(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 October 2014 (09.10.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/163700 A1

(51) International Patent Classification:
*B01F 9/00* (2006.01) *G01N 35/10* (2006.01)
*B01L 9/06* (2006.01)

(21) International Application Number:
PCT/US2013/078036

(22) International Filing Date:
27 December 2013 (27.12.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
13/801,154 13 March 2013 (13.03.2013) US

(71) Applicant: **ABBOTT LABORATORIES** [US/US]; 100 Abbott Park Road, Dept. 377, AP6A-1, Abbott Park, Illinois 60064-6008 (US).

(72) Inventor: **LUOMA, Robert Paul**; 4300 Shadow Ridge Drive, Colleyville, Texas 76034 (US).

(74) Agent: **FLECK, Michael H.**; HANLEY, FLIGHT & ZIMMERMAN, LLC, 150 S. Wacker Drive, Suite 2200, Chicago, Illinois 60606 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,

*[Continued on next page]*

(54) Title: METHODS AND APPARATUS TO AGITATE A LIQUID

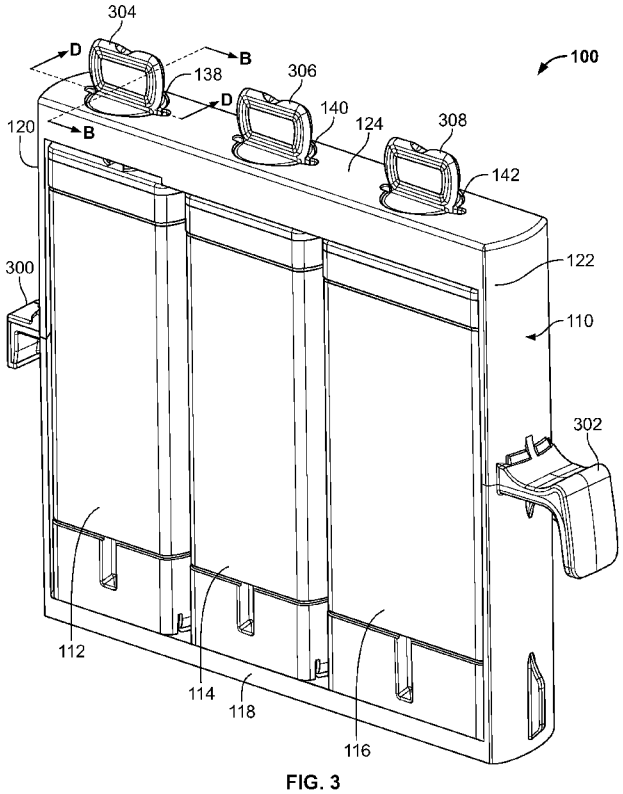



FIG. 3

(57) Abstract: Method and apparatus to agitate a liquid are disclosed herein. An example apparatus includes a first sidewall and a second sidewall substantially parallel to the first sidewall. The example apparatus also includes a top wall coupled to the first sidewall and the second sidewall. The example apparatus further includes a bottom wall opposite the top wall and coupled to the first sidewall and the second sidewall. The bottom wall has a first side to define a cavity to hold a liquid. The example apparatus also includes a protrusion extending from the first side of the bottom wall toward the top wall.

WO 2014/163700 A1

EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

**Published**:

— *with international search report (Art. 21(3))*

# METHODS AND APPARATUS TO AGITATE A LIQUID

## FIELD OF THE DISCLOSURE

**[0001]** This disclosure relates generally to fluid analyzers and, more particularly, to methods and apparatus to agitate a liquid.

## BACKGROUND

**[0002]** Automated analyzers are used to analyze samples including biological material gathered from patients for diagnostic purposes. Generally, analysis of a sample involves reacting the sample with one or more reagents in a liquid container. Some automated analyzers store reagents in containers on a carousel. When a particular reagent is needed, the carousel is rotated to move the container holding the reagent to be adjacent an aspirating/dispensing device. The carousel moves by accelerating and decelerating, which subjects the reagents to rotational forces that could cause microparticles to be suspended in the reagents. However, some of the microparticles in the container may accumulate at the bottom of the container.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0003]** FIG. 1A illustrates an example cartridge that is holding a plurality of example containers and which is coupled to a portion of an example carousel with a first container in a first position.

**[0004]** FIG. 1B illustrates the example cartridge of FIG. 1A with the first container in a second position.

**[0005]** FIG. 2 is a cross-sectional view taken along the A-A line of FIG. 1A.

**[0006]** FIG. 3 is a perspective view of the example cartridge and containers of FIGS. 1A and 2 decoupled from the carousel and sealed.

**[0007]** FIG. 4 illustrates a plurality of seats for the example containers of the example cartridge of FIGS. 1A-3.

**[0008]** FIG. 5 is an enlarged view of the lower portion of the example containers and cartridge of FIG. 2 decoupled from the example carousel.

**[0009]** FIG. 6 is a perspective, cross-sectional view of a top portion of an example first container and the example cartridge taken along the B-B line of FIG. 3.

**[0010]** FIG. 7 is an enlarged view of the first container of FIG. 2 in an unlocked position.

**[0011]** FIG. 8 is a top, cross-sectional view of the example first container taken along the C-C- line of FIG. 1A.

**[0012]** FIG. 9 is a cross-sectional view of the example first container taken along the D-D line of FIG. 3 and removed from the example cartridge.

**[0013]** FIG. 10 is a side cross-sectional view of the example first container taken along the B-B line of FIG. 3 and removed from the example cartridge.

**[0014]** FIG. 11 illustrates an alternative bottom wall of the example first container of FIGS. 6-9.

**[0015]** FIG. 12 is a top view of the example bottom wall of FIG. 11.

**[0016]** FIG. 13 is a flowchart representative of an example method disclosed herein.

**[0017]** Some of the figures or some of the portions of the figures may not be to scale. Instead, to clarify multiple layers and regions, the thickness of the layers may be enlarged in the drawings. Wherever possible, the same reference numbers will be used throughout the drawing(s) and accompanying written description to refer to the same or like parts. As used in this patent, stating that any part (e.g., a layer, film, area, or plate) is in any way positioned on (e.g., positioned on, located on, disposed on, or formed on, etc.) another part, means that the referenced part is either in contact with the other part, or that the referenced part is above the other part with one or more intermediate part(s) located therebetween. Stating that any part is in contact with another part means that there is no intermediate part between the two parts.

## DETAILED DESCRIPTION

**[0018]** Disclosed herein are methods and apparatus to agitate a liquid such as, for example, a liquid reagent in a container of an automatic diagnostic analyzer, which may be, for example, a clinical chemistry analyzer, an immunoassay analyzer, and/or a hematology analyzer. Some reagents used in automatic diagnostic analyzers include a liquid and microparticles, where the microparticles are to be mixed and, in some examples, substantially uniformly dispersed in the liquid. Automatic diagnostic analyzers typically rotate reagent containers or bottles about an axis and the rotation imparts forces on the contents of the containers to mix the contents. Traditional reagent bottles are cylindrical and include internal fins that are used to mix and disperse particles in the liquid of the reagent.

**[0019]** The examples disclosed herein use rectangular, rounded rectangular or substantially rectangularly-shaped reagent containers. The examples disclosed herein achieve uniform mixing and dispersion of reagents such as, for example, reagents including microparticles. These disclosed examples provide greater space utilization in diagnostic systems than many known configurations. As a result, using examples described herein, analyzers can have an increased load capacity and/or smaller size, compared to many known systems. In some examples, one of the containers or bottles is about 20 millimeters (mm) deep, about 36 mm wide and about 92 mm high. Other examples may have other dimensions. Another advantage of the disclosed examples is that the example bottles can be created with fabrication techniques such as, for example, blow molding, that reduce cost compared to the fabrication techniques of many known configurations.

**[0020]** In the examples disclosed herein, flat opposing sides of the example bottles create a mixing action in a liquid in the bottle in response to acceleration and deceleration of the bottles. An example bottle disclosed herein is rotated about its central longitudinal axis in an oscillating manner. In addition, the bottle is coupled to a cartridge that is rotated about a rotational axis of a carousel. The bottle and a cap include features, as disclosed herein, that provide bearing surfaces for rotation of the bottle. The bottle may be composed of a material or materials to enable one or more surfaces of the

bottle to function as a disposable bearing. In some examples, the bottle may be composed of a high density polyethlyene that has excellent wear characteristics and which can withstand, for example, a 30-day on-board use period (e.g., continuous use on a diagnostic analyzer) with negligible wear. The acceleration and deceleration and the rectangular walls impart forces on the liquid in the bottle to promote mixing of the contents of the bottle. A rounded or curved bottom of the interior of the bottle also aids in mixing by creating upward motion on particles that may accumulate at the bottom of the bottle as a result of settling that occurs when the bottle is stationary. More specifically, centrifugal force created by the rotation of the bottle moves such settled particles out from the center of the bottom of the bottle and lifts the particles as the particles follow the contour of the bottle bottom. In some examples, visible confirmation of a uniform mixing is achieved in about one minute of oscillating motion. Other mixing periods and oscillation rates may be used depending on the reagent(s) used, the microparticle(s) used, the diagnostic test(s) to be conducted and/or other factors.

**[0021]** Disclosed herein is an example apparatus that includes a base, a first end wall and a second end wall. The example apparatus also includes a first container and a second container having a rounded rectangular cross-sectional shape and forming a rounded rectangular block i.e., a bar-shaped object having rounded edges (collectively referred to as a rounded rectangular shape). In addition, the example apparatus includes a first container support to retain the first container The example first container support includes first posts to engage a first rim of the first container to non-rotatably couple the first container to the base. Also, the example apparatus includes a second container support to retain the second container. The example second container support includes a collar to engage a groove of the second container and a ridge to engage a second rim of the second container. The example second container is selectively rotatable relative to the base.

**[0022]** In some examples, the example apparatus also includes a third container support to retain a third container. The example third container

support includes second posts to engage a third rim of the third container to non-rotatably couple the third container to the base.

**[0023]** In some examples, the apparatus is to rotate about a first axis of rotation, and the second container is to rotate relative to the base about a second axis of rotation.

**[0024]** In some examples, the second container is movable between a locked position in which the second rim of the second container is engaged with the ridge to non-rotatably couple the second container to the base and an unlocked position in which the second container is raised so that the second rim is disengaged from the ridge and the groove is rotatable about the collar.

**[0025]** In some examples, the apparatus includes a cover having a first aperture to access the first container and a second aperture to access the second container.

**[0026]** Also disclosed herein is an example apparatus that includes a first sidewall and a second sidewall substantially parallel to the first sidewall. The example apparatus also includes a top wall coupled to the first sidewall and the second sidewall. The example apparatus further includes a bottom wall opposite the top wall and coupled to the first sidewall and the second sidewall. The bottom wall has a first side to define a cavity to hold a liquid. The example apparatus also includes a protrusion extending from the first side of the bottom wall toward the top wall.

**[0027]** In some examples, the protrusion is disposed on a center of the bottom wall. Also, in some examples, the protrusion is disposed on an axis of rotation of the bottom wall. In addition, in some examples, the protrusion has an apex disposed along an axis of rotation of the bottom wall.

**[0028]** In some examples, the example apparatus includes a third sidewall and a fourth sidewall opposite the third sidewall. In this example, the third sidewall and the fourth sidewall are curved.

**[0029]** In some examples, the bottom wall has a first radius of curvature, and the protrusion has a second radius of curvature different than the first radius of curvature. In some examples, the first radius of curvature is oriented in a first

direction and the second radius of curvature is oriented in a second direction different than the first direction.

**[0030]** In some examples, the first sidewall includes a rib extending toward the second sidewall. Also, in some examples, the apparatus includes a post depending from a first side of the bottom wall. In such examples, the protrusion extends from a second side of the bottom wall. In some examples, the post defines a plurality of notches. Also, in some examples, the notches are engageable with a rotation mechanism to rotate the apparatus about an axis of rotation aligned with the concave portion, i.e., coaxial with a central axis of the concave portion.

**[0031]** In some examples, the first sidewall includes a first planar portion and the second sidewall includes a second planar portion. In addition, in some examples, the example apparatus includes a third sidewall and a fourth sidewall opposite the third sidewall. In such examples, at least two of the first sidewall, second sidewall, third sidewall or fourth sidewall include a rim to engage a ridge on a carrier to hold the container in a non-rotatable position.

**[0032]** Also disclosed herein is an example method that includes lifting a first container from a first position in which a rim of the first container is engaged with a ridge of a carrier and a groove of the first container is engaged with a collar of the carrier to a second position in which the rim is disengaged from the ridge and the groove is engaged with the collar. The example method also includes rotating the first container about an axis of rotation and mixing contents of the first container. In such examples, the contents are mixed by a first substantially flat sidewall of the first_container and a bottom protrusion of the first_container.

**[0033]** In some examples, the example method includes non-rotatably supporting a second container on the carrier while rotating the first container. In addition, in some examples, the example method includes lowering the first container to the first position to non-rotatably couple the first container to the carrier.

**[0034]** Turning now to the figures, FIG. 1A is a perspective view of an example cartridge 100 coupled to a carousel 102 of a diagnostic analyzer. In

the illustrated example, the carousel 102 includes a platform 104 on which the cartridge 100 is supported. The cartridge 100 may be transported to and/or placed on the platform 104 manually, by a robotic device, via a conveyer, and/or via any other device and/or technique. During operation of the example carousel 102, the platform 104 and, thus, the cartridge 100 rotates about a first axis of rotation 106 along a substantially circular path 108 defined by the carousel 102. In some examples, multiple cartridges are coupled to the platform 104.

**[0035]** In some examples, the platform 104 moves periodically or aperiodically in one direction, e.g., in the direction of path 108. In other examples, the platform 104 moves in a back-and-forth (e.g., oscillating) motion. For example, the platform 104 may repeatedly move a first distance in a first direction (e.g., clockwise) and then a second distance in a second direction (e.g., counterclockwise) opposite the first direction. In some examples, the first direction is greater than the second direction such that the cartridge 100 on the platform 104 revolves about the first axis of rotation 106 via the back-and-forth motion. In some examples, after the platform 104 moves in the first direction, the platform 104 is substantially stationary for a given amount of time before moving in the second direction.

**[0036]** In the illustrated example, the cartridge 100 includes a base or carrier 110, a first container 112, a second container 114 and a third container 116. In some examples, there may be other numbers of containers, including, for example, one, two, four, five, six, etc. Also, in some examples, one or more containers may be divided into a multiple compartments to increase the number of compartments on a carrier. Thus, a carrier could include three containers, and one container could have three compartments so that there are a total of five compartments on a carrier. Other combinations are possible. In the illustrated example, the carrier 110 is coupled to the platform 104 to rotate with the platform 104. The example carrier 110 includes a seat 118, a first end wall 120, a second end wall 122 and a cover 124. In the illustrated example, first ends 126, 128, 130 of the first container 112, the second container 114 and the third container 116, respectively, are coupled to the seat 118, and

second ends 132, 134, 136 of the first container 112, the second container 114 and the third container 116, respectively, are coupled to the cover 124.

**[0037]** In the illustrated example, the first container 112, the second container 114 and the third container 116 are arranged in the carrier 110 radially relative to the circular path 108 defined by carousel 102. In the illustrated example, the first container 112 is disposed adjacent the first end wall 120, the third container 116 is disposed adjacent the second end wall 122, and the second container 114 is disposed between the first container 112 and the second container 114. The example containers 112, 114, 116 have rounded-rectangular shapes. In other examples, the containers 112, 114, 116 have other shapes (e.g., rectangular, square, cylindrical, triangular shapes or other suitable shapes). Each of the containers 112, 114, 116 is to hold a liquid. In some examples, the liquid includes a sample to be analyzed, one or more reagents and/or solid particles (e.g., latex coated paramagnetic particles and/or other microparticles). The example cover 124 includes three apertures 138, 140, 142 to provide access to the containers 112, 114, 116. For example, the liquid may be deposited into and/or removed from the first container 112, the second container 114 and the third container 116 via the respective apertures 138, 140, 142. In some examples, the first container 112, the second container 114 and/or the third container 116 have about the same liquid volume capacity. In other examples, the first container 112, the second container 114 and/or the third container 116 have different liquid volume capacities. The first container 112, the second container 114 and/or the third container 116 may be filled with the same amount or different amounts of liquid.

**[0038]** FIG. 1B is a perspective view of the example cartridge 100 as the first container 112 is rotated relative to the carrier 110 about a second axis of rotation 144. In the illustrated example, the first container 112 is coupled to the carrier 110 to enable the first container 112 to rotate with the carrier 110 about the first axis of rotation 106 and relative to the carrier 110 about a second axis of rotation 144. In some examples, the rotation of the first container 112 relative to the carrier 110 corresponds to the movement of the platform 104. In the illustrated example, as the cartridge 100 moves in the

first direction with the platform 104, the first container 112 is rotated two revolutions relative to the carrier 110 in the first direction. As the cartridge 100 moves in the second direction with the platform 104, the first container 112 moves one revolution relative to the carrier 110 in the second direction. In this manner, the first container 112 moves in a back-and-forth and/or oscillating motion relative to the carrier 110. The above-noted numbers of revolutions of the first container 112 relative to the carrier 110 in the first direction and the second direction and the manner (e.g., the back-and-forth movement) in which the container moves relative to the carrier 110 are merely examples. In other examples, the first container 112 rotates relative to the carrier 110 in other manners, numbers of revolutions, directions, etc. In some examples, the first container 112 rotates fully about the second axis of rotation 144, and in some examples, the first container 112 oscillates back and forth about the second axis of rotation 144. Also, in some examples, the first container 112 moves about the second axis of rotation 144 while the carousel 102 is stationary relative to the first axis of rotation 106.

**[0039]** FIG. 2 is a cross-sectional view of the example cartridge 100 coupled to the carousel 102 taken along the A-A line of FIG. 1A. The example cartridge 100 is removably coupled to the carousel 102 via the carrier 110. In the illustrated example, the platform 104 includes a first prong 200 and a second prong 202 to engage corresponding structures (e.g., apertures, female connectors, etc.) on the carrier 110 and hold the carrier 110 in place relative to the platform 104. In other examples, the cartridge 100 is removably coupled to the carousel 102 in other manners (e.g., via one or more clamps, clips, bolts, snaps, spring-loaded pins, and/or other mechanical fasteners).

**[0040]** In the illustrated example, the first container 112, the second container 114 and the third container 116 each includes a throat 203, 205, 206 (e.g., a tube or pipe in fluid communication with one of the containers 112, 114, 116) in communication with (e.g., extending into) one of the apertures 138, 140, 142 of the cover 124. During operation of the example carousel 102, liquid may be dispensed (e.g., deposited) and/or aspirated (e.g., removed) from the containers 112, 114, 116 via the throats 203, 205, 206 (e.g., via a pipette).

**[0041]** In the illustrated example, the second container 114 and the third container 116 are coupled to the carrier 110 such that the second container 114 and the third container 116 are substantially stationary relative to the carrier 110 during operation of the carousel 102 (e.g., as the platform 104 moves the cartridge 100 along the circular path 108).

**[0042]** In the illustrated example, the carousel 102 includes a coupling 210 to rotate the first container 112 relative to the carrier 110 about the second axis of rotation 144. In the illustrated example, the seat 118 of the carrier 110 defines a fourth aperture 212 adjacent the first end 126 of the first container 112. In the illustrated example, the coupling 210 extends from beneath the platform 104 in the orientation of FIG. 2 through the fourth aperture 212 to engage the first container 112. As described in greater detail below in conjunction with FIG. 8, the coupling 210 lifts the first container 112 from the seat 118 to enable the first container 112 to rotate relative to the carrier 110 about the second axis of rotation 144.

**[0043]** The example coupling 210 of FIG. 2 is a male connector to engage a female connector 214 disposed on the first end 126 of the example first container 112. In other examples, the male connector 210 and the female connector 214 may be reversed. In the illustrated example, the male coupling 210 includes a shaft 216 having protrusions 218, and the example female connector 214 includes a post 220 having notches 222 to receive the protrusions 218 of the shaft 216. In the illustrated example, the coupling 210 is operatively coupled to a rotation mechanism 224 (e.g., a gear). The rotation mechanism 224 is operatively coupled to a drive mechanism (e.g., a motor) (not shown) of the carousel 102.

**[0044]** In some examples, as the carousel 102 rotates the platform 104 about the first axis of rotation 106, the rotation mechanism 224 and the coupling 210 are rotated about the second axis of rotation 144 to rotate the first container 112 about the second axis of rotation 144 relative to the carrier 110. Thus, in the illustrated example, the coupling 210 defines the second axis of rotation 144. In the illustrated example, the second axis of rotation 144 is substantially parallel to a longitudinal axis of the first container 112.

**[0045]** FIG. 3 is a perspective view of the example cartridge 100 decoupled from the carousel 102 of FIGS. 1A-2. In the illustrated example, the carrier 110 includes a first handle 300 and a second handle 302 to facilitate grasping, holding, lifting, maneuvering and/or transporting of the cartridge 100 by a human (e.g., manually) and/or a robot. In the illustrated example, a first cap 304 is coupled to the first container 112, a second cap 306 is coupled to the second container 114 and a third cap 308 is coupled to the third container 116. The caps 304, 306, 308 substantially cover and/or seal the throats 203, 205, 206 of the containers 112, 114, 116. In some examples, the first container 112, the second container 114 and/or the third container 116 are at least partially filled with liquid before the cartridge 100 is coupled to the carousel 102. Thus, the example caps 304, 306, 308 prevent liquid from flowing out of the containers 112, 114, 116 while the cartridge 100 is being lifted, handled, maneuvered, transported, etc. As described in greater detail below, the example first cap 304 may hold the first container 112 in a locked position.

**[0046]** FIG. 4 illustrates the example seat 118 of the carrier 110 of FIGS. 1A-3. In the illustrated example, the seat 118 includes a support surface 400, a first container support 402, a second container support 404 and a third container support 406. The second container 114 and the third container 116 couple to the seat 118 via the second container support 404 and the third container support 406, respectively. In the illustrated example, the second container support 404 and the third container support 406 include first protrusions 408 (e.g., ridges) and second protrusions 410 (e.g., posts). In the illustrated example, when the second container 114 and third container 116 are coupled to the seat 118, the second container 114 and the third container 116 rest on the support surface 400 and engage the first protrusions 408 and the second protrusions 410. The first protrusions 408 and the second protrusions 410 retain the second container 114 and the third container 116 and substantially prevent movement of the second container 114 and third container 116 relative to the carrier 110. In other examples, the carrier 110 employs additional and/or different protrusions, retaining members and/or devices to retain the second container 114 and/or the third container 116.

**[0047]** The example first container support 402 includes a third protrusion 412 (e.g., a ridge) to retain the first container 112 and/or substantially prevent the first container 112 from rotating relative to the carrier 110 when the first container 112 is in the locked position (e.g., an non-rotatable position) (FIG. 5). In the illustrated example, the third protrusion 412 is a ridge having a rounded-rectangular cross-sectional shape corresponding to the rounded-rectangular shape of the first container 112. In the illustrated example, the third protrusion 412 is raised to a first height relative to the support surface 400 of the seat 118. The example first container support 402 also includes an annular ridge or collar 414. In the illustrated example, the fourth aperture 212 is defined by the first container support 402 and the collar 414 is disposed on the support surface 400 about the fourth aperture 212. The example collar 414 provides a bearing surface, retains, supports, stabilizes, aligns and/or orients the first container 112 during operation of the example rotation mechanism 224 and the example carousel 102. The example collar 414 is raised to a second height relative to the support surface 400 greater than the first height. As described in greater detail below in conjunction with FIG. 7, when the cartridge 100 is placed onto the platform 104, the coupling 210 of the carousel 102 engages the first container 112 and lifts the first container 112 relative to the support surface 400 of the carrier 110 to an unlocked position in which the first container 112 is free to rotate via the coupling 210.

**[0048]** FIG. 5 is a cross-sectional view of the first end 126 of the example first container 112 when the first container 112 is in the lowered or locked position. In the illustrated example, the cartridge 100 is decoupled from the carousel 102 (e.g., during transport of the cartridge 100 to the platform 104). In the locked position, a first perimeter edge or rim 500 of the first container 112 is supported on the support surface 400 of the carrier 110. The first rim 500 of the first container 112 engages the third protrusion 412 such that the third protrusion 412 substantially prevents the first container 112 from rotating relative to the carrier 110 (e.g., the third protrusion 412 obstructs rotation of the first container 112). Thus, in the illustrated example, the first container 112 is non-rotatably coupled to the carrier 110 when the first container 112 is

in the locked position. In some examples, a shape and size of the first rim 500 of the first container 112 substantially conforms to the shape of the third protrusion 412. In the illustrated example, the female connector 214 of the first container 112 is disposed in a space defined by the collar 414 (e.g., the fourth aperture 212), and the collar 414 is received in a groove 501 of the first container 112.

**[0049]** The example second container 114 includes a second rim 502 and a second groove 503. In the illustrated example, the second rim 502 engages the first protrusions 408 and the second protrusions 410 of the second container support 404 to couple the second container 114 non-rotatably to the carrier 110. The example third container 116 includes a third rim 504 and a third groove 506. In the illustrated example, the first protrusions 408 and the second protrusions 410 of the third container support 406 are disposed in the third groove 506 and engaged with the third rim 504 of the third container 116 to couple the third container 116 non-rotatably to the carrier 110.

**[0050]** FIG. 6 is a cross-sectional view along the B-B line of FIG. 3 of the second end 132 of the first container 112 when the first container 112 is in the locked position. The example first cap 304 of FIG. 5 extends into the first aperture 138 of the cover 124 and is coupled to the throat 203 of the first container 112. The example first cap 304 includes a sealing portion 600 to cover 124 and/or seal the throat 203 of the first container 112. In the illustrated example, the first cap 304 includes a handle 602 coupled to the sealing portion 600. The handle 602 facilitates handling of the first cap 304, coupling and decoupling (e.g., removal) of the first cap 304 to the first container 112, etc.

**[0051]** When the first container 112 is coupled to the carrier 110 and the first cap 304 is coupled to the first container 112, the first cap 304 engages (e.g., contacts) the cover 124 to substantially hold or retain the first container 112 in the locked position. In the illustrated example, a fourth protrusion 606 extends from the sealing portion of the first cap 304. The example fourth protrusion 606 extends radially from a circumferential surface 608 of the sealing portion 600. The example cover 124 of the example carrier 110 includes a lip 610

extending into a portion of the first aperture 138. In the orientation of FIG. 6, the first cap 304 is in a first position such that the fourth protrusion 606 is disposed underneath the lip 610. Thus, when the first cap 304 is in the first position, the fourth protrusion 606 engages the lip 610 to substantially prevent the first container 112 from moving parallel to the second axis of rotation 144 relative to the carrier 110. For example, the fourth protrusion 606 may contact the lip 610 to prevent the first container 112 from being lifted above the third protrusion 412 (FIG. 5). Thus, in the illustrated example, the first cap 304 holds the first container 112 in engagement with the third protrusion 412, thereby retaining the first container 112 in the locked position.

**[0052]** Removal of the example first cap 304 enables the first container 112 to move from the lowered or locked position (FIG. 5) to a raised or unlocked position (FIG. 7) in which the first container 112 may rotate relative to the carrier 110. To remove the example first cap 304 of FIG. 6 from the first container 112, the first cap 304 is rotated until the fourth protrusion 606 is aligned in a notch or space 612 of the first aperture 138 clear of the lip 610 of the cover 124 (e.g., a slot in communication with the first aperture 138). The first cap 304 may then be removed from the first container 112 (e.g., via the handle 602). As described in greater detail below, when the first container 112 is in the unlocked position, the first container 112 can be lifted from the support surface 400 to enable rotation of the first container 112 relative to the carrier 110. The second cap 306 and the third cap 308 operate similarly to secure the second container 114 and the third container 116, respectively and to secure the position of cover 124.

**[0053]** FIG. 7 illustrates the example first container 112 in the unlocked position. In the illustrated example, the cartridge 100 is coupled to the carousel 102, and the first cap 304 is removed from the first container 112. The example coupling 210 of the carrier 110 extends through the fourth aperture 212 and moves (e.g., lifts or raises) the first container 112 along the second axis of rotation 144. In the illustrated example, the coupling 210 moves the first container 112 to a third height greater than the first height of the third protrusion 412 (FIGS. 4 and 5) and less than the second height of the

collar 414. When the example first container 112 is lifted to the third height, the first rim 500 of the first container 112 disengages the third protrusion 412. As a result, the first container 112 is free to rotate about the second axis of rotation 144 (e.g., the third protrusion 412 does not obstruct rotation of the first container 112). In the illustrated example, the female connector 214 remains in the space defined by the collar 414 when the first container 112 is moved to the unlocked position. In some examples, as the first container 112 rotates relative to the carrier 110, the female connector 214 of the first container 112 and the collar 414 function as a bearing.

**[0054]** FIG. 8 is a cross-sectional view of the example first container 112 of FIGS. 1A-7 taken along the C-C line of FIG. 1A. In the illustrated example, the first container 112 includes a first sidewall 800, a second sidewall 802, a third sidewall 804 and a fourth sidewall 804. The first sidewall 800 is opposite the second sidewall 802. In the illustrated example, the first sidewall 800 includes a first rib 808 extending toward the second sidewall 802. The example second sidewall 802 includes a second rib 810 extending toward the first sidewall 800. The example first rib 808 and the example second rib 810 extend along the first sidewall 800 and the second sidewall 802, respectively, substantially parallel to the second axis of rotation 144. In the illustrated example, the first rib 808 and the second rib 810 are each disposed approximately equidistant from the third sidewall 804 and the fourth sidewall 806. The first rib 808 and the second rib 810 illustrated in FIG. 8 are merely examples. Thus, the first rib 808 and/or the second rib 810 may have other orientations, shapes, sizes, etc. in other examples. In some examples, the first sidewall 800 and/or the second sidewall 802 may include other numbers of ribs (e.g., 0, 2, 3, etc.). In addition, in some examples, one or more ribs may extend only partially down a wall, in an angled orientation relative to the second axis of rotation 144 and/or closer to one of the end walls 804, 806 than the other.

**[0055]** The example first container 112 has a rounded-rectangular shape. In the illustrated example, the first sidewall 800 is substantially parallel to the second sidewall 802. The example first sidewall 800 includes a first flat or

planar portion 812, and the example second sidewall 802 includes a second flat or planar portion 814 parallel to the first planar portion 812. In the illustrated example, the third sidewall 804 is opposite the fourth sidewall 806 and the third sidewall 804 and the fourth sidewall 806 are curved. In the illustrated example, the third sidewall 804 and the fourth sidewall 806 curve outwardly relative to the longitudinal axis of the first container 112. In the illustrated example, a first distance between the first sidewall 800 and the second sidewall 802 is less than a second distance between the third sidewall 804 and the fourth sidewall 806. In other examples, the first distance is greater than or equal to the second distance. In some examples, the first container 112 has a depth (e.g., a distance from an outermost point of the first sidewall 800 to an outermost point on the second sidewall 802) of about 20 millimeters and a width (e.g., a distance from an outermost point on the third sidewall 804 to an outmost point on the fourth sidewall 806) of about 36 millimeters. Other examples have other dimensions. In other examples, the first container 112 has other shapes such as, for example, rectangular, square, cylindrical, triangular and/or other suitable shape(s) or combination of shape(s).

**[0056]** FIG. 9 is a cross-sectional view of the example first container 112 of FIGS. 1A-8 taken along the D-D line of FIG. 3 and removed from the cartridge 100. FIG. 10 is a cross-sectional view of the example first container 112 taken along the B-B line of FIG. 3, similar to FIG. 6, but showing the full length of the first container 112. Referring to FIG. 9, the example first container 112 includes a bottom wall 900 and a top wall 902 opposite the bottom wall 900. The example top wall 902 is coupled to the first sidewall 800, the second sidewall 802, the third sidewall 804 and the fourth sidewall 806. In the illustrated example, the top wall 902 is substantially planar. The throat 203 extends upwardly from the example top wall 902 in the orientation of FIG. 9. In the illustrated example, a height of the first container 112 excluding the throat 203 and the first cap 304 (e.g., from an outermost point of the first rim 500 to an outmost point on the top wall 902) is about 94 millimeters. Other examples may include heights.

**[0057]** The example bottom wall 900 of FIG. 9 is coupled to the first sidewall 800, the second sidewall 802, the third sidewall 804 and the fourth sidewall 806. In the illustrated example, the bottom wall 900 is bowed or curved away from the top wall 902 about a first axis passing through the first sidewall 800 and the second sidewall 802. Thus, the bottom wall 900 is convex when viewed from outside of the container 112 (e.g., from the bottom exterior of the container 112) or concave when viewed from inside of the container 112. The example bottom wall 900 is also bowed or curved away from the top wall 902 about a second axis passing through the third sidewall 804 and the fourth sidewall 806. Thus, the example bottom wall 900 forms a bowl-like structure.

**[0058]** In some examples, the first container 112 is at least partially filled with a reagent including solid particles (e.g., latex coated paramagnetic particles). Some of the particles in the liquid may settle and rest on the bottom wall 900 (e.g., during transport of the cartridge 100 to the carousel 102). During operation of the carousel 102, the first container 112 moves about the first axis of rotation 106 (e.g., in the back-and-forth motion) and the second axis of rotation 144 to agitate the liquid and/or disperse the particles in the liquid. For example, when the first container 112 is moved via the carousel 102, curvatures of the bottom wall 900 direct the liquid and/or the particles on or near the bottom wall 900 to move (e.g., flow) toward the top wall 902, thereby agitating the liquid and dispersing the particles. Further, movement of the sidewalls 800, 802, 804, 806, the first rib 808 and/or the second rib 810 with and/or relative to the liquid agitates the liquid and disperses the particles. In some examples, the first container 112 agitates the liquid such that the particles are substantially uniformly dispersed within the liquid during operation of the carousel 102.

**[0059]** FIGS. 11-12 illustrate the first container 112 having an alternative bottom wall 1100 disclosed herein. FIG. 11 is a perspective, cross-sectional view of a lower portion of the first container 112 showing the example bottom wall 1100. In the illustrated example, the sidewalls 800, 802, 804, 806, the top wall 902 and the bottom wall 1100 define a cavity 1101 to receive and hold liquid. In the illustrated example, the bottom wall 1100 includes a basin or

concave portion 1102 (when viewed from inside the container 112) extending from first sidewall 800 to the second sidewall 802 and from the third sidewall 804 to the fourth sidewall 806. The example concave portion 1102 bows outward away from the top wall 902 about a first axis 1104 and a second axis 1106 (e.g., axes perpendicular to each other and to the second axis of rotation 144). In some examples, the concave portion 1102 is a bowl-like or semispherical structure.

**[0060]** The example bottom wall 1100 also includes a bulge or protrusion 1108 extending from a first side 1110 of the bottom wall 1100 toward the top wall 902 (e.g., extending into the cavity 1101). In the illustrated example, the post 220 of the female connector 214 is aligned with the protrusion 1108 and depends from a second side 1112 of the bottom wall 1100 opposite the first side 1110. In the illustrated example, the protrusion 1108 is a convexity (e.g., a rounded or curved protrusion or bulge) having a crest or apex 1114. Thus, the example bottom wall 1100 of FIG. 11 includes the concave portion 1102 and a convex portion (e.g., the example protrusion 1108). In other examples, the protrusion 1108 has other shapes (e.g., cone-shaped, pyramid -shaped, etc.). The example protrusion 1108 of FIG. 12 has a first radius of curvature and the example concave portion 1102 has a second radius of curvature. In the illustrated example, the first radius of curvature is less than the second radius of curvature. Also, in the illustrated example, the first radius of curvature and the second radius of curvature of disposed in opposite directions.

**[0061]** FIG. 12 is a top view of the example bottom wall 1100 of FIG. 11. In the illustrated example, the protrusion 1108 has a substantially circular base 1200 disposed on a center 1202 of the bottom wall 1100. In the illustrated example, the center 1202 of the bottom wall 1100 is along the second axis of rotation 144. Thus, when the example first container 112 rotates about the second axis of rotation 144, the bottom wall 1100 rotates about the second axis of rotation 144. The apex 1114 of the example protrusion 1108 is also disposed on the center 1202 of the bottom wall 1100 and, thus, the apex 1114 is disposed along the second axis of rotation 144 in the illustrated example.

As a result, the protrusion 1108 slopes downward from the second axis of rotation 144.

**[0062]** When the example first container 112 rotates about the second axis of rotation 144, particles disposed in a liquid in the first container 112 along the second axis of rotation 144 may experience little or no centrifugal force. As a result, these particles may settle onto or near the protrusion 1108 of the bottom wall 1100. In the illustrated example, when the particles settle onto the protrusion 1108 of the bottom wall 1100, the particles slide and/or roll on the protrusion 1108 away from the apex 1114. As a result, the particles move toward the sidewalls 800, 802, 804, 806 where centrifugal force facilitates uniform dispersion of the particles in the liquid.

**[0063]** A flowchart representative of an example method is shown in FIG. 13. Although the example process is described with reference to the flowchart illustrated in FIG. 13, many other methods may alternatively be used. For example, the order of execution of the blocks may be changed, and/or some of the blocks described may be changed, eliminated, or combined.

**[0064]** The method of FIG. 13 begins at block 1302 by lowering the first container 112 into a first position to couple the first container 112 non-rotatably to the carrier 110. For example, the first container 112 of FIGS. 1A-12 may be lowered onto the first container support 402 of the seat 118 of the carrier 110. In some such examples, first container 112 engages a first portion of the carrier 110 and a second portion of the carrier 110 in the first position. For example, the first rim 500 engages the third protrusion 412, and the female connector 214 engages the collar 414. In some examples, the first cap 304 is coupled to the first container 112 to hold or retain the first container 112 in the first position.

**[0065]** At block 1304, the second container 114 is non-rotatably supported on the carrier 110. In some examples, the second container 114 is coupled non-rotatably to the second container support 404 via the first protrusions 408 and the second protrusions 410 of the second container support 404. In some examples, the third container 116 is also non-rotatably supported on the carrier

110 via the first protrusions 408 and the second protrusions 410 of the third container support 406.

**[0066]** At block 1306, the first container 112 is lifted from the first position to a second position in which the first container 112 is disengaged from the first portion of the carrier 110 while engagement with the second portion of the carrier 110 is maintained. For example, the first container 112 may be lifted to the third height from the supporting surface by the example coupling 210 of the carousel 102. When the cartridge 100 is coupled to the carousel 102, the coupling 210 extends into the fourth aperture 212 and lifts the first container 112 to the third height. When the first container 112 is lifted to the third height, the first rim 500 disengages the third protrusion 412 and the female connector 214 is disposed in the space defined by the collar 414.

**[0067]** At block 1308, the first container 112 is rotated (e.g., oscillated and/or spun) about an axis of rotation. In some examples, the first container 112 is rotated about the first axis of rotation 106 with the platform 104 and about the second axis of rotation 144 via the coupling 210. At block 1310, contents of the first container 112 are mixed. For example, liquid and/or particles in the container are agitated by the planar portions of the first side-wall 800 and/or the second sidewall 802. In some examples, the contents of the first container 112 are also mixed by a bottom protrusion of the container such as, for example, the protrusion 1108 of the bottom wall 1100 of FIGS. 11 and 12. In some examples, the contents of the first container 112 are mixed such that the particles are substantially uniformly dispersed in the liquid in the first container 112.

**[0068]** Although certain example methods, apparatus and articles of manufacture have been described herein, the scope of coverage of this patent is not limited thereto. On the contrary, this patent covers all methods, apparatus and articles of manufacture fairly falling within the scope of the claims of this patent.

What Is Claimed Is:

1. An apparatus comprising:

a base;

a first end wall;

a second end wall;

a first container;

a second container having a rounded rectangular shape;

a first container support to retain the first container, the first container support comprising first posts to engage a first rim of the first container to non-rotatably couple the first container to the base; and

a second container support to retain the second container, the second container support comprising a collar to engage a groove of the second container and a ridge to engage a second rim of the second container, the second container selectively rotatable relative to the base.

2. The apparatus of claim 1 further comprising a third container support to retain a third container, the third container support comprising second posts to engage a third rim of the third container to non-rotatably couple the third container to the base.

3. The apparatus of claim 1, wherein the apparatus is to rotate about a first axis of rotation, and the second container is to rotate relative to the base about a second axis of rotation.

4. The apparatus of claim 1, the second container being movable between a locked position in which the second rim of the second container is engaged with the ridge to non-rotatably couple the second container to the base and an unlocked position in which the second container is raised so that the second rim is disengaged from the ridge and the groove is rotatable about the collar.

5. The apparatus of claim 1 further comprising a cover having a first aperture to access the first container and a second aperture to access the second container.

6. An apparatus comprising:

a first sidewall;

a second sidewall substantially parallel to the first sidewall;

a top wall coupled to the first sidewall and the second sidewall;

a bottom wall opposite the top wall and coupled to the first sidewall and the second sidewall, the bottom wall having a first side to define a cavity to hold a liquid; and

a protrusion extending from the first side of the bottom wall toward the top wall.

7. The apparatus of claim 6, wherein the protrusion is disposed on a center of the bottom wall.

8. The apparatus of claim 6, wherein the protrusion is disposed on an axis of rotation of the bottom wall.

9. The apparatus of claim 6, wherein the protrusion has an apex disposed along an axis of rotation of the bottom wall.

10. The apparatus of claim 6 further comprising:

a third sidewall; and

a fourth sidewall opposite the third sidewall, the third sidewall and the fourth sidewall being curved, wherein the first sidewall includes a first planar portion and the second sidewall includes a second planar portion..

11. The apparatus of claim 6, wherein the bottom wall has a first radius of curvature, and the protrusion has a second radius of curvature different than the first radius of curvature.

12. The apparatus of claim 11, wherein the first radius of curvature is oriented in a first direction and the second radius of curvature is oriented in a second direction different than the first direction.

13. The apparatus of claim 6, wherein the first sidewall includes a rib extending toward the second sidewall.

14. The apparatus of claim 6 further comprising a post depending from a second side of the bottom wall.

15. The apparatus of claim 13, wherein the post defines a notch.

16. The apparatus of claim 13, wherein the notches are engageable with a rotation mechanism to rotate the apparatus about an axis of rotation aligned with the protrusion.

17. The apparatus of claim 6 further comprising:

a third sidewall; and

a fourth sidewall opposite the third sidewall, at least two of the first sidewall, second sidewall, third sidewall or fourth sidewall include a rim to engage a ridge on a carrier to hold the container in a non-rotatable position.

18. A method comprising:

lifting a first container from a first position in which a rim of the first container is engaged with a ridge of a carrier and a groove of the first container is engaged with a collar of the carrier to a second

position in which the rim is disengaged from the ridge and the groove is engaged with the collar;

rotating the first container about an axis of rotation; and

mixing contents of the first container, the contents mixed by a first substantially flat sidewall of the first container and a bottom protrusion of the first container.

19. The method of claim 18 further comprising non-rotatably supporting a second container on the carrier while rotating the first container.

20. The method of claim 18 further comprising lowering the first container to the first position to non-rotatably couple the first container to the carrier.

21. The method of claim 18 further comprising removing a cap from the first container to enable the first container to move from the first position to the second position.

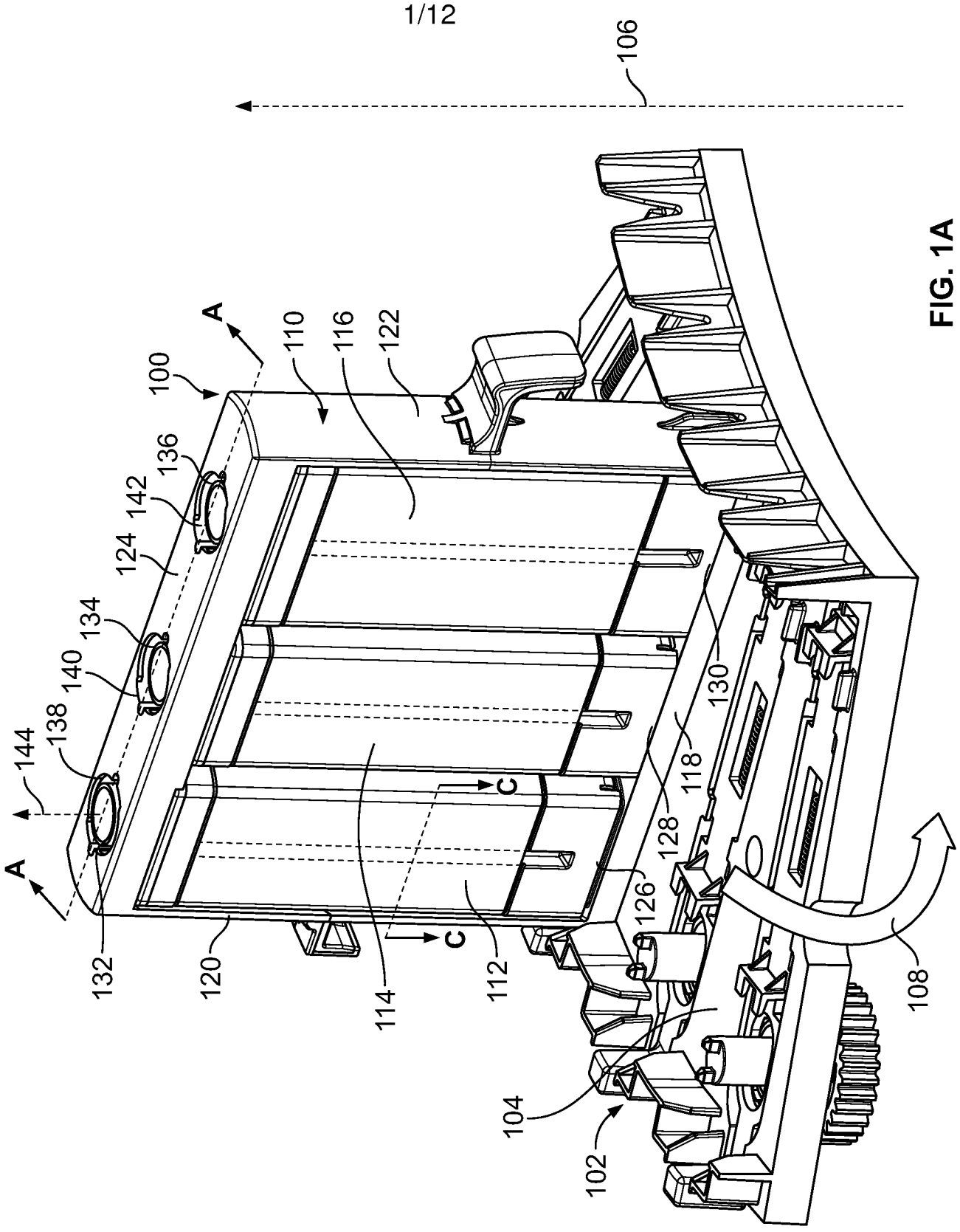

106
100
110
116
122
136
142
124
134
140
138
144
A
A
A
C
C
132
120
114
112
104
102
126
128
118
130
108

FIG. 1A

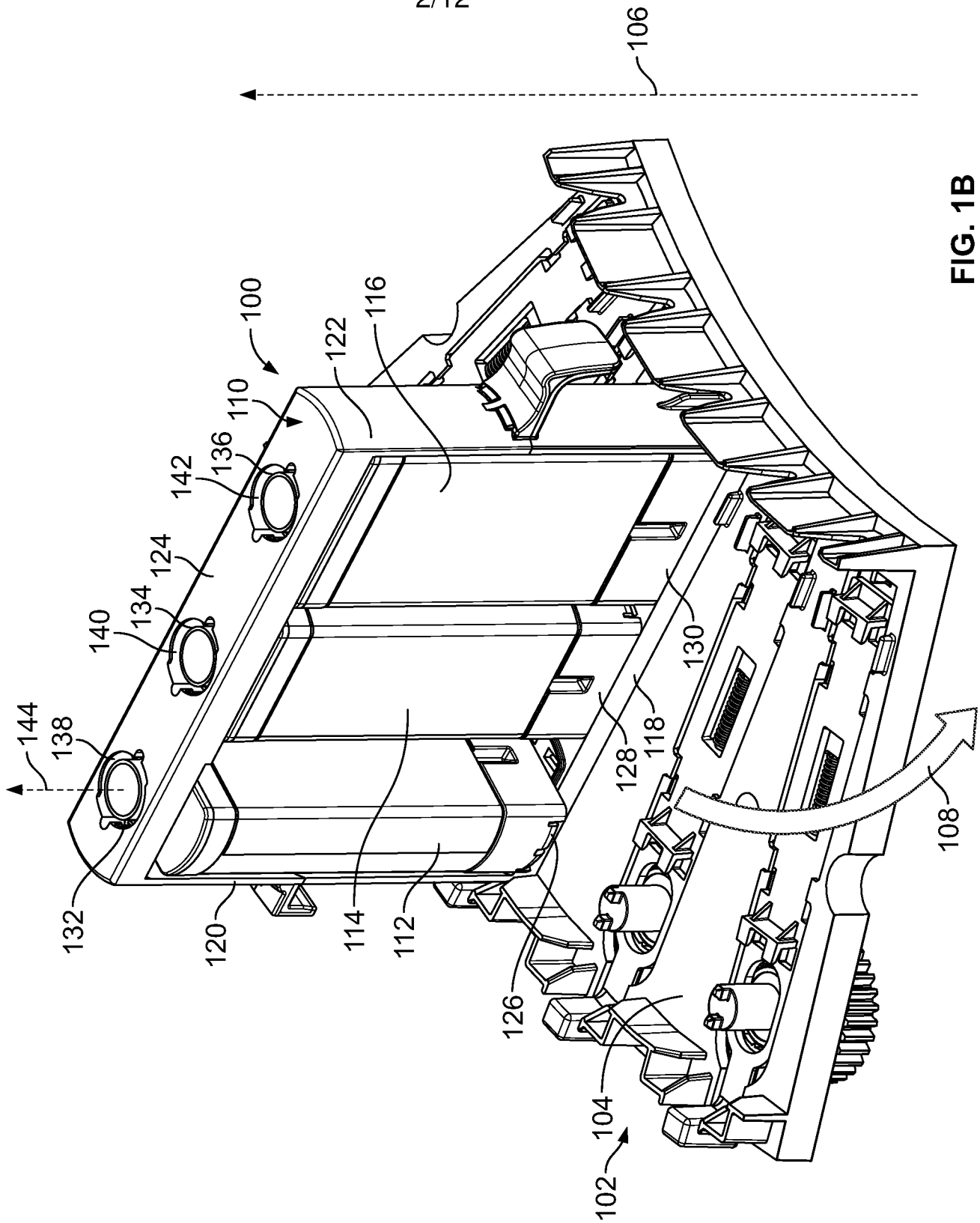

106
100
110
122
116
142
136
124
134
140
144
138
132
120
114
112
126
104
102
130
128
118
108

FIG. 1B

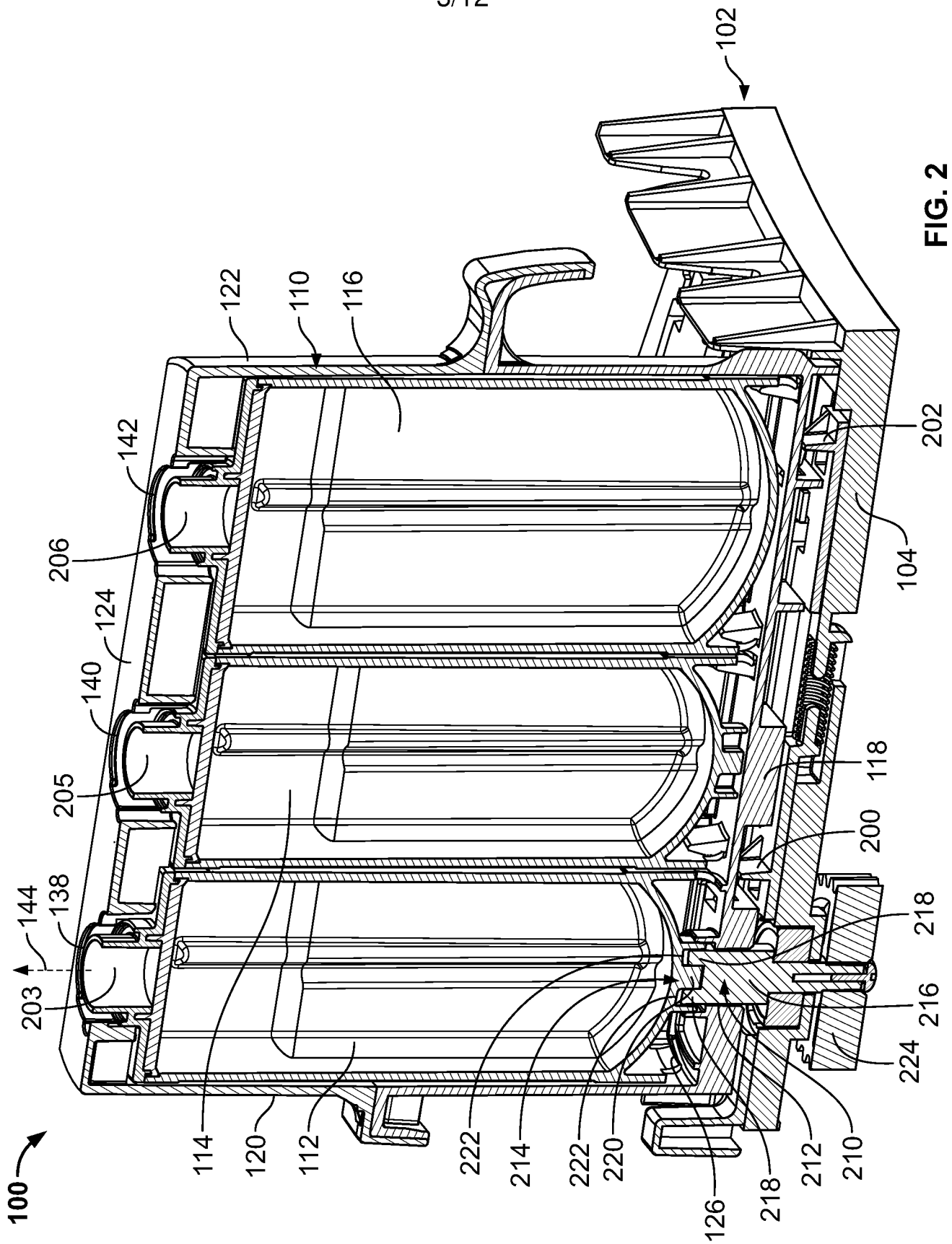

102
122
110
116
142
206
124
140
205
144
138
203
202
104
118
200
218
216
224
114
120
112
222
214
222
220
126
218
212
210
100

FIG. 2

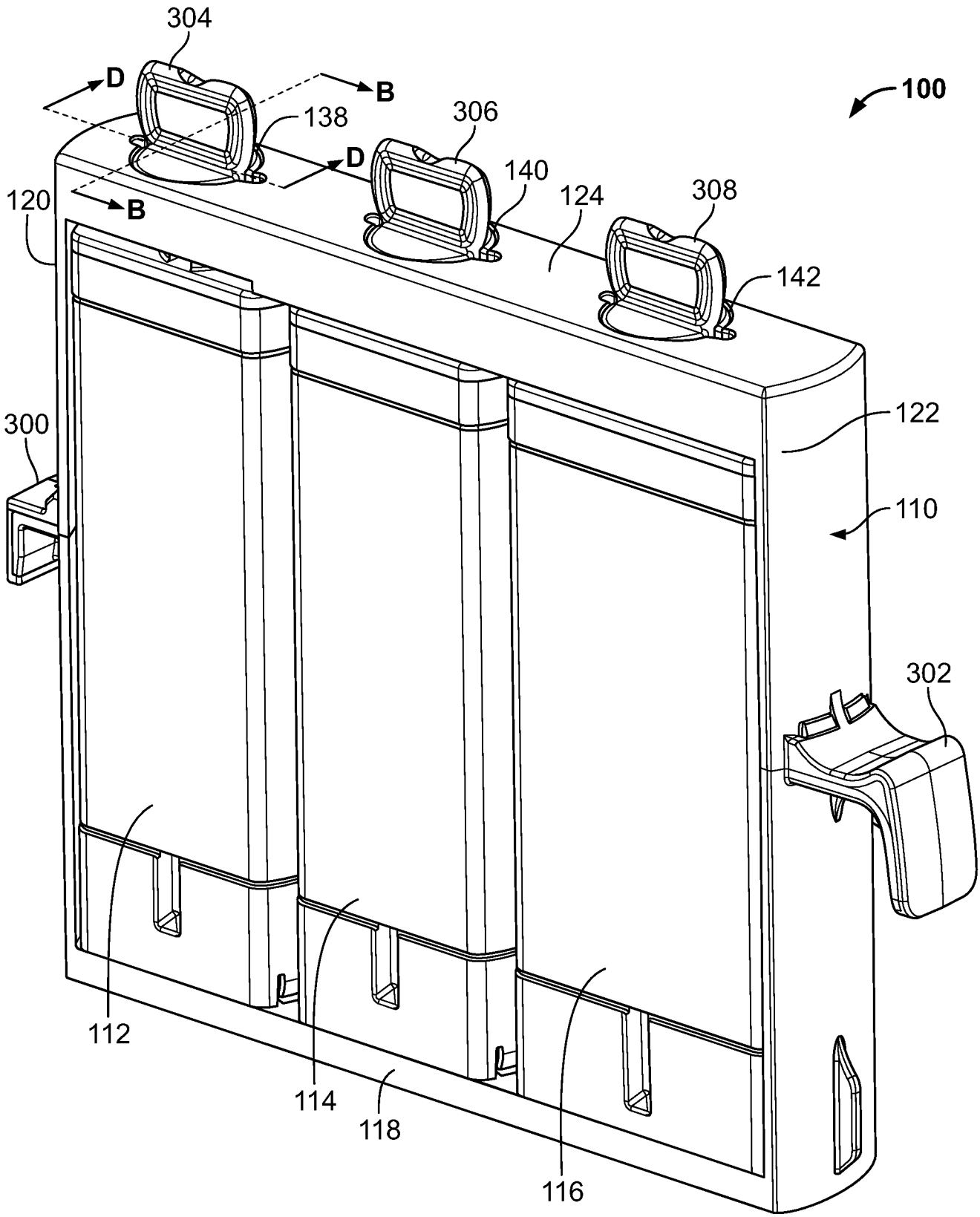

304
D
B
138
306
100
D
140
120
B
124
308
142
300
122
110
302
112
114
118
116

FIG. 3

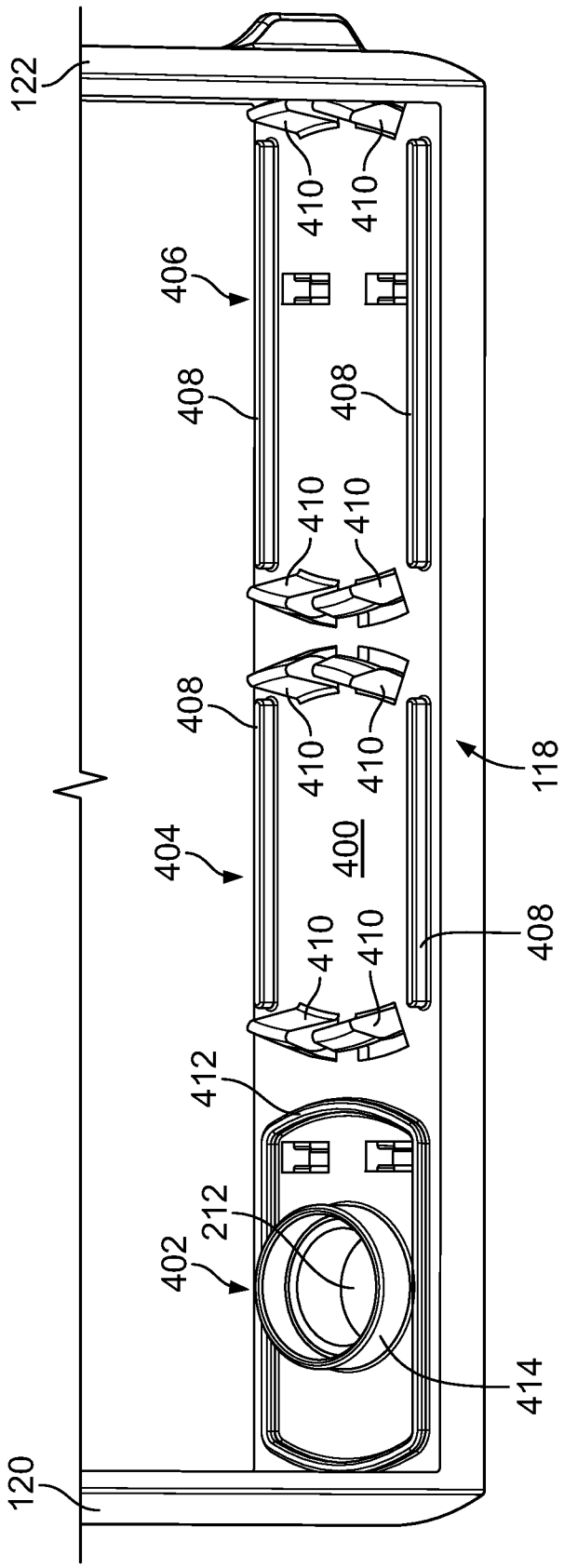

122
410
410
406
408
408
410
410
408
410
410
118
404
400
408
410
410
412
212
402
414
120

FIG. 4

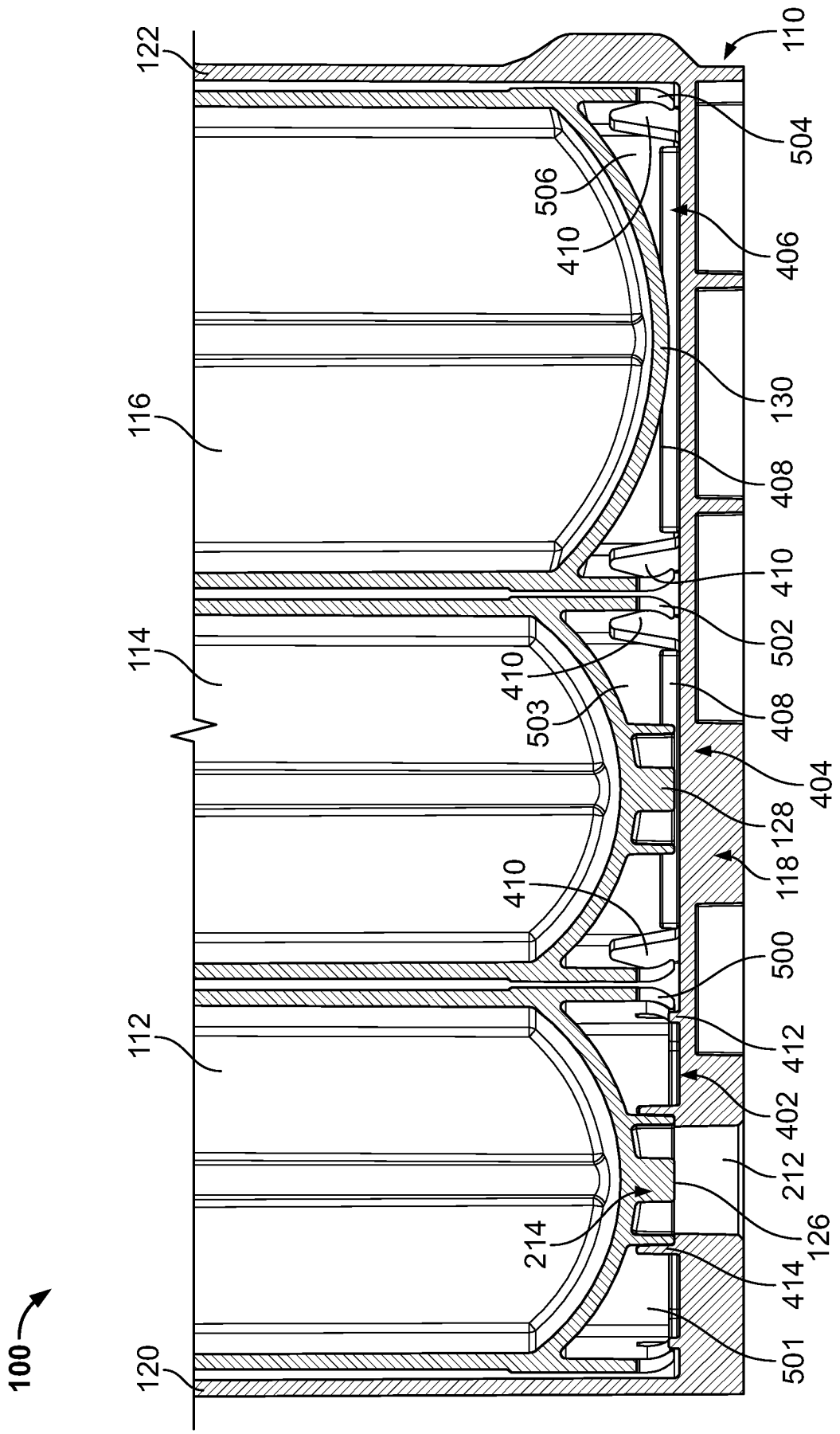

100
120
122
110
112
114
116
118
126
128
130
212
214
402
404
406
408
410
412
414
500
501
502
503
504
506

FIG. 5

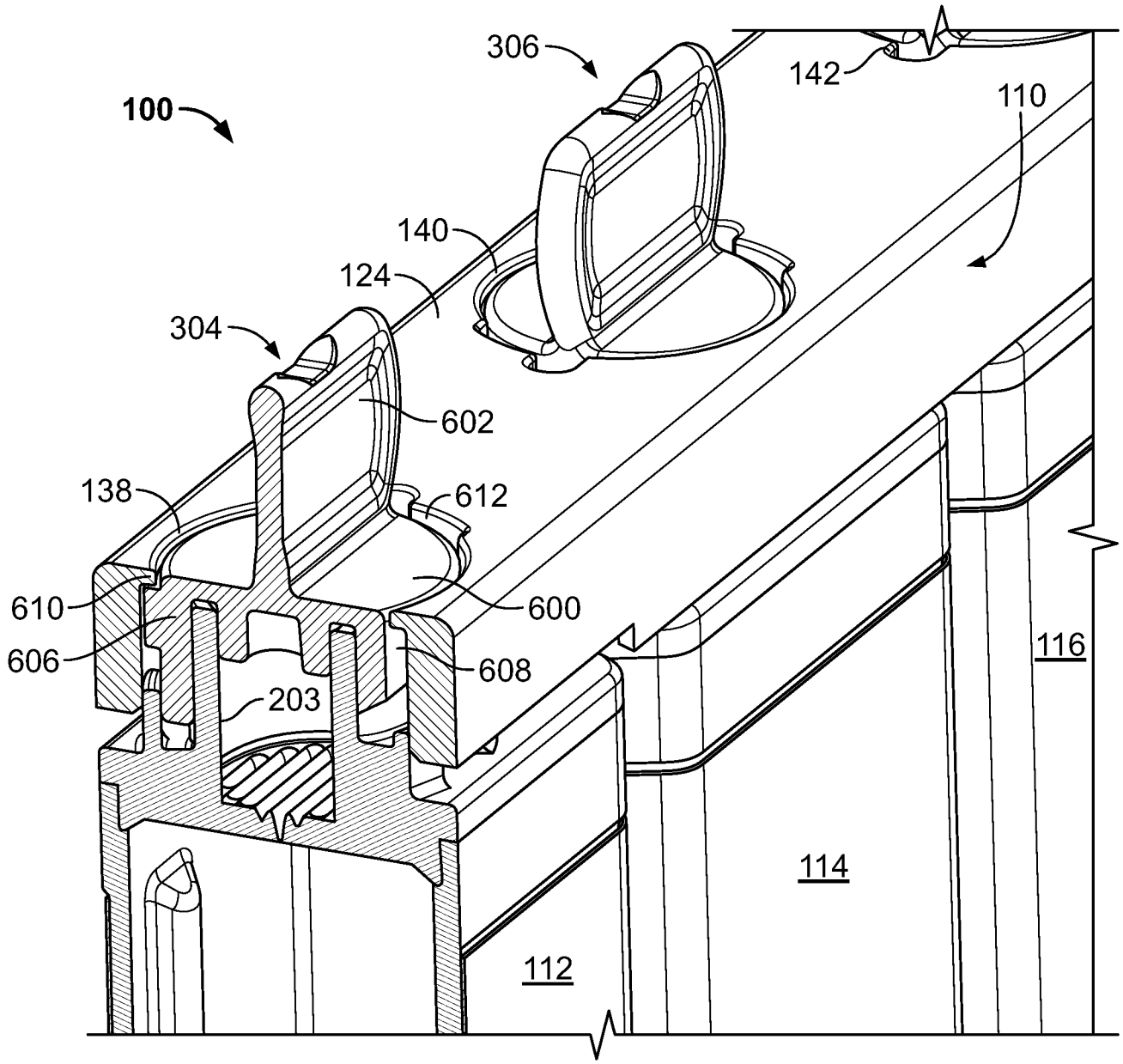

100
306
142
110
140
124
304
602
138
612
610
600
606
608
203
116
114
112

FIG. 6

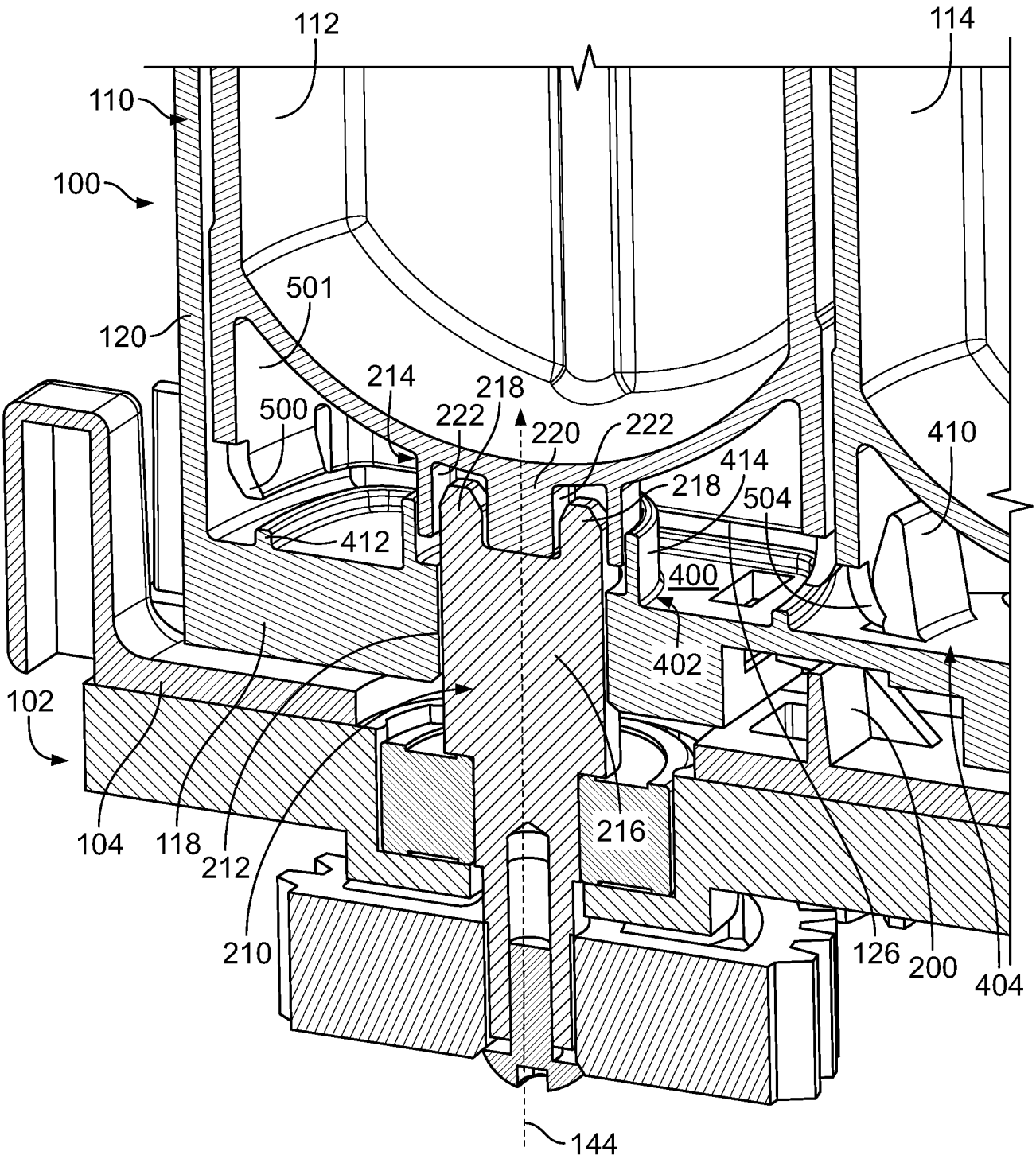

112
114
110
100
501
120
214
218
500
222
220
222
410
414
218
504
412
400
402
102
216
104
118
212
210
126
200
404
144

FIG. 7

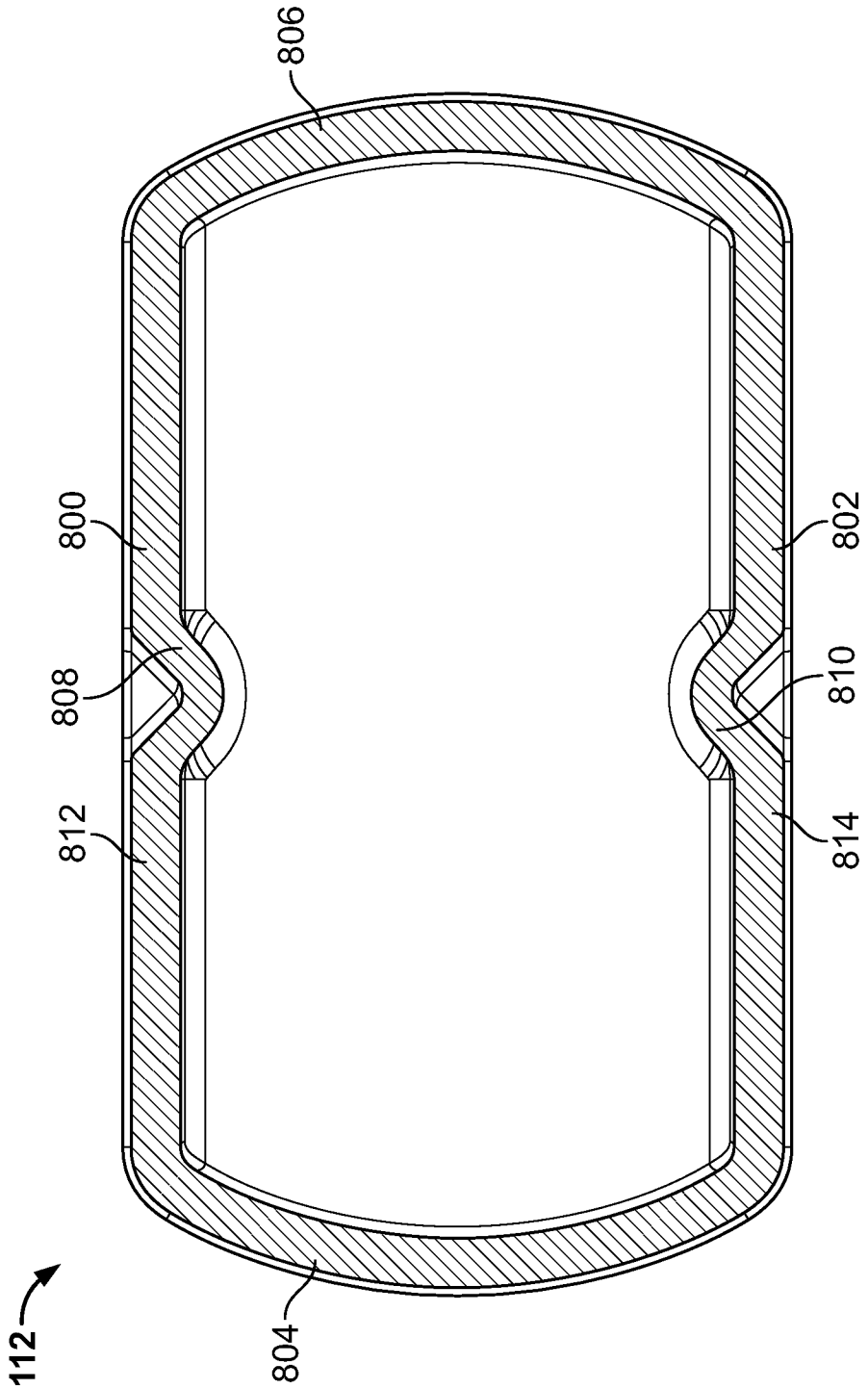



FIG. 8

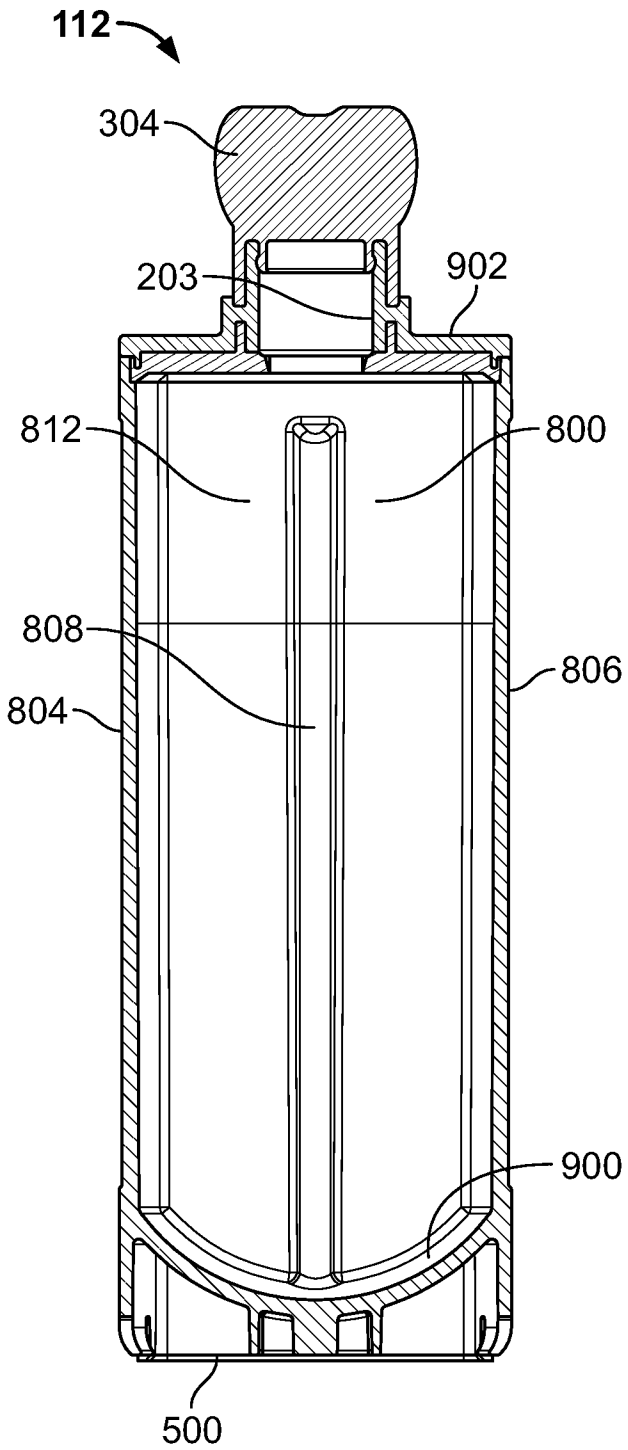

112
304
203
902
812
800
808
806
804
900
500

FIG. 9

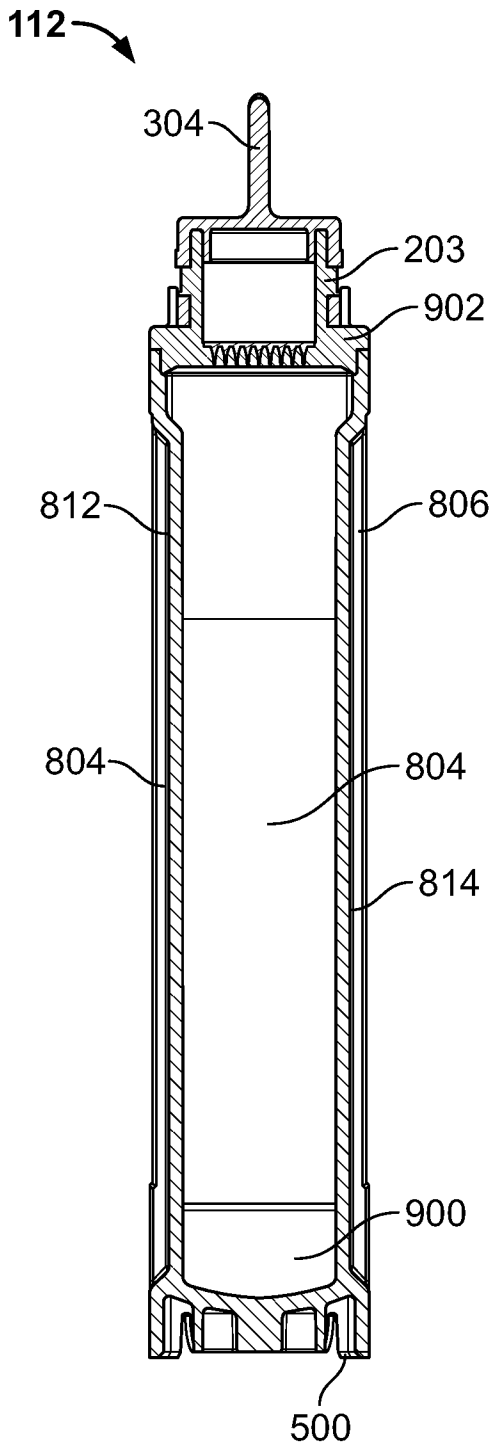

112
304
203
902
812
806
804
804
814
900
500

FIG. 10

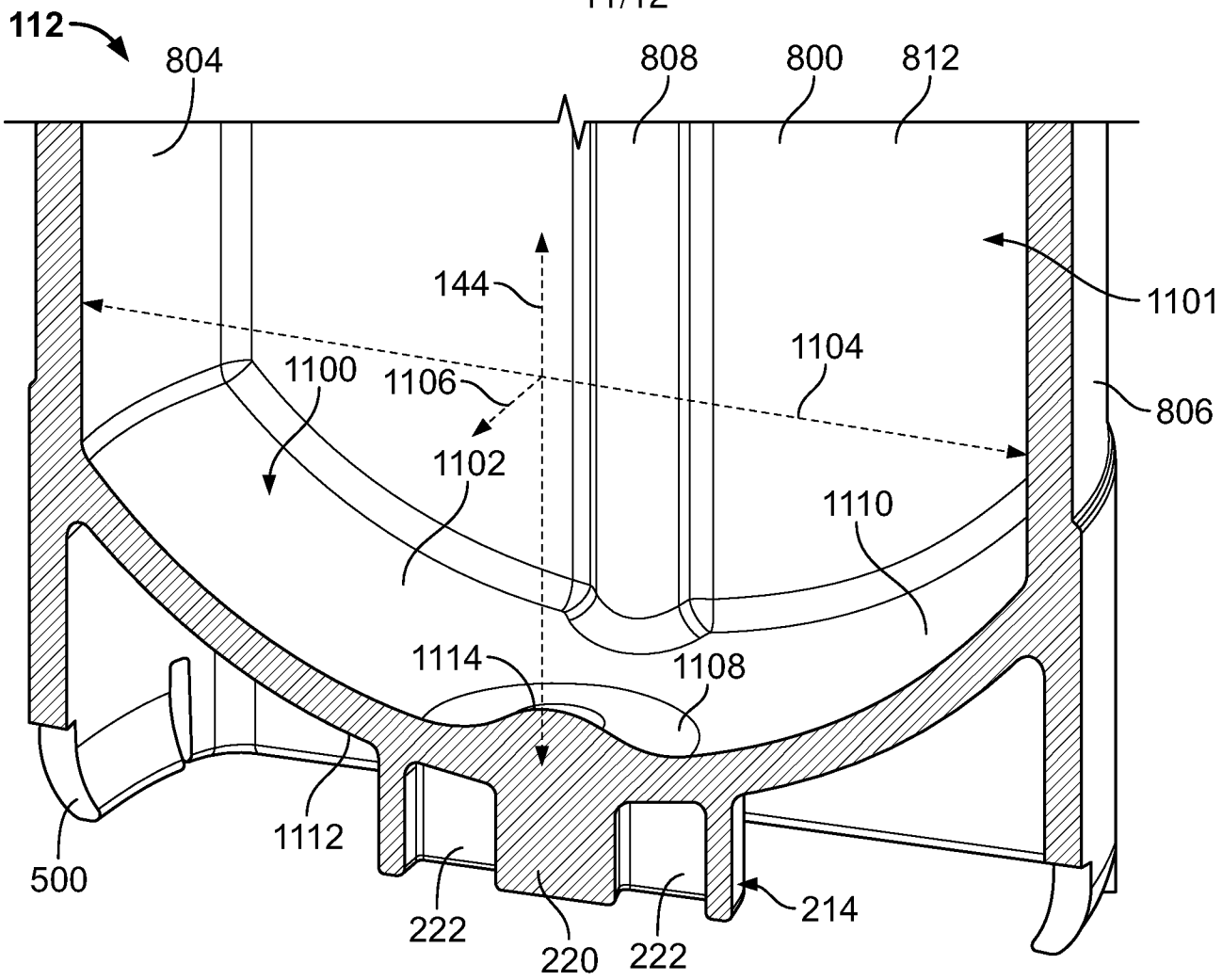

112
804
808
800
812
144
1101
1104
1100
1106
806
1102
1110
1114
1108
1112
500
222
220
222
214

FIG. 11

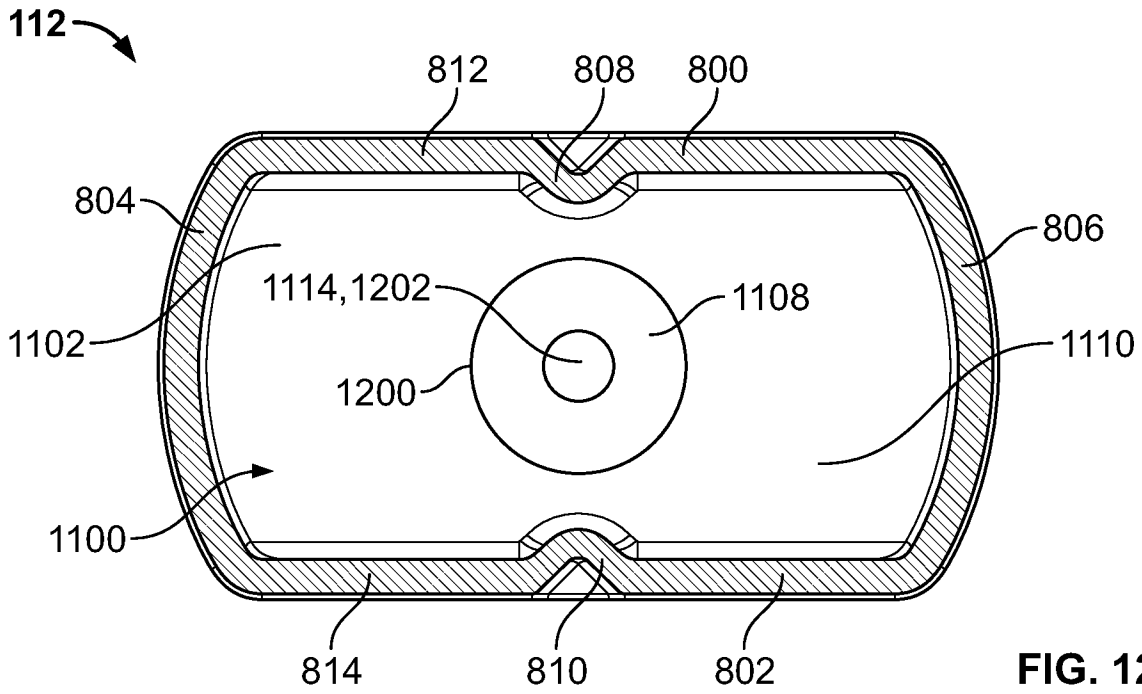

112
812
808
800
804
806
1114,1202
1108
1102
1110
1200
1100
814
810
802

FIG. 12

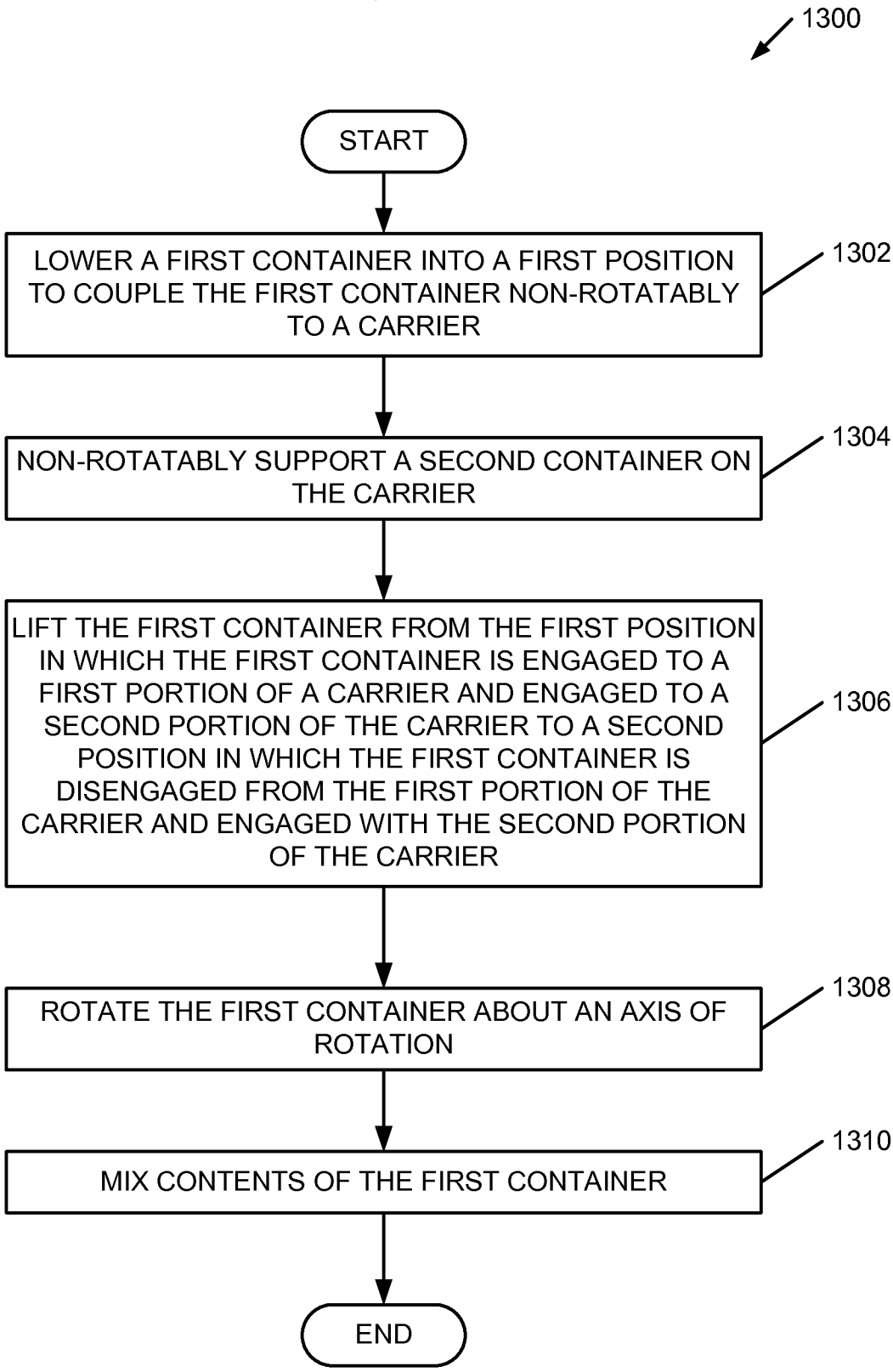

1300
START
LOWER A FIRST CONTAINER INTO A FIRST POSITION TO COUPLE THE FIRST CONTAINER NON-ROTATABLY TO A CARRIER
1302
NON-ROTATABLY SUPPORT A SECOND CONTAINER ON THE CARRIER
1304
LIFT THE FIRST CONTAINER FROM THE FIRST POSITION IN WHICH THE FIRST CONTAINER IS ENGAGED TO A FIRST PORTION OF A CARRIER AND ENGAGED TO A SECOND PORTION OF THE CARRIER TO A SECOND POSITION IN WHICH THE FIRST CONTAINER IS DISENGAGED FROM THE FIRST PORTION OF THE CARRIER AND ENGAGED WITH THE SECOND PORTION OF THE CARRIER
1306
ROTATE THE FIRST CONTAINER ABOUT AN AXIS OF ROTATION
1308
MIX CONTENTS OF THE FIRST CONTAINER
1310
END

**FIG. 13**

# INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/078036

A. CLASSIFICATION OF SUBJECT MATTER
INV. B01F9/00 B01L9/06 G01N35/10
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)
B01F B01L G01N

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. |
|---|---|---|
| X | WO 03/020427 A1 (QUEST DIAGNOSTICS INVEST INC [US]) 13 March 2003 (2003-03-13)<br>page 1, line 13 - line 17<br>page 2, line 1 - line 14<br>page 3, line 26 - page 4, line 7<br>page 4, line 9 - line 23<br>page 5, line 19 - line 21<br>page 6, line 11 - line 19<br>page 7, line 21 - line 25<br>page 8, line 1 - line 2<br>page 8, line 13 - line 17<br>page 9, lines 6-24<br>figures 1-4B | 1-3,5 |
| A | US 6 149 872 A (MACK MICHAEL [DE] ET AL)<br>21 November 2000 (2000-11-21)<br>the whole document | 1-5,<br>18-21 |

-/--

[X] Further documents are listed in the continuation of Box C.

[X] 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 | Date of mailing of the international search report |
|---|---|
| 11 April 2014 | 25/06/2014 |

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

2

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | US 2004/134750 A1 (LUOMA ROBERT PAUL [US] LUOMA II ROBERT PAUL [US]) 15 July 2004 (2004-07-15) the whole document | 1-5, 18-21 |
| A | WO 2006/119361 A2 (ABBOTT LAB [US]; GOMM CORDELL K [US]; LUOMA II ROBERT P [US]; ARNQUIST) 9 November 2006 (2006-11-09) the whole document | 1-5, 18-21 |
| A | EP 0 435 481 A2 (ANAGEN LTD [GB] ALFA BIOTECH SPA [IT]) 3 July 1991 (1991-07-03) the whole document | 1-5, 18-21 |

2

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2013/078036

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| WO 03020427 A1 | 13-03-2003 | AT 447183 T | 15-11-2009 |
| | | EP 1432516 A1 | 30-06-2004 |
| | | JP 2005502034 A | 20-01-2005 |
| | | US 2003044323 A1 | 06-03-2003 |
| | | WO 03020427 A1 | 13-03-2003 |
| US 6149872 A | 21-11-2000 | AT 224546 T | 15-10-2002 |
| | | DE 19540877 A1 | 07-05-1997 |
| | | DK 0871894 T3 | 13-01-2003 |
| | | EP 0871894 A1 | 21-10-1998 |
| | | ES 2183981 T3 | 01-04-2003 |
| | | JP H11515106 A | 21-12-1999 |
| | | PT 871894 E | 28-02-2003 |
| | | US 6149872 A | 21-11-2000 |
| | | WO 9716734 A1 | 09-05-1997 |
| US 2004134750 A1 | 15-07-2004 | AT 415633 T | 15-12-2008 |
| | | AT 418075 T | 15-01-2009 |
| | | CA 2531690 A1 | 20-01-2005 |
| | | EP 1649294 A2 | 26-04-2006 |
| | | EP 1681569 A2 | 19-07-2006 |
| | | EP 2175279 A1 | 14-04-2010 |
| | | ES 2317045 T3 | 16-04-2009 |
| | | ES 2318674 T3 | 01-05-2009 |
| | | JP 4932477 B2 | 16-05-2012 |
| | | JP 5478337 B2 | 23-04-2014 |
| | | JP 2007524842 A | 30-08-2007 |
| | | JP 2010156716 A | 15-07-2010 |
| | | JP 2012230127 A | 22-11-2012 |
| | | US 2004134750 A1 | 15-07-2004 |
| | | US 2007010019 A1 | 11-01-2007 |
| | | WO 2005005992 A2 | 20-01-2005 |
| WO 2006119361 A2 | 09-11-2006 | AT 428117 T | 15-04-2009 |
| | | CA 2606050 A1 | 09-11-2006 |
| | | EP 1883822 A2 | 06-02-2008 |
| | | EP 2053410 A2 | 29-04-2009 |
| | | ES 2323597 T3 | 21-07-2009 |
| | | JP 4950182 B2 | 13-06-2012 |
| | | JP 2008541054 A | 20-11-2008 |
| | | JP 2012132925 A | 12-07-2012 |
| | | US 2006263248 A1 | 23-11-2006 |
| | | US 2010111765 A1 | 06-05-2010 |
| | | WO 2006119361 A2 | 09-11-2006 |
| EP 0435481 A2 | 03-07-1991 | AT 157459 T | 15-09-1997 |
| | | AU 644830 B2 | 23-12-1993 |
| | | AU 6816490 A | 27-06-1991 |
| | | CA 2032696 A1 | 23-06-1991 |
| | | DE 69031334 D1 | 02-10-1997 |
| | | EP 0435481 A2 | 03-07-1991 |
| | | ES 2106023 T3 | 01-11-1997 |
| | | IE 904647 A1 | 17-07-1991 |
| | | IL 96697 A | 12-04-1994 |
| | | JP H04208864 A | 30-07-1992 |
| | | PT 96355 A | 30-09-1992 |
| | | US 6299567 B1 | 09-10-2001 |

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/078036

**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.:

1-5, 18-21

**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.

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/** 210

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

1. claims: 1-5, 18-21

Apparatus and method comprising a carrier and a container, the carrier having posts to engage a rim of the container and a ridge to engage a groove of the container, solving the problem to enable a container to rotate on itself in order to mix its content.

---

2. claims: 6-17

Apparatus comprising a first sidewall, a second sidewall substantially parallel to the first sidewall, a top wall coupled to the first sidewall and the second sidewall, a bottom wall opposite the top wall and coupled to the first sidewall and the second sidewall, the bottom wall having a first side to define a cavity to hold a liquid, and a protrusion extending from the first side of the bottom wall toward the top wall, solving the problem to improve mixing of a reagent.

---