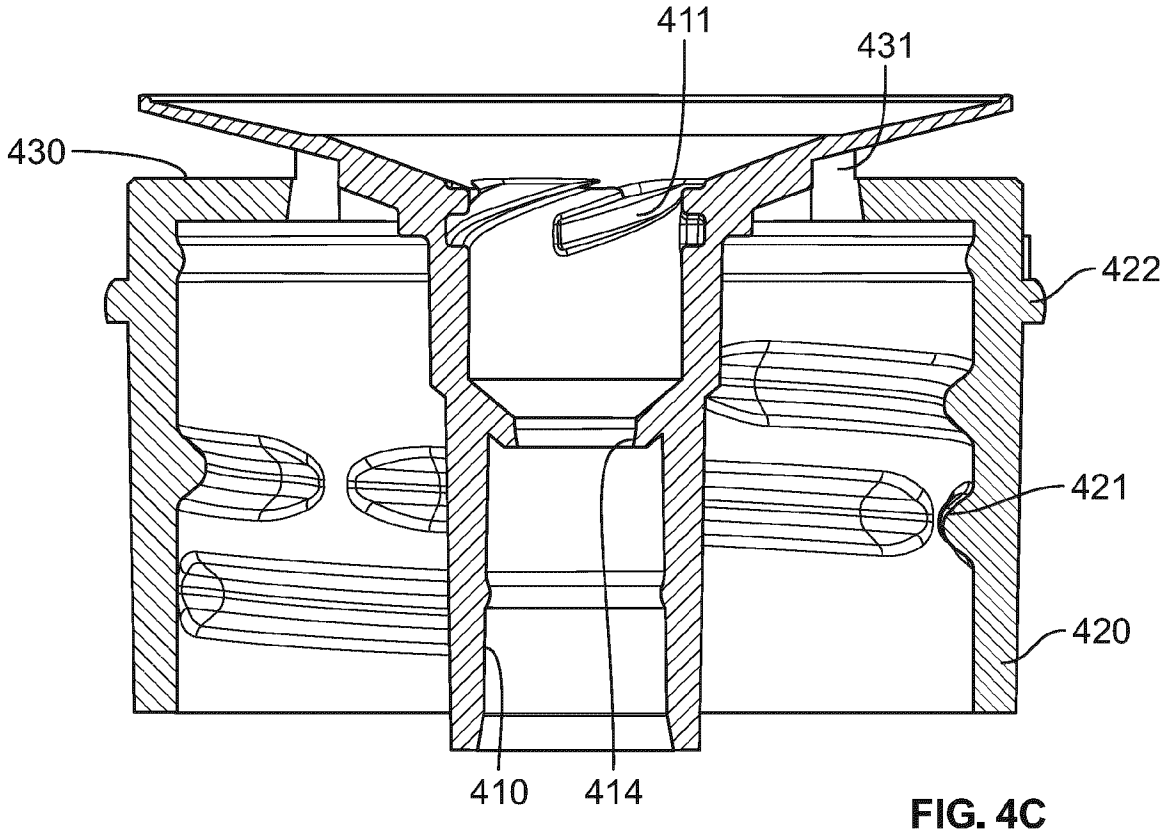

FIG. 4C

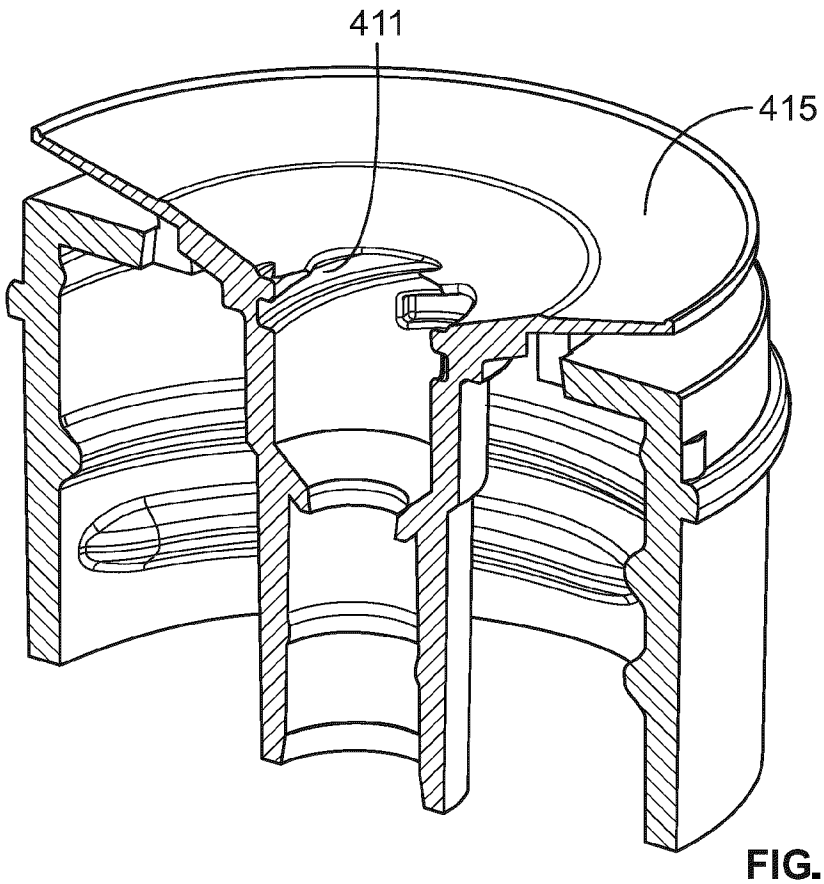

FIG. 4D

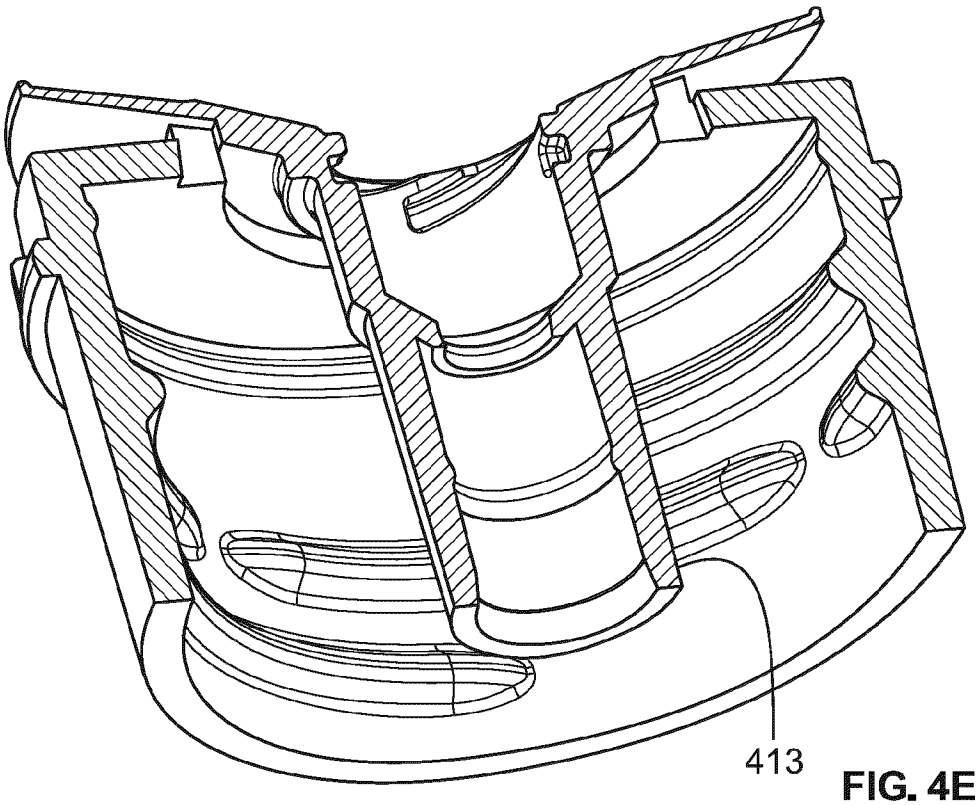

FIG. 4E

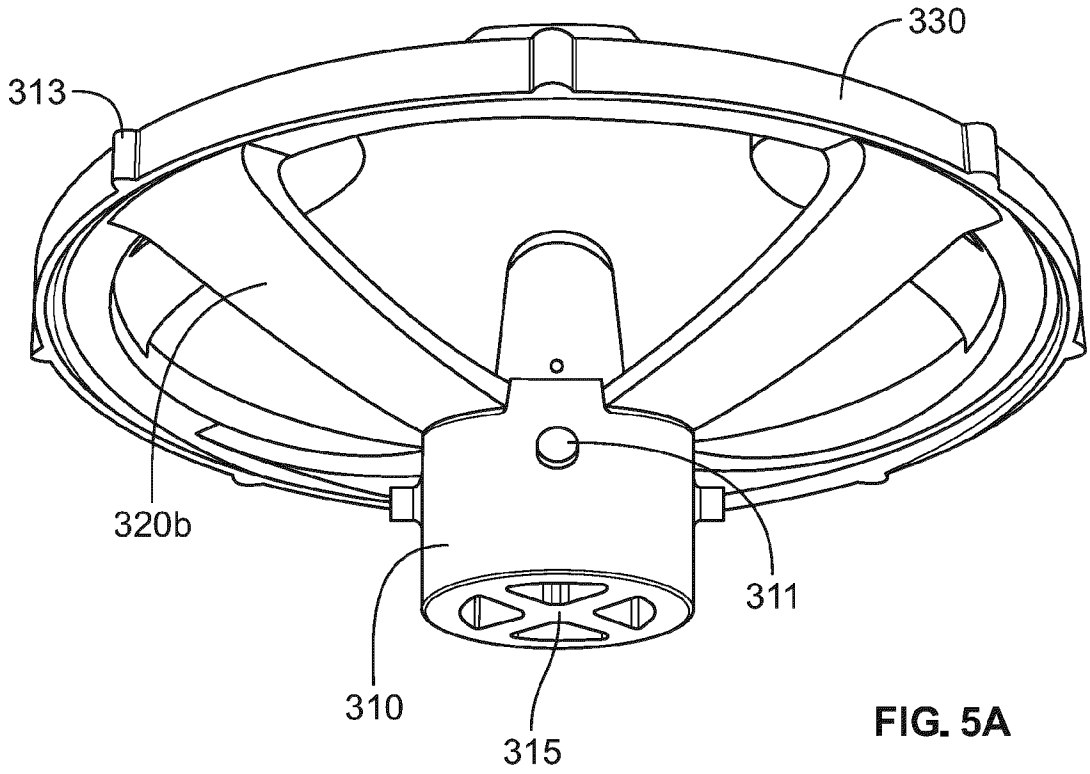

FIG. 5A

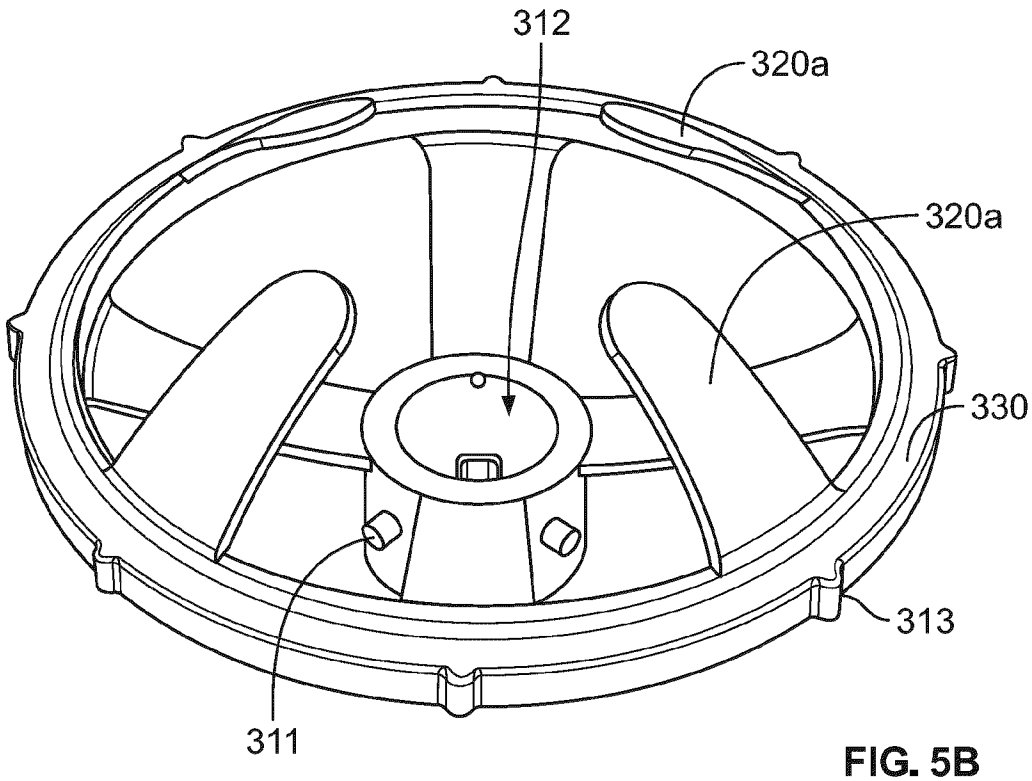

FIG. 5B

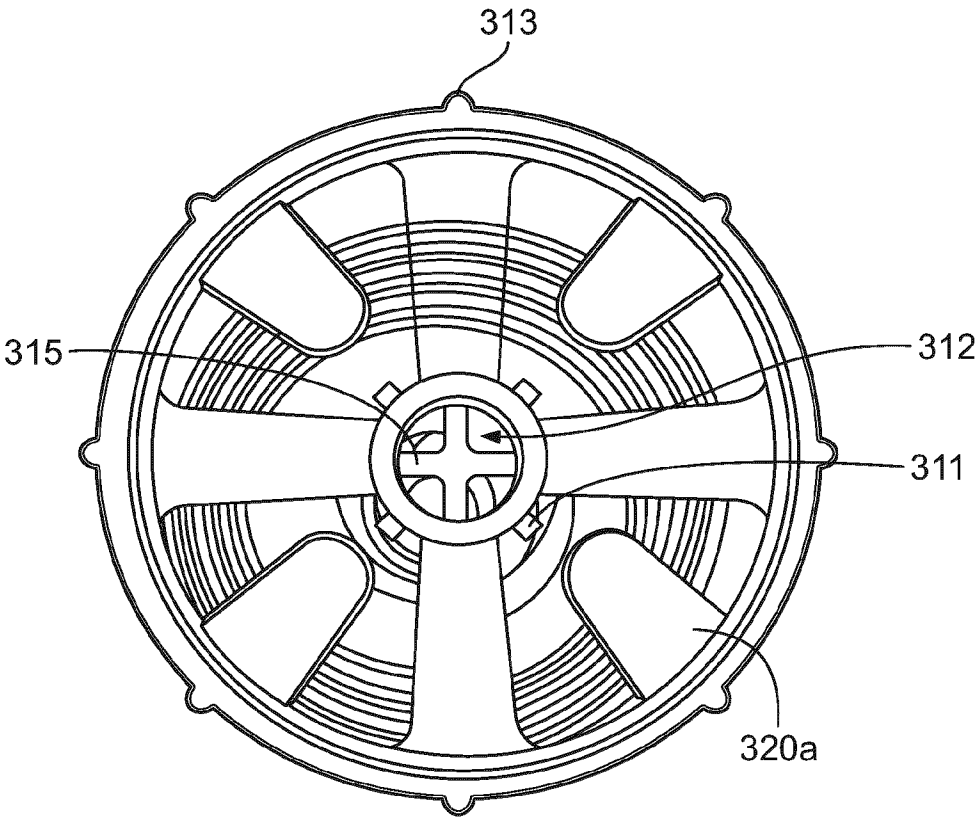

FIG. 5C

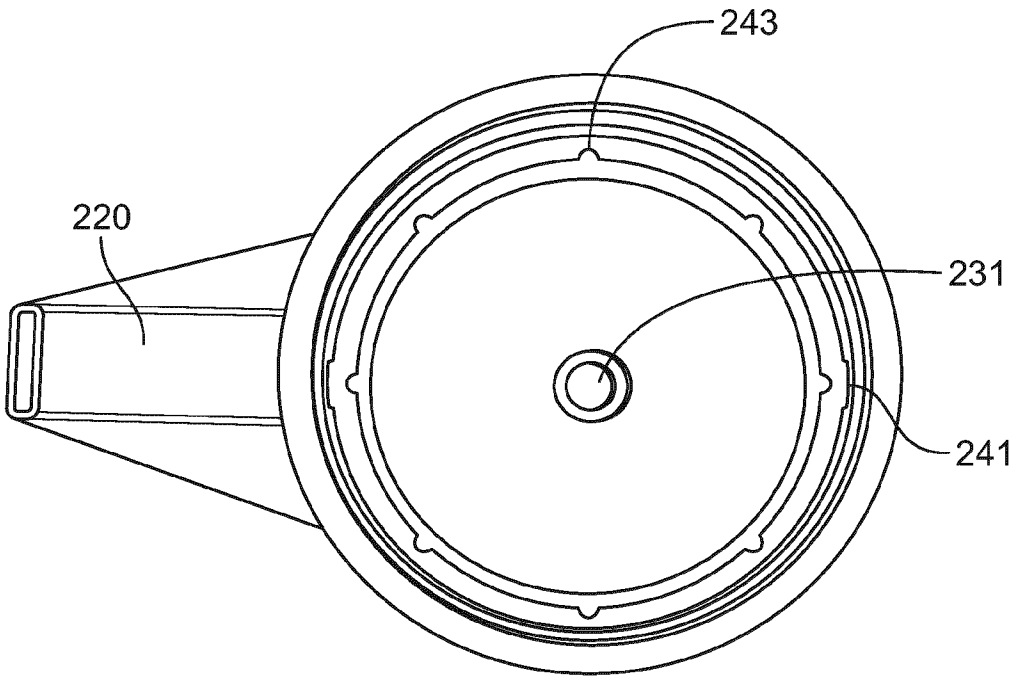

FIG. 6A

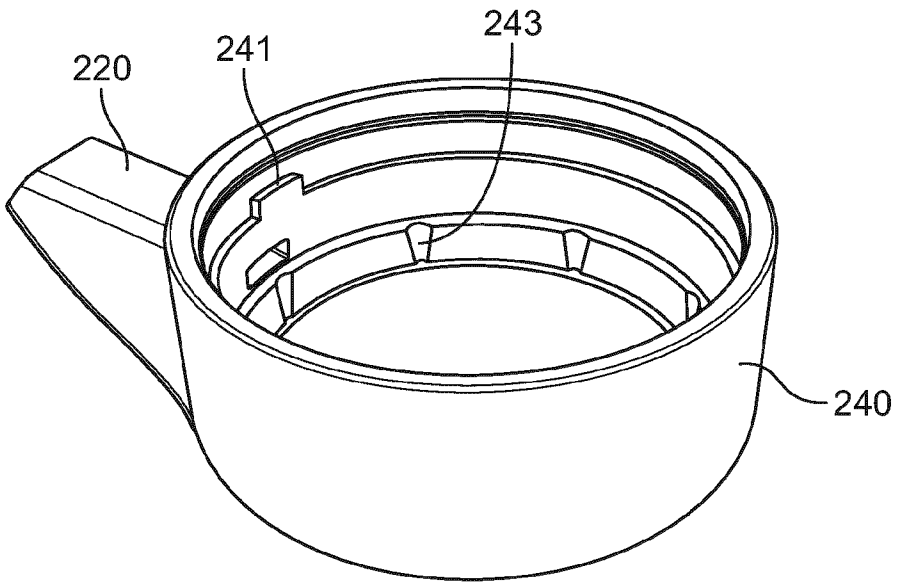

FIG. 6B

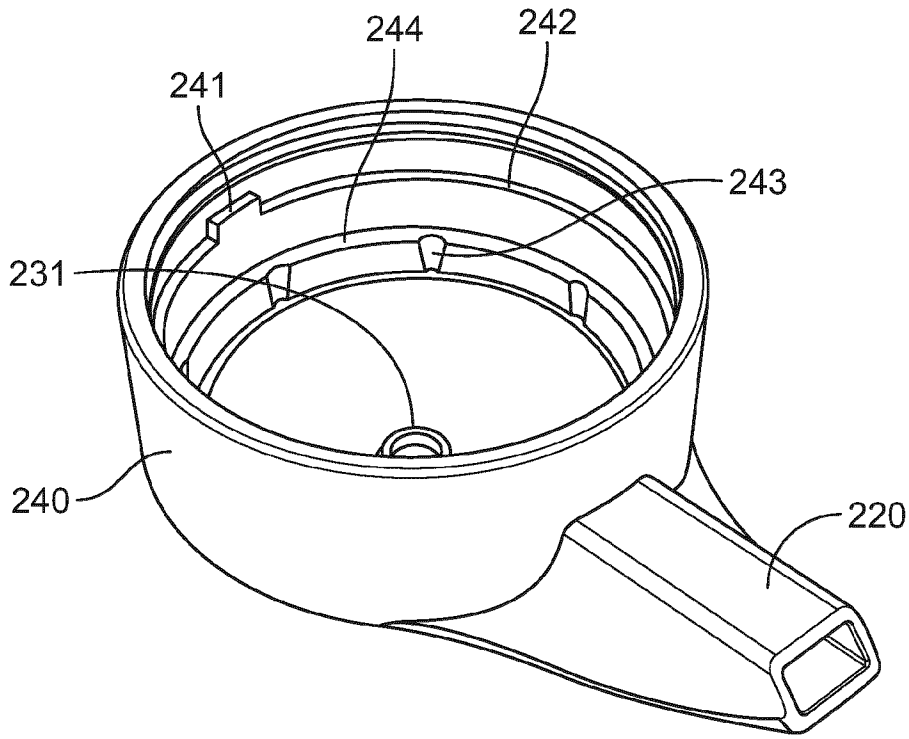

FIG. 6C

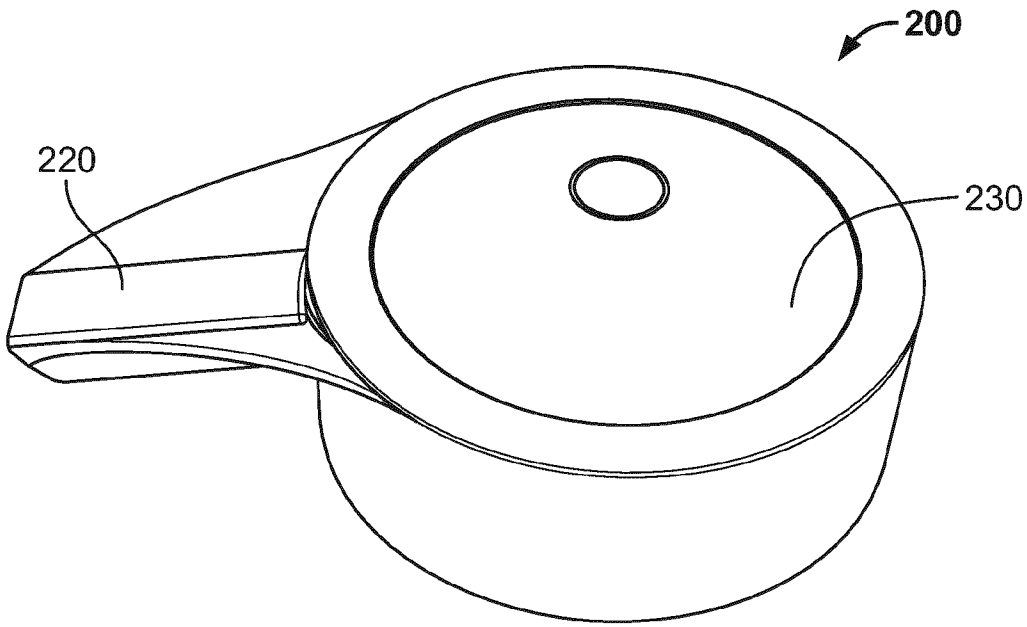

FIG. 6D

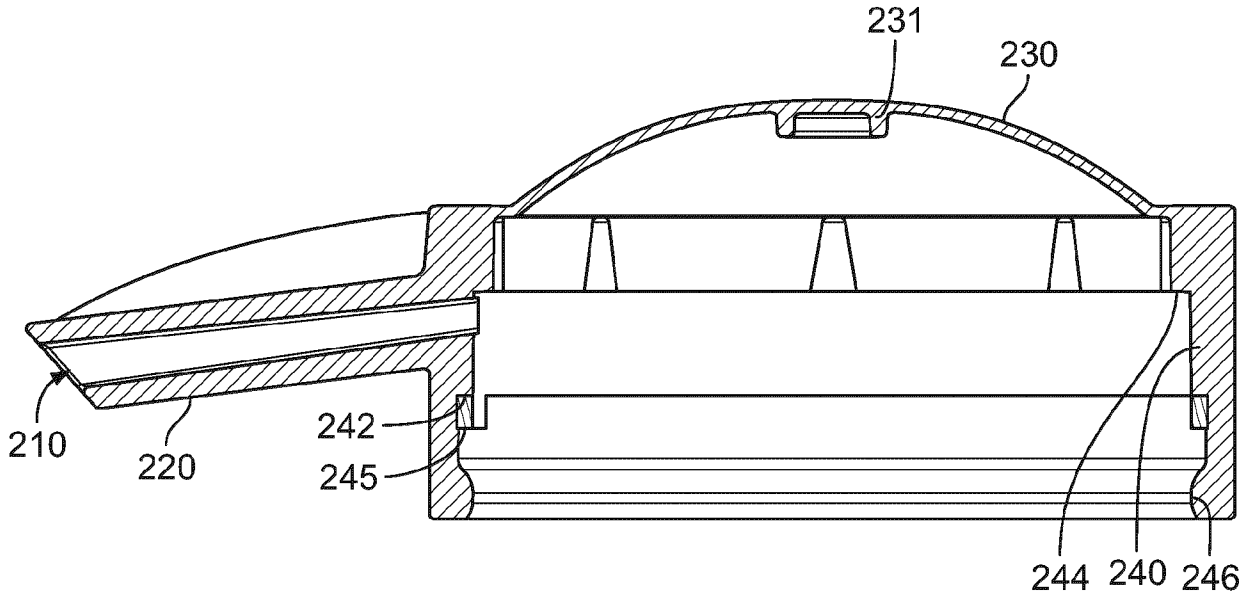

FIG. 6E

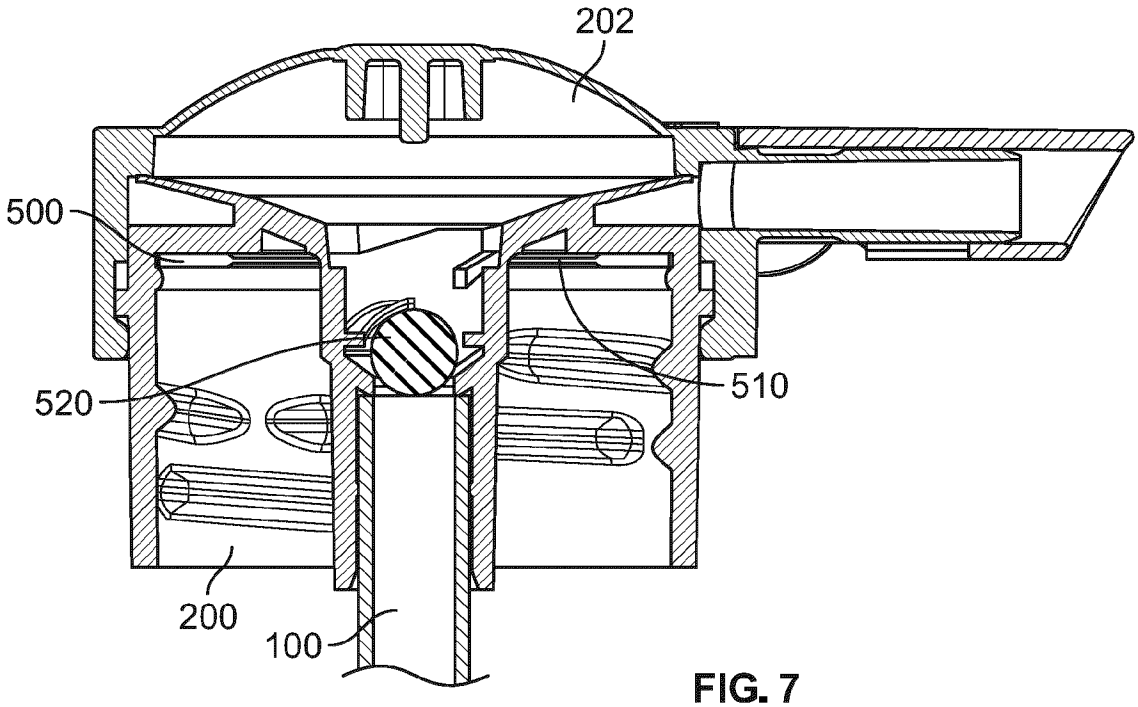

FIG. 7

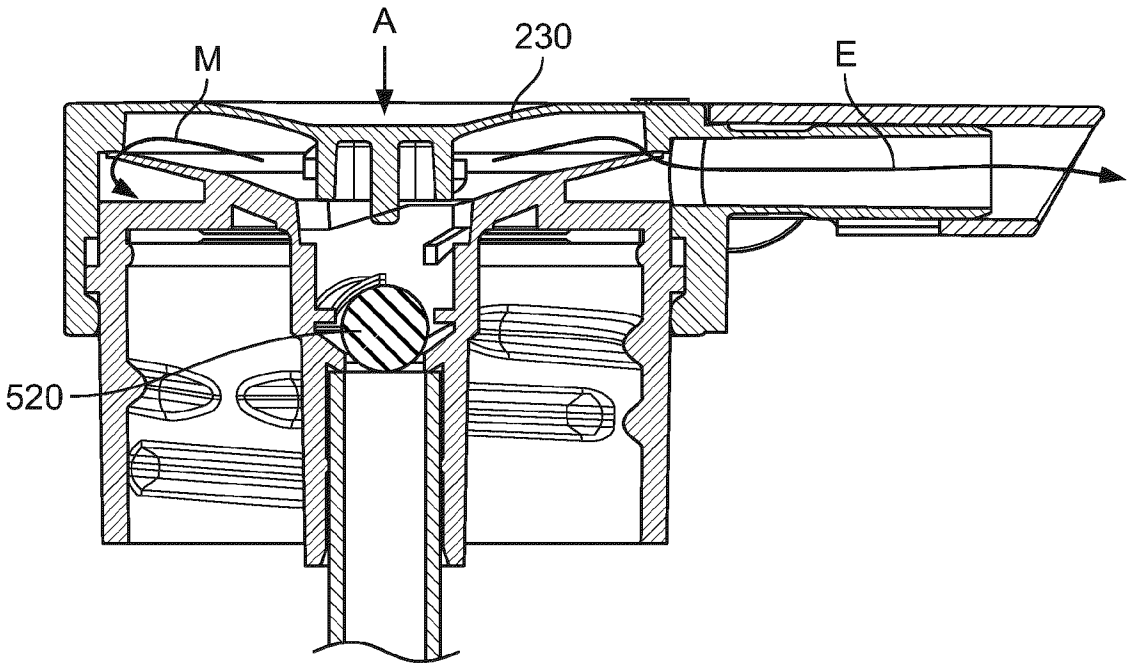

FIG. 8

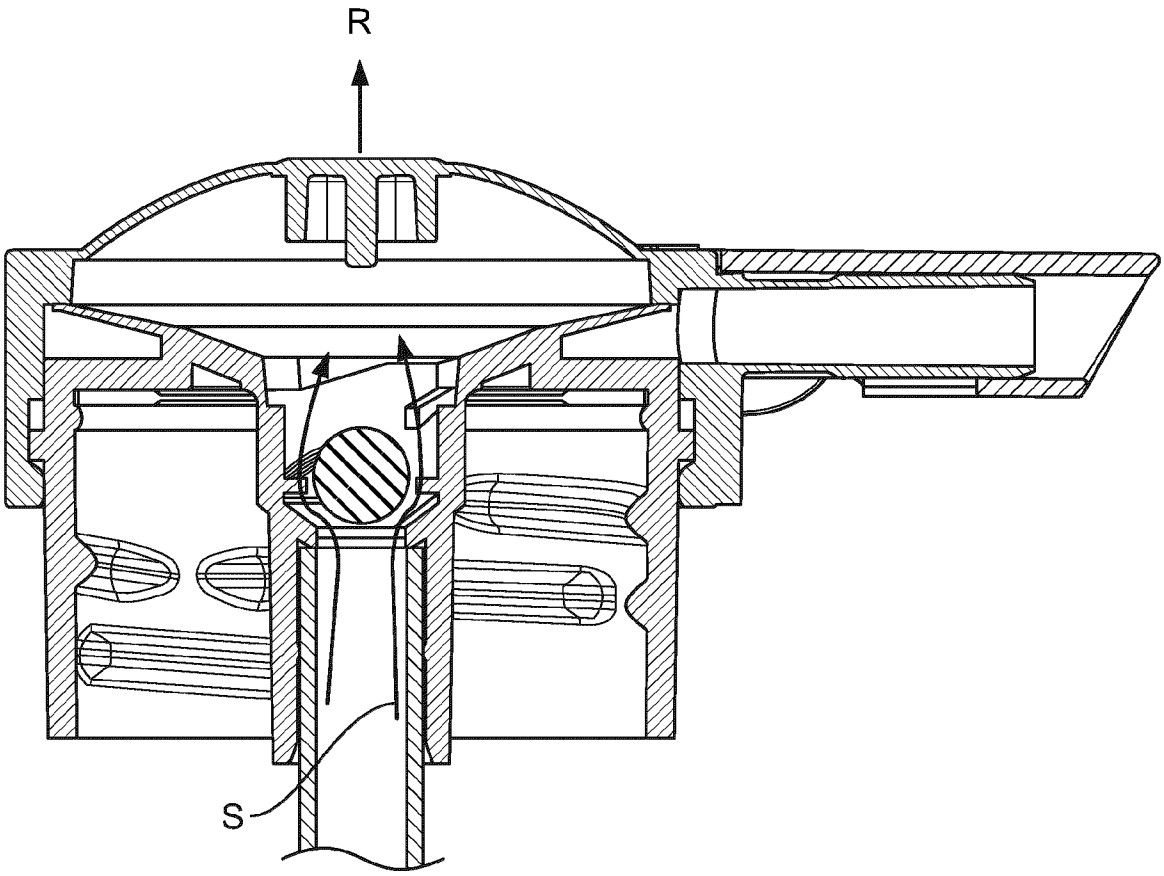

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2022/071869

A. CLASSIFICATION OF SUBJECT MATTER
INV. B05B11/00
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)
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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2011/139825 A1 (HOUGHTON WESTON RICHARD [US]) 16 June 2011 (2011-06-16) the whole document	1-15
A	US 5 871 126 A (BENNETT ROBERT [US] ET AL) 16 February 1999 (1999-02-16) the whole document	1-15
A	WO 2020/144532 A1 (TAPLAST SRL [IT]) 16 July 2020 (2020-07-16) the whole document	1-15
A	US 2007/164052 A1 (JULIAN PIDEVALL SANTIAGO [ES] ET AL) 19 July 2007 (2007-07-19) the whole document	1-15

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

☒ See patent family annex.

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"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	Date of mailing of the international search report
11 November 2022	21/11/2022

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Lindner, Volker

INTERNATIONAL SEARCH REPORT

Information on patent family members

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