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(54) Title: VALVE CARTRIDGE WITH LOW POINT OF CONTACT FOR INSTALLATION

(57) Abstract: A one-handle valve cartridge has a low point of contact for installing the valve cartridge in a valve body. A retention nut bears down on the low point of contact to secure the valve cartridge in the valve body.

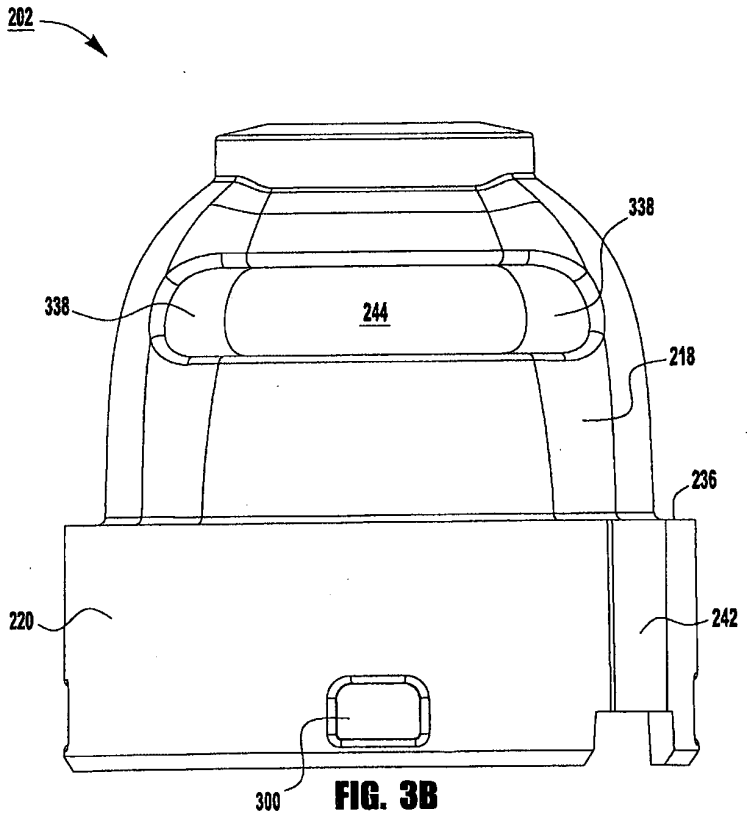

FIG. 3B

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VALVE CARTRIDGE WITH LOW POINT OF CONTACT FOR INSTALLATION

RELATED APPLICATION

[0001] The present application is being filed as a non-provisional patent application claiming priority under 35 U.S.C. § 119(e) from, and any other benefit of, U.S. Provisional Patent Application No. 60/898,542 filed on January 31, 2007, the entire disclosure of which is herein incorporated by reference.

FIELD

[0002] The invention relates generally to valve cartridges and, more particularly, to a valve cartridge having a low point of contact for installing the valve cartridge in a valve body.

BACKGROUND

[0003] Typically, for a plumbing fixture (e.g., a faucet, a tub spout, a shower head), a valve body conveys water flowing from a main water source to a desired destination (e.g., a sink, a tub, a basin). The valve body generally has two water inlet passages through which cold water and hot water from the main water source can respectively flow. The valve body also has a water outlet passage through which the cold water, the hot water or a mixture of the cold and hot water can be discharged to an outlet portion of the plumbing fixture (e.g., a spout). In a one-handle version of the valve body, the valve body has a cavity for receiving a valve cartridge which allows a user to control the flow rate and the temperature of the water

flowing through the water inlet passages to the water outlet passage using a single valve actuating mechanism.

[0004] One type of (conventional) valve cartridge is a structural assembly including a housing in which two or more disks, plates or the like are disposed. The disks are generally made of a hard material (e.g., ceramic or metal). At least one of the disks (i.e., a fixed disk) is fixed relative to the housing. Another of the disks (i.e., a movable disk) is disposed above the fixed disk and is movable relative to the fixed disk. The valve cartridge includes the actuating mechanism that is directly or indirectly connected at one end to the movable disk. Another end of the actuating mechanism extends through an opening in the housing for manipulation by a user. The end of the actuating mechanism extending through the opening in the housing can be connected to a handle, knob or the like to assist the user in operating the valve cartridge.

[0005] In a one-handle version of this type of valve cartridge for use in the one-handle version of the valve body, the fixed disk includes two inlet openings (i.e., a cold water inlet opening and a hot water inlet opening) that substantially align with the water inlet passages of the valve body when the valve cartridge is installed in the valve body. Furthermore, the fixed disk includes an outlet opening that substantially aligns with the water outlet passage of the valve body when the valve cartridge is installed in the valve body. The actuating mechanism is connected to the movable disk via a coupling. The actuating mechanism can be pivoted to cause translational movement of the movable disk. The actuating mechanism can be rotated to cause angular movement of the movable disk.

[0006] In this manner, the movable disk can assume different positions relative to the fixed disk. In particular, pivoting of the actuating mechanism changes the flow rate of the water from zero to a maximum flow rate, whereas rotation of the actuating mechanism changes the temperature of the water. Accordingly, a one-handle actuating mechanism can

control both the flow rate and the temperature of the water flowing through the valve cartridge.

[0007] The valve cartridge also includes one or more seals for preventing water from leaking out of the valve cartridge. The seals can be located, for example, below, between and/or above the disks in the valve cartridge. When the valve cartridge is installed in the valve body, a retention nut is used to secure the valve cartridge in the valve body. The retention nut engages an installation ledge of the housing of the valve cartridge such that the seals in the valve cartridge are compressed and, thus, apply a loading force to the components (including the disks) in the valve cartridge. Accordingly, the fixed disk and the movable disk are kept in water tight contact after installation of the valve cartridge in the valve body.

[0008] Typically, the conventional valve cartridge has the installation ledge formed high on the housing of the valve cartridge, for example, near an upper opening of the valve cartridge. The high installation ledge forms the point of contact between the retention nut and the valve cartridge when the valve cartridge is installed in the valve body.

[0009] As one example, a conventional valve cartridge 100 is illustrated in Figs. 1A-1C and also illustrated in U.S. Patent No. 7,063,106. As shown in Figs. 1A-1B, the conventional valve cartridge 100 has several discrete components including a housing 102, a lower seal 104, a bottom member 106, an upper seal 108, a fixed plate 110, a mobile plate 112, a carrier 114, a rotatable support member 116, an operating lever 118 and a cover 120. The housing 102 has a tubular shape for receiving the remaining components of the valve cartridge 100.

[0010] The operating lever 118 is part of the actuating mechanism of the valve cartridge 100. The operating lever 118 is connected to the rotatable support member 116 via a pin 122. A lower surface of the rotatable support member 116 rests on an upper surface of the carrier 114. The rotatable support member 116 can rotate relative to the housing 102. A

portion of the operating lever 118 extends below the rotatable support member 116 and into the housing 102 which facilitates connecting the operating lever 118 to the mobile plate 112, as described below. A portion of the operating lever 118 extends above the rotatable support member 116 and out of the housing 102 which facilitates connecting the operating lever 118 to an operating member (not shown), such as a handle, a knob or the like.

[0011] The housing 102 has an internal shoulder 124 formed near a lower opening of the housing 102, wherein the internal shoulder 124 is shaped to receive a correspondingly shaped portion of the bottom member 106. The cover 120 has teeth 126 that snap fit into openings 128 formed near an upper opening of the housing 102. Accordingly, the lower opening of the housing 102 is closed by the bottom member 106 and the upper opening of the housing 102 is closed by the cover 120, thereby securing the components in the valve cartridge 100.

[0012] The fixed plate 110 has a pair of water inlet passages 130 and a water outlet passage 132. The fixed plate 110 is disposed above the bottom member 106. The mobile plate 112 is supported on top of the fixed plate 110 and can slide on top of the fixed plate 110. The mobile plate 112 includes a mixing chamber 134 for mixing cold and hot water flowing into the valve cartridge 100 through the respective water inlet passages 130 in the fixed plate 110. The mixed water then flows out of the valve cartridge 100 through the water outlet passage 132 in the fixed plate 110.

[0013] The carrier 114 and the rotatable support member 116 function to translate movement of the of the operating lever 118 into movement of the mobile plate 112. A lower portion of the carrier 114 engages an upper portion of the mobile plate 112. An upper portion of the carrier 114 has a recess 136 for receiving a lower end 138 of the operating lever 118, thereby connecting the operating lever 118 (which is connected to the rotatable support member 116 via the pin 122) to the carrier 114 and the mobile plate 112.

[0014] The lower seal 104 fits in a recess on a lower surface of the bottom member 106 and the upper seal 108 fits into a recess on an upper surface of the bottom member 106. The lower seal 104 forms a water tight seal between a valve body 140 in which the valve cartridge 100 is installed and the bottom member 106 (see Fig. 1C). The upper seal 108 forms a water tight seal between the bottom member 106 and the fixed plate 110 (see Fig. 1B). The lower seal 104 and the upper seal 108 prevent water from leaking out of the valve cartridge 100.

[0015] As shown in Fig. 1C, when the valve cartridge 100 is installed in the valve body 140 of the plumbing fixture 142 (e.g., a faucet), a retention nut 144 is used to secure the valve cartridge 100 in the valve body 140. The retention nut 144 engages an installation ledge 146 formed on the cover 120 of the housing 102 of the valve cartridge 100 such that the seals 104 and 108 in the valve cartridge 100 are compressed and, thus, apply a loading force to the components (including the fixed plate 110 and the mobile plate 112) in the valve cartridge 100. Accordingly the fixed plate 110 and the mobile plate 112 are kept in water tight contact after installation of the valve cartridge 100 in the valve body 140.

[0016] The position and the orientation of the mobile plate 112 relative to the fixed plate 110 are controlled by the operating lever 118 projecting out of the housing 102. In particular, the operating lever 118 can be pivoted within the rotatable support member 116 about the pin 122 and can cause the rotatable support member 116 to rotate by rotation of the operating lever 118. The operating member (not shown) can be connected to the operating lever 118 to facilitate manipulation of the operating lever 118 by the user. Accordingly, after the valve cartridge 100 is installed in the valve body 140, the user can manipulate the operating member which moves the operating lever 118 to change the position and/or orientation of the mobile plate 112 relative to the fixed plate 110, thereby controlling the flow

rate and/or the temperature of the water flowing through the valve cartridge 100 and out the plumbing fixture 142, such as through a spout 148 (see Fig. 1C).

[0017] The installation ledge 146 is formed on the cover 120 so as to be disposed high on the valve cartridge 100. As noted above, the retention nut 144 engages the installation ledge 146 to secure the valve cartridge 100 in the valve body 140. In this manner, the seals 104 and 108 are compressed and a loading force resulting from the compression of the seals 104 and 108 is transmitted up to the components in the valve cartridge 100.

[0018] The high installation ledge 146 of the valve cartridge 100, however, has several drawbacks. For example, the high installation ledge 146 results in less freedom in the design of plumbing fixtures for receiving the valve cartridge 100. Furthermore, the high installation ledge 146 can result in increased costs, as a height of sidewalls 150 of the valve body 140 is often at least as high as the installation ledge 146.

[0019] Consequently, there is a need in the art for a valve cartridge having a low point of contact for installing the valve cartridge in a valve body.

SUMMARY

[0020] In view of the above, it is an exemplary aspect to provide a valve cartridge having a housing with a low point of contact formed on the housing for installing the valve cartridge in a valve body.

[0021] It is another exemplary aspect to provide a valve cartridge having a housing with at least one installation ledge formed on the housing, wherein a ratio of a height of a highest installation ledge of the housing to a largest outer diameter of the housing is less than or equal to 0.53.

[0022] It is yet another exemplary aspect to provide a valve cartridge having a housing with at least one installation ledge formed on the housing, wherein a ratio of a height

of a highest installation ledge of the housing to a largest outer diameter of the housing is less than or equal to 0.50.

[0023] It is still another exemplary aspect to provide a valve cartridge having a housing with at least one installation ledge formed on the housing, wherein a ratio of a height of a highest installation ledge of the housing to a largest outer diameter of the housing is less than or equal to 0.41.

[0024] It is another exemplary aspect to provide a valve cartridge having a housing with at least one installation ledge formed on the housing, wherein a ratio of a height of a highest installation ledge of the housing to a height of the housing is less than or equal to 0.49.

[0025] It is yet another exemplary aspect to provide a valve cartridge having a housing with at least one installation ledge formed on the housing, wherein a ratio of a height of a highest installation ledge of the housing to a height of the housing is less than or equal to 0.39.

[0026] It is still another exemplary aspect to provide a valve cartridge having a housing with at least one installation ledge formed on the housing, wherein a ratio of a height of a highest installation ledge of the housing to a height of a pin of the valve cartridge is less than or equal to 0.67.

[0027] It is another exemplary aspect to provide a valve cartridge having a housing with at least one installation ledge formed on the housing, wherein a ratio of a height of a highest installation ledge of the housing to a height of a pin of the valve cartridge is less than or equal to 0.55.

[0028] It is yet another exemplary aspect to provide a valve cartridge having a housing with at least one installation ledge formed on the housing, wherein a highest installation ledge of the housing is below an actuating mechanism of the valve cartridge.

[0029] It is still another exemplary aspect to provide a valve cartridge having a housing with at least one installation ledge formed on the housing, wherein a highest installation ledge of the housing is below an actuating mechanism of the valve cartridge and above a mixing chamber of the valve cartridge.

[0030] It is another exemplary aspect to provide a valve cartridge having a housing with at least one installation ledge formed on the housing, wherein a highest installation ledge of the housing is below an actuating mechanism of the valve cartridge and above a fixed disk of the valve cartridge. The highest installation ledge of the housing can extend over a portion of the fixed disk.

[0031] It is yet another exemplary aspect to provide a valve cartridge having a housing with at least one installation ledge formed on the housing, wherein a height of a highest installation ledge of the housing is between 0.641 and 0.651 inches.

[0032] It is still another exemplary aspect to provide a valve cartridge having a housing with at least one installation ledge formed on the housing, wherein a height of a highest installation ledge of the housing is between 0.486 and 0.494 inches.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] The above aspects and additional aspects, features and advantages will become readily apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings, wherein like reference numerals denote like elements, and:

[0034] Figures 1A-1C show a conventional valve cartridge in which a point of contact between the valve cartridge and a retention nut for securing the valve cartridge in a valve body is high. Fig. 1A shows the valve cartridge in unassembled form, as a cross-section. Fig. 1B shows the valve cartridge of Fig. 1A in assembled form, as a cross-section. Fig. 1C

shows the valve cartridge of Fig. 1B after installation in a plumbing fixture, as a cross-section.

[0035] Figure 2 is a perspective exploded view of a valve cartridge, according to an exemplary embodiment.

[0036] Figures 3A-3E show an exemplary housing used in the exemplary valve cartridge of Fig. 2. Fig. 3A is a perspective view of the housing. Fig. 3B is a side elevational view of the housing. Fig. 3C is a cross-sectional view of the housing shown in Fig. 10A, along line A-A. Fig. 3D is a cross-sectional view of the housing shown in Fig. 10A, along line B-B. Fig. 3E is a cross-sectional view of the housing of Fig. 3C, along line C-C.

[0037] Figure 4 is a perspective view of an exemplary ball-stem of the exemplary valve cartridge of Fig. 2.

[0038] Figures 5A-5C show an exemplary spring used in the exemplary valve cartridge of Fig. 2. Fig. 5A is a perspective view of the spring. Fig. 5B is a plan view of the spring. Fig. 5C is a side elevational view of the spring.

[0039] Figures 6A-6D show an exemplary bushing used in the exemplary valve cartridge of Fig. 2. Fig. 6A is a perspective view of the bushing. Fig. 6B is a side elevational view of the bushing. Fig. 6C is a bottom view of the bushing. Fig. 6D is a cross-sectional view of the bushing of Fig. 6C, along line A-A.

[0040] Figures 7A-7D show an exemplary flow plate used in the exemplary valve cartridge of Fig. 2. Fig. 7A is a perspective view of the flow plate. Fig. 7B is a plan view of the flow plate. Fig. 7C is a cross-sectional view of the flow plate of Fig. 7B, along line A-A. Fig. 7D is a cross-sectional view of the flow plate of Fig. 7B, along line B-B.

[0041] Figure 8 is a perspective view of an exemplary manifold of the exemplary valve cartridge of Fig. 2.

[0042] Figures 9A-9B show an exemplary base seal used in the exemplary valve cartridge of Fig. 2. Fig. 9A is a top perspective view of the base seal. Fig. 9B is a bottom perspective view of the base seal.

[0043] Figures 10A-10C show the exemplary valve cartridge of Fig. 2 in assembled form. Fig. 10A is a plan view of the valve cartridge in assembled form. Fig. 10B is a cross-sectional view of the valve cartridge of Fig. 10A, along line A-A. Fig. 10C is a cross-sectional view of the valve cartridge of Fig. 10A, along line B-B.

[0044] Figure 11 is a mirror image of a cross-sectional view (along line B-B in Fig. 10A) of the exemplary valve cartridge of Fig. 2 after installation in a plumbing fixture.

[0045] Figure 12 is a perspective exploded view of a valve cartridge, according to another exemplary embodiment.

[0046] Figures 13A-13C show an exemplary upper housing used in the exemplary valve cartridge of Fig. 12. Fig. 13A is a perspective view of the upper housing. Fig. 13B is a side elevational view of the upper housing. Fig. 13C is a cross-sectional view of the upper housing of Fig. 13B, along line A-A.

[0047] Figure 14 is a perspective view of an exemplary ball-stem of the exemplary valve cartridge of Fig. 12.

[0048] Figures 15A-15C show an exemplary spring used in the exemplary valve cartridge of Fig. 12. Fig. 15A is a perspective view of the spring. Fig. 15B is a plan view of the spring. Fig. 15C is a cross-sectional view of the spring of Fig. 15B, along line A-A.

[0049] Figures 16A-16C show an exemplary bushing used in the exemplary valve cartridge of Fig. 12. Fig. 16A is a side elevational view of the bushing. Fig. 16B is a cross-sectional view of the bushing of Fig. 16A along line A-A. Fig. 16C is a plan view of the bushing.

[0050] Figures 17A-17D show an exemplary carrier used in the exemplary valve cartridge of Fig. 12. Fig. 17A is a perspective view of the carrier. Fig. 17B is a plan view of the carrier. Fig. 17C is a bottom view of the carrier. Fig. 17D is a side elevational view of the carrier.

[0051] Figures 18A-18C show an exemplary movable disk used in the exemplary valve cartridge of Fig. 12. Fig. 18A is a plan view of the movable disk. Fig. 18B is a cross-sectional view of the movable disk of Fig. 18A, along line A-A. Fig. 18C is a bottom view of the movable disk.

[0052] Figures 19A-19D show an exemplary fixed disk used in the exemplary valve cartridge of Fig. 12. Fig. 19A is a top perspective view of the fixed disk. Fig. 19B is a bottom perspective view of the fixed disk. Fig. 19C is a plan view of the fixed disk. Fig. 19D is a bottom view of the fixed disk.

[0053] Figures 20A-20B show an exemplary base seal used in the exemplary valve cartridge of Fig. 12. Fig. 20A is a top perspective view of the base seal. Fig. 20B is a plan view of the base seal.

[0054] Figures 21A-21D show an exemplary lower housing used in the exemplary valve cartridge of Fig. 12. Fig. 21A is a top perspective view of the lower housing. Fig. 21B is a bottom perspective view of the lower housing. Fig. 21C is a plan view of the lower housing. Fig. 21D is a bottom view of the lower housing.

[0055] Figures 22A-22C show the exemplary valve cartridge of Fig. 12 in assembled form. Fig. 22A is a plan view of the valve cartridge in assembled form. Fig. 22B is a cross-sectional view of the valve cartridge of Fig. 22A, along line A-A. Fig. 22C is a cross-sectional view of the valve cartridge of Fig. 22A, along line B-B.

DETAILED DESCRIPTION

[0056] While the general inventive concept is susceptible of embodiment in many different forms, there are shown in the drawings and will be described herein in detail specific embodiments thereof with the understanding that the present disclosure is to be considered as an exemplification of the principles of the general inventive concept. Accordingly, the general inventive concept is not intended to be limited to the specific embodiments illustrated herein.

[0057] A one-handle valve cartridge 200, according to an exemplary embodiment, has a low point of contact for securing the valve cartridge 200 in a valve body 240. Accordingly, the valve cartridge 200 may overcome the drawbacks of conventional valve cartridges having a high point of contact.

[0058] As shown in Figs. 2 and 10A-10C, the exemplary valve cartridge 200 has several discrete components including a housing 202, a ball-stem 204, a pin 206, a spring 208, a bushing 210, a flow plate 212, a manifold 214 and a base seal 216. The flow plate 212 and/or the manifold 214 can be made of a hard material. For example, the flow plate 212 and/or the manifold 214 can be made of stainless steel. The housing 202, for example, can be made of plastic or metal.

[0059] As shown in Figs. 3A-3E, the housing 202 has a domed portion 218 and a cylindrical portion 220. A cavity 222 is formed in the housing 202 for receiving the remaining components of the valve cartridge 200. The cavity 222 extends inside the domed portion 218 and the cylindrical portion 220 of the housing 202. The cylindrical portion 220 of the housing 202 includes a lower opening 224 through which the components can be inserted into the housing 202. The domed portion 218 of the housing 202 includes an upper opening 226 through which a stem portion 228 of the ball-stem 204 extends. The cavity 222 in the housing 202 is wider near the lower opening 224 than near the upper opening 226. A

portion of the cavity 222 near the upper opening 226 of the housing 202 receives a ball portion 230 of the ball-stem 204. Accordingly, a first inner surface 232 of the portion of the cavity 222 near the upper opening 226 has a shape that substantially conforms to a shape of the ball portion 230 of the ball-stem 204 (see Figs. 10B-10C and 11).

[0060] A portion of the cavity 222 near the lower opening 224 of the housing 202 receives the bushing 210, the flow plate 212, the manifold 214 and the base seal 216. A diameter of the cavity 222 near the lower opening 224 is substantially the same as a diameter of the base seal 216, the manifold 214 and a flat annular portion 234 of the bushing 210, such that only a small gap is present between these components and the housing 202 when the components are received in the housing 202.

[0061] A portion of the housing 202 where the domed portion 218 meets the cylindrical portion 220 forms an installation ledge 236 on an outer surface of the housing 202. The installation ledge 236 is substantially below the upper opening 226 of the housing 202. A retention nut 238 engages the installation ledge 236 to secure the valve cartridge 200 in a valve body 240 (see Fig. 11). Furthermore, the housing 202 has one or more keys 242 that each engage a complementary-shaped recess (not shown) in the valve body 240 to prevent rotation of the housing 202 relative to the valve body 240 after the valve cartridge 200 is installed. The one or more keys 242 can have a lobular shape. The housing 202 also includes a pair of slots 244 formed on opposing sides of the housing 202 that interface with distal ends of the pin 206 to function as temperature-limit stops, as described below.

[0062] As shown in Fig. 4, the ball-stem 204 is the actuating mechanism for the valve cartridge 200. The ball-stem 204 includes the ball portion 230 and the stem portion 228. The ball portion 230 and the stem portion 228 can be discrete components or can be formed integrally. The ball portion 230 includes a projection 246 extending from a side of the ball portion 230 that is opposite a side of the ball portion 230 from which the stem portion 228

extends. The projection 246 acts as a coupling device for connecting the ball-stem 204 to the flow plate 212, as described below. The ball portion 230 and the projection 246 can be discrete components or can be formed integrally.

[0063] A bore 248 is formed through a center of the ball portion 230 of the ball-stem 204. The bore 248 is orthogonal to the stem portion 228 of the ball-stem 204. After the ball-stem 204 is inserted into the cavity 222 of the housing 202, the pin 206 can be inserted through one of the slots 244 in the housing 202 and into the bore 248 of the ball-stem 204. In this manner, the pin 206 retains the ball-stem 204 in the housing 202.

[0064] As shown in Figs. 5A-5C, the spring 208 has an annular shape with a central opening 250. The spring 208 is disposed below the ball portion 230 of the ball-stem 204 in the housing 202 (see Figs. 10B-10C). The spring 208 is connected to a second inner surface 252 of the housing 202 (e.g., by or through threading, friction fitting, snap fitting, welding), such that the spring 208 also retains the ball-stem 204 in the housing 202. The spring 208 has a plurality of notches 254 formed on an outer periphery 256 of the spring 208. The notches 254 engage corresponding tabs 258 formed on the second inner surface 252 of the housing 202 (see Fig. 3C), thereby securing the spring 208 within the housing 202 below the ball-stem 204.

[0065] The projection 246 of the ball-stem 204 extends through the central opening 250 in the spring 208. Some of the ball portion 230 of the ball-stem 204 can also extend through the central opening 250 in the spring 208. The spring includes a plurality of elastic flanges 260 surrounding the central opening 250. The elastic flanges 260 of the spring 208 contact the ball portion 230 of the ball-stem 204 and urge the ball portion 230 of the ball-stem 204 against the complementary-shaped first inner surface 232 of the housing 202.

[0066] As shown in Figs. 6A-6D, the bushing 210 includes the flat annular portion 234 and a raised annular portion 262. A diameter of the flat annular portion 234 is greater

than a diameter of the raised annular portion 262. The bushing 210 is disposed below and can be spaced apart from the spring 208 in the cavity 222 of the housing 202 (see Figs. 10B-10C). An upper surface 264 of the flat annular portion 234 of the bushing 210 contacts a third inner surface 266 of the housing 202, which is located below the installation ledge 236 (see Figs. 3C-3D and 10B-10C). A lower surface 268 of the flat annular portion 234 of the bushing 210 rests on an upper surface 270 of a flat portion 272 of the flow plate 212. Additionally, the raised annular portion 262 of the bushing 210 extends into a portion of the cavity 222 of the housing 202 immediately above the installation ledge 236. The raised annular portion 262 of the bushing 210 is sized to fit closely in that portion of the cavity 222 of the housing 202 receiving the raised annular portion 262 of the bushing 210. Accordingly, the bushing 210 provides a support surface between the housing 202 and the flow plate 212.

[0067] The bushing 210 has an opening 274 that extends through the flat annular portion 234 and the raised annular portion 262 of the bushing 210. A raised portion 276 of the flow plate 212 extends into the opening 274 of the bushing 210. The raised portion 276 of the flow plate 212 forms a mixing chamber 278. A portion of the opening 274 of the bushing 210 has an inner surface shaped to conform to a shape of the raised portion 276 of the flow plate 212 (see Figs. 6C-6D). Additionally, a coupling recess 280 is formed on the raised portion 276 of the flow plate 212 (see Figs. 7A-7D). After the flow plate 212 is installed in the valve cartridge 200, the coupling recess 280 is positioned within the opening 274 of the bushing 210 and surrounded by the raised annular portion 262 of the bushing 210 (see Figs. 10B-10C).

[0068] The coupling recess 280 of the flow plate 212 receives the projection 246 of the ball-stem 204, thereby connecting the actuating mechanism (i.e., the ball-stem 204) and the flow plate 212. The projection 246 of the ball-stem 204 can have four sides that contact four corresponding sides of the coupling recess 280. The projection 246 of the ball-stem 204

does not contact a bottom surface of the coupling recess 280. It will be appreciated that notwithstanding the exemplary embodiments described herein, the ball-stem 204 can be connected to the flow plate 212 in any suitable manner that allows the ball-stem 204 to impart translational and angular movement to the flow plate 212.

[0069] As shown in Figs. 7A-7D, the flow plate 212 is a valve member formed as a plate, disk or the like that is movable relative to the housing 202. The flow plate 212 includes the flat portion 272 and the raised portion 276. The flat portion 272 of the flow plate 212 forms a sealing surface that can cover and uncover water inlet apertures 282 and 284 in the manifold 214 to allow only cold water, only hot water or both cold and hot water to flow through the manifold 214. The water flowing through the water inlet apertures 282 and 284 in the manifold 214 enters the mixing chamber 278 (i.e., a cavity formed under the raised portion 276 of the flow plate 212) where the cold and hot water mixes prior to being discharged through a water outlet aperture 286 in the manifold 214. Furthermore, as noted above, the flow plate 212 also includes the coupling recess 280, which is formed on the raised portion 276 of the flow plate 212.

[0070] As shown in Fig. 8, the manifold 214 is a valve member formed as a plate, disk or the like that is fixed relative to the housing 202. The manifold 214 includes one or more projections 288 formed on a periphery 290 of the manifold 214, wherein each of the projections 288 fits inside an internal cavity 292 of one of the keys 242 of the housing 202 (see Figs. 3A and 3E). The projections 288 fix the manifold 214 relative to the housing 202, thereby preventing rotation of the manifold 214 within the housing 202.

[0071] The manifold 214 includes the water inlet apertures 282 and 284, which correspond to a cold water inlet aperture and a hot water inlet aperture, respectively. The manifold 214 also includes the water outlet aperture 286 through which cold water flowing through the cold water inlet aperture 282, hot water flowing through the hot water inlet

aperture 284 or a mixture of the cold and hot water can flow to a water outlet passage (not shown) of the valve body 240.

[0072] As shown in Figs. 9A-9B, the base seal 216 is a sealing member formed of an elastic material (e.g., rubber). The base seal 216 includes one or more projections 294 formed on a periphery 296 of the base seal 216, wherein each of the projections 294 fits inside the internal cavity 292 of one of the keys 242 of the housing 202. The projections 294 fix the base seal 216 relative to the housing 202, thereby preventing rotation of the base seal 216 within the housing 202. The base seal 216 also includes one or more tabs 298 formed on the periphery 296 of the base seal 216, wherein the one or more tabs 298 are deformable to fit in and extend through a corresponding one or more openings 300 formed in the housing 202 to secure the base seal 216 in the housing 202. The one or more tabs 298 can have different sizes.

[0073] Like the manifold 214, the base seal 216 has a cold water inlet aperture 302, a hot water inlet aperture 304 and a water outlet aperture 306. The cold water inlet aperture 302 and the hot water inlet aperture 304 of the base seal 216 each have walls 308 that slope from near a lower surface 310 of the base seal 216 to near an upper surface 312 of the base seal 216 to improve the flow of water through the base seal 216 and into the valve cartridge 200. The water outlet aperture 306 of the base seal 216 has walls 314 that slope from near the upper surface 312 of the base seal 216 to near the lower surface 310 of the base seal 216 to improve the flow of water through the base seal 216 and out of the valve cartridge 200. It is important that the apertures 282, 284 and 286 in the manifold 214 are aligned with the apertures 302, 304 and 306 in the base seal 216 when the valve cartridge 200 is assembled. Accordingly, the projections 288 on the manifold 214 and the projections 294 on the base seal 216 insure that the manifold 214 and the base seal 216 fit into the housing 202 in only

one orientation, wherein the apertures 282, 284 and 286 in the manifold 214 are aligned with the apertures 302, 304 and 306 in the base seal 216 in this orientation.

[0074] A ridge 316 surrounds the apertures 302, 304 and 306 in the base seal 216 on the upper surface 312 of the base seal 216 (see Fig. 9A). Similarly, a ridge 318 surrounds the apertures 302, 304 and 306 in the base seal 216 on the lower surface 310 of the base seal 216 (see Fig. 9B). The ridges 316 and 318 of the base seal 216 are compressed when the valve cartridge 200 is installed in the valve body 240 (see Figs. 10B-10C and 11 which show the ridges 316 and 318 overlapped with the compressing structure for purposes of illustration only). In particular, as the retention nut 238 is tightened down on the installation ledge 236 of the housing 202, the ridge 316 is compressed between the manifold 214 of the valve cartridge 200 and the base seal 216, while the ridge 318 is compressed between the base seal 216 and a seating surface 320 of the valve body 240 (see Fig. 11). It should be noted that although the projections 288 of the manifold 214 prevent the manifold 214 from rotating within the housing 202, the projections 288 nonetheless allow the manifold 214 to move axially within the housing 202. In this manner, the compression of the ridges 316 and 318 of the base seal 216 exerts a loading force on the flow plate 212 and the manifold 214. Accordingly, the flow plate 212 and the manifold 214 are kept in water-tight engagement with one another, after installation of the valve cartridge 200.

[0075] The retention nut 238 is a hollow nut that engages sidewalls 322 of the valve body 240 to secure the valve cartridge 200 in the valve body 240 (see Fig. 11). For example, the retention nut 238 can have external threads for engaging complementary threads on the sidewalls 322. An inner surface of the retention nut 238 is shaped to conform substantially to a shape of the domed portion 218 of the housing 202. The installation ledge 236, however, is the only portion of the housing 202 that the retention nut 238 contacts during installation of the valve cartridge 200 in the valve body 240.

[0076] Additionally, the retention nut 238 and/or the valve body 240 can have structural features that prevent an excessive amount of torque from being transferred to the valve cartridge 200. For example, the retention nut 238 includes an annular flange 326 that bottoms out on a surface 328 of the valve body 240 to prevent excessive tightening of the retention nut 238 (see Fig. 11). Accordingly, the annular flange 326 functions to limit the maximum amount of torque that can be transferred from the retention nut 238 to the valve cartridge 200.

[0077] The position and the orientation of the flow plate 212 relative to the manifold 214 are controlled by the stem portion 228 of the ball-stem 204 projecting out of the housing 202 through the upper opening 226. For example, pivoting the stem portion 228 of the ball-stem 204 about the pin 206 changes the position of the flow plate 212 relative to the manifold 214, which changes the flow rate of the water. Rotating the stem portion 228 of the ball-stem 204 changes the orientation of the flow plate 212 relative to the manifold 214, which changes the temperature of the water.

[0078] An operating member 330 such as a handle, knob or the like (see Fig. 11) can be connected to the stem portion 224 of the ball-stem 204 to facilitate manipulation of the stem portion 228 by the user. Accordingly, after the valve cartridge 200 is installed in the valve body 240, the user can manipulate the operating member 330 which moves the stem portion 228 of the ball-stem 204 to change the position and/or orientation of the flow plate 212 relative to the manifold 214, thereby controlling the flow rate and temperature of the water flowing through the valve cartridge 200 and out a plumbing fixture 332, such as through a spout (not shown) of the plumbing fixture 332 (see Fig. 11).

[0079] Pivoting of the stem portion 228 of the ball-stem 204 about the pin 206 can be limited by the stem portion 228 contacting opposing surfaces of the upper opening 226 of the housing 202. Thus, the stem portion 224 of the ball-stem 204 contacts a first surface 334 of

the upper opening 226 of the housing 202 when the valve cartridge 200 is in a fully closed position corresponding to a flow rate of zero (see Fig. 10C). The stem portion 228 of the ball-stem 204 contacts a second surface 336 of the upper opening 226 of the housing 202 when the valve cartridge 200 is in a fully open position corresponding to a maximum flow rate.

[0080] Rotation of the stem portion 228 of the ball-stem 204 can be limited by the distal ends of the pin 206 contacting end portions 338 of the slots 244 (see Figs. 2, 3A-3B and 10A). Accordingly, the length of the slots 244, which function as temperature limit stops, define the range of temperatures for which the valve cartridge 200 can deliver the water.

[0081] The valve cartridge 200 has a low point of contact (i.e., the installation ledge 236 formed on the housing 202) on which the retention nut 238 bears down. The installation ledge 236 is a circular ledge that extends around the housing 202 where the domed portion 218 of the housing 202 meets the cylindrical portion 220 of the housing 202. The installation ledge 236 is the highest point on the housing 202 that contacts the retention nut 238.

[0082] In an exemplary embodiment of the exemplary valve cartridge 200, one or more installation ledges (e.g., the installation ledge 236) are formed on the housing 202 of the valve cartridge 200. The highest of the installation ledges is a low point of contact on the housing 202 for installing the valve cartridge 200 in the valve body 240.

[0083] A ratio R_l of a height h_l of the highest installation ledge on the housing 202 to a largest outer diameter d of the housing 202 is less than or equal to 0.50 (see Fig. 10B), which can be expressed as $h_l/d \leq 0.50$. In another exemplary embodiment of the exemplary valve cartridge 200, the ratio R_l of the height h_l to the largest outer diameter d is less than or equal to 0.41 (see Fig. 10B). In still another exemplary embodiment, the ratio R_l of the height h_l to the largest outer diameter d is approximately equal to 0.40.

[0084] According to still another exemplary embodiment of the exemplary valve cartridge 200, a ratio R_2 of the height h_1 to a height h_2 of the housing 202 is less than or equal to 0.39 (see Fig. 10B), which can be expressed as $h_1/h_2 \leq 0.39$. In another exemplary embodiment, the ratio R_2 of the height h_1 to the height h_2 is approximately equal to 0.38. In still another exemplary embodiment, the ratio R_2 of the height h_1 to the height h_2 is approximately equal to 0.36.

[0085] According to yet another exemplary embodiment of the exemplary valve cartridge 200, a ratio R_3 of the height h_1 to a height h_3 of the pin 206 (e.g., from a bottom of the housing 202 to a centerline of the pin 206) is less than or equal to 0.55 (see Fig. 10B), which can be expressed as $h_1/h_3 \leq 0.55$. In another exemplary embodiment, ratio R_3 of the height h_1 to the height h_3 is approximately equal to 0.54. In still another exemplary embodiment, ratio R_3 of the height h_1 to the height h_3 is approximately equal to 0.50.

[0086] According to another exemplary embodiment of the exemplary valve cartridge 200, the highest installation ledge on the housing 202 is below an actuating mechanism (e.g., the ball-stem 204) of the valve cartridge 200 (see Fig. 10B). In still another exemplary embodiment of the exemplary valve cartridge 200, the highest installation ledge on the housing 202 is below the actuating mechanism and above a mixing chamber (e.g., the mixing chamber 278) of the valve cartridge 200. In yet another exemplary embodiment of the exemplary valve cartridge 200, the highest installation ledge on the housing 202 is below the actuating mechanism and above a fixed disk (e.g., the manifold 214) of the valve cartridge 200.

[0087] According to an exemplary embodiment of the exemplary valve cartridge 200, the height h_1 of the highest installation ledge on the housing 202 is between 0.486 and 0.494 inches. In one exemplary embodiment, the height h_1 of the highest installation ledge on the housing 202 is approximately equal to 0.490 inches.

[0088] According to another exemplary embodiment of the exemplary valve cartridge 200, the height h_2 of the housing 202 is between 1.377 and 1.385 inches. In another exemplary embodiment, the height h_2 of the housing 202 is between 1.277 and 1.285 inches. In one exemplary embodiment, the height h_2 of the housing 202 is approximately equal to 1.381 inches. In another exemplary embodiment, the height h_2 of the housing 202 is approximately equal to 1.281 inches.

[0089] According to still another exemplary embodiment of the exemplary valve cartridge 200, the height h_3 of the pin 206 is between 0.977 and 0.994 inches. In another exemplary embodiment, the height h_3 of the pin 206 is between 0.902 and 0.919 inches. In one exemplary embodiment, the height h_3 of the pin 206 is approximately equal to 0.986 inches. In another exemplary embodiment, the height h_3 of the pin 206 is approximately equal to 0.911 inches.

[0090] According to yet another exemplary embodiment of the exemplary valve cartridge 200, the outer diameter d of the housing 202 is between 1.216 and 1.224 inches. In one exemplary embodiment, the outer diameter d of the housing 202 is approximately equal to 1.220 inches.

[0091] As illustrated by way of the exemplary embodiments described herein, the installation ledge 236 (as a highest installation ledge on the housing 202) is a low point of contact on the housing 202 on which the retention nut 238 can bear down during installation of the valve cartridge 200 in the valve body 240. Accordingly, the valve cartridge 200 has a compact structure that provides increased flexibility in the design of plumbing fixtures (e.g., the plumbing fixture 332 shown in Fig. 11) that will accommodate the valve cartridge 200. Furthermore, the low installation ledge 236 allows less material to be used in forming the valve body 240, since sidewalls 322 of the valve body 240 can be made shorter (see Fig. 11). As a result, the low installation ledge 236 provides a cost savings.

[0092] A one-handle valve cartridge 400, according to another exemplary embodiment, has a low point of contact for securing the valve cartridge 400 in a valve body (e.g., the exemplary valve body 240 shown in Fig. 11). Accordingly, the valve cartridge 400 may overcome the drawbacks of conventional valve cartridges having a high point of contact.

[0093] As shown in Figs. 12 and 22B-22C, the exemplary valve cartridge 400 has several discrete components including an upper housing 402, a ball-stem 404, a pin 406, a spring 408, a bushing 410, a carrier 412, a movable disk 414, a fixed disk 416, a base seal 418 and a lower housing 420. The movable disk 414 and/or the fixed disk 416 can be made of a hard material. For example, the movable disk 414 and/or the fixed disk 416 can be made of ceramic. The upper housing 402, for example, can be made of plastic or metal.

[0094] As shown in Figs. 13A-13C, the upper housing 402 has a domed portion 422 and a cylindrical portion 424. A cavity 426 is formed in the upper housing 402 for receiving the remaining components of the valve cartridge 400. The cavity 426 extends inside the domed portion 422 and the cylindrical portion 424 of the upper housing 402. The cylindrical portion 424 of the upper housing 402 includes a lower opening 428 through which the components can be inserted into the upper housing 402. The dome portion 422 of the upper housing 402 includes an upper opening 430 through which a stem portion 432 of the ball-stem 404 extends. The cavity 426 in the upper housing 402 is wider near the lower opening 428 than near the upper opening 430. A portion of the cavity 426 near the upper opening 430 of the upper housing 402 receives a ball portion 434 of the ball-stem 404. Accordingly, a first inner surface 436 of the portion of the cavity 426 near the upper opening 430 has a shape that substantially conforms to a shape of the ball portion 434 of the ball-stem 404 (see Figs. 13C and 22B).

[0095] A portion of the cavity 426 near the lower opening 428 of the upper housing 402 receives the bushing 410, the carrier 412, the movable disk 414, the fixed disk 416 and

the base seal 418 (see Figs. 22B-22C). Furthermore, as described below, the lower housing 420 interfaces with the upper housing 402 to form a housing assembly 438 that retains these components in the cavity 426 of the upper housing 402 (see Figs. 22B-22C).

[0096] A portion of the upper housing 402 where the domed portion 422 meets the cylindrical portion 424 forms an installation ledge 440 on an outer surface of the upper housing 402 (see Figs. 13A-13C and 22A-22C). The installation ledge 440 is substantially below the upper opening 430 of the upper housing 402. In one exemplary embodiment, a retention nut (e.g., the retention nut 234 shown in Fig. 11) engages the installation ledge 440 to secure the valve cartridge 400 in a valve body (e.g., the valve body 240 shown in Fig. 11). Furthermore, the upper housing 402 has one or more keys 442 that each engage a complementary-shaped recess in the valve body to prevent rotation of the upper housing 402 relative to the valve body after the valve cartridge 400 is installed. The one or more keys 442 can have a lobular shape. The upper housing 402 also includes a pair of slots 444 formed on opposing sides of the upper housing 402 that interface with distal ends of the pin 406 to function as temperature-limit stops, as described below.

[0097] As shown in Fig. 14, the ball-stem 404 is the actuating mechanism for the valve cartridge 400. The ball-stem 404 includes the ball portion 434 and the stem portion 432. The ball portion 434 and the stem portion 432 can be discrete components or can be formed integrally. The ball portion 434 includes a projection 446 extending from a side of the ball portion 446 that is opposite a side of the ball portion 434 from which the stem portion 432 extends. The projection 446 acts as a coupling device for connecting the ball-stem 404 to the carrier 412, as described below. The ball portion 434 and the projection 446 can be discrete components or can be formed integrally.

[0098] A bore 448 is formed through a center of the ball portion 434 of the ball-stem 404. The bore 448 is orthogonal to the stem portion 432 of the ball-stem 404. After the ball-

stem 404 is inserted into the cavity 426 of the upper housing 402, the pin 406 can be inserted through one of the slots 444 in the upper housing 402 and into the bore 448 of the ball-stem 404. In this manner, the pin 406 retains the ball-stem 404 in the upper housing 402.

[0099] As shown in Figs. 15A-15C, the spring 408 has an annular shape with a central opening 450. The spring 408 is disposed below the ball portion 434 of the ball-stem 404 in the upper housing 402 (see Figs. 22B-22C). The spring 408 is connected to a second inner surface 452 of the upper housing 402 (e.g., by or through threading, friction fitting, snap fitting, welding), such that the spring 408 also retains the ball-stem 404 in the upper housing 402 (see Figs. 13C and 22C). In one exemplary embodiment, at least a portion of an outer periphery 454 of the spring 408 is welded to the second inner surface 452 of the upper housing 402.

[00100] The projection 446 of the ball-stem 404 extends through the central opening 450 in the spring 408. Some of the ball portion 434 of the ball-stem 404 can also extend through the central opening 450 in the spring 408. The spring 408 includes a plurality of elastic flanges 456 surrounding the central opening 450. The elastic flanges 456 are spaced apart from one another such that gaps 458 are formed between the elastic flanges 456. The elastic flanges 456 of the spring 408 contact the ball portion 434 of the ball-stem 404 and urge the ball portion 434 of the ball-stem 404 against the complementary-shaped first inner surface 436 of the upper housing 402. The gaps 458, for example, function to reduce the stress placed on the spring 408 from engaging the ball-stem 404.

[00101] As shown in Figs. 16A-16C, the bushing 410 includes a flat annular portion 460 and a raised annular portion 462. A diameter of the flat annular portion 460 is greater than a diameter of the raised annular portion 462. The bushing 410 is disposed below and can be spaced apart from the spring 408 in the cavity 426 of the upper housing 402 (see Figs. 22B-22C). An upper surface 464 of the flat annular portion 460 of the bushing 410 contacts a

third inner surface 466 of the upper housing 402, which is located below the installation ledge 440 (see Figs. 13C and 22B). A lower surface 468 of the flat annular portion 460 of the bushing 410 rests on an upper surface 470 of a flat portion 472 of the carrier 412 (see Figs. 17A-17B, 17D and 22B-22C). Additionally, the raised annular portion 462 of the bushing 410 extends into a portion of the cavity 426 of the upper housing 402 immediately above (and adjacent to) the installation ledge 440. The raised annular portion 462 of the bushing 410 is sized to fit closely in that portion of the cavity 426 of the upper housing 402 receiving the raised annular portion 462 of the bushing 410. Accordingly, the bushing 410 provides a support surface between the upper housing 402 and the carrier 412.

[00102] The bushing 410 has an opening 474 that extends through the flat annular portion 460 and the raised annular portion 462 of the bushing 410. The raised annular portion 462 can include a first raised annular portion 476 and a second raised annular portion 478 with ribs 480 disposed between the first and second raised annular portions 476, 478 (see Fig. 16C). A raised portion 482 of the carrier 412 extends into the opening 474 of the bushing 410 (see Figs. 17A-17B and 17D). Additionally, a coupling recess 484 is formed in the raised portion 482 of the carrier 412. After the carrier 412 is installed in the valve cartridge 400, the raised portion 482 including the coupling recess 484 is positioned within the opening 474 of the bushing 410 and surrounded by the bushing 410 (see Figs. 22B-22C).

[00103] The coupling recess 484 of the carrier 412 receives the projection 446 of the ball-stem 404, thereby connecting the actuating mechanism (i.e., the ball-stem 404) and the carrier 412 (see Figs. 22B-22C). The projection 446 of the ball-stem 404 can have four sides that contact four corresponding sides of the coupling recess 484. The projection 446 of the ball-stem 404 does not contact a bottom surface of the coupling recess 484. It will be appreciated that notwithstanding the exemplary embodiments described herein, the ball-stem

404 can be connected to the carrier 412 in any suitable manner that allows the ball-stem 404 to impart translational and angular movement to the carrier 412.

[00104] As shown in Figs. 17A-17D, the carrier 412 includes the flat portion 472 and the raised portion 482. A lower surface 486 of the flat portion 472 of the carrier 412 includes structure for interfacing with an upper surface 488 of the movable disk 414, such that the carrier 412 and the movable disk 414 are joined and do not move relative to one another. In one exemplary embodiment, the lower surface 486 of the carrier 412 includes three U-shaped projections 490 that friction fit into three corresponding U-shaped recesses 492 formed in the upper surface 488 of the movable disk 414. The spacing between adjacent U-shaped projections 490 (and, thus, the corresponding U-shaped recesses 492) can be varied so that the carrier 412 will only interface with the movable disk 414 in one orientation. Furthermore, as noted above, the carrier 412 also includes the coupling recess 484, which is formed in the raised portion 482 of the carrier 412. In this manner, the carrier 412 functions to interconnect the actuating mechanism (e.g., the ball-stem 404) and the dynamic sealing elements (e.g., the movable disk 414), in the valve cartridge 400.

[00105] As shown in Figs. 18A-18C, the movable disk 414 is a valve member formed as a plate, disk or the like that is movable relative to the upper housing 402. As noted above, the upper surface 488 of the movable disk 414 includes the U-shaped recesses 492. The upper surface 488 is substantially flat. A lower surface 494 of the movable disk 414 includes a mixing chamber 496 (i.e., a cavity formed in the movable disk 414). In an alternative exemplary embodiment, the mixing chamber 496 extends through the movable disk 414 (i.e., from the lower surface 494 to the upper surface 488). The lower surface 494 is substantially flat. The lower surface 494 of the movable disk 414 forms a sealing surface that can cover and uncover water inlet apertures 498 and 500 in the fixed disk 416 to allow only cold water, only hot water or both cold and hot water to flow through the fixed disk 416. The water

flowing through the water inlet apertures 498 and 500 in the fixed disk 416 enters the mixing chamber 496 where the cold and hot water mix prior to being discharged through a water outlet aperture 502 in the fixed disk 416.

[00106] As shown in Figs. 19A-19D, the fixed disk 416 is a valve member formed as a plate, disk or the like that is fixed relative to the upper housing 402. The fixed disk 416 has an upper surface 504 and a lower surface 506. The fixed disk 416 includes structure for interfacing with the lower housing 420 to fix (i.e., prevent rotation) of the fixed disk 416 relative to the housing assembly 438 once the valve cartridge 400 is assembled. For example, four notches 508 are formed along a periphery 510 of the fixed disk 416. One or more notches 508 engage corresponding projections 512 formed on the lower housing 420, thereby preventing the fixed disk 416 from rotating relative to the lower housing 420. In one exemplary embodiment, two notches 508 engage corresponding projections 512. By varying the size of and/or the spacing between the notches 508 (and, thus, the corresponding projections 512), it is possible to insure that the fixed disk 416 will interface with the lower housing 420 in only one orientation. Thus, because the fixed disk 416 is prevented from rotating relative to the lower housing 420 and the lower housing 420 is secured to the upper housing 402, as described below, the fixed disk 416 will not rotate within the housing assembly 438.

[00107] The fixed disk 416 includes the water inlet apertures 498 and 500, which correspond to a cold water inlet aperture and a hot water inlet aperture, respectively. The fixed disk 416 also includes the water outlet aperture 502 through which cold water flowing through the cold water inlet aperture 498, hot water flowing through the hot water inlet aperture 500 or a mixture of the cold and hot water can flow to a water outlet passage of the valve body. The cold water inlet aperture 498 and the hot water inlet aperture 500 of the fixed disk 416 each have walls 514 that slope from near the lower surface 506 of the fixed

disk 416 to near the upper surface 504 of the fixed disk 416 to improve the flow of water through the fixed disk 416 and into the valve cartridge 400. The water outlet aperture 502 of the fixed disk 416 has walls 516 that slope from near the upper surface 504 of the fixed disk 416 to near the lower surface 506 of the fixed disk 416 to improve the flow of water through the fixed disk 416 and out of the valve cartridge 400.

[00108] As shown in Figs. 20A-20B, the base seal 418 is a sealing member formed of an elastic material (e.g., rubber). The base seal 418 forms a watertight seal around the cold water inlet aperture 498, the hot water inlet aperture 500 and the water outlet aperture 502 of the fixed disk 416. Like the fixed disk 416, the base seal 418 has a cold water inlet aperture 518, a hot water inlet aperture 520 and a water outlet aperture 522. In one exemplary embodiment, the water outlet aperture 522 of the base seal 418 is formed by inserting a member 524 (e.g., a plastic insert) having the water outlet aperture 522 therein into an opening in the base seal 418. In another exemplary embodiment, the base seal 418 is formed integrally with the lower housing 420.

[00109] The cold water inlet aperture 518, the hot water inlet aperture 520 and the water outlet aperture 522 are all connected by a hub 526 near the center of the base seal 418. Furthermore, the cold water inlet aperture 518 is connected to the water outlet aperture 522 by a first connection 528; the hot water inlet aperture 520 is connected to the water outlet aperture 522 by a second connection 530; and the cold water inlet aperture 518 is connected to the hot water inlet aperture 520 by a third connection 532. The joining of the cold water inlet aperture 518 to the water outlet aperture 522 by the first connection 528 forms a first space 534; the joining of the hot water inlet aperture 520 to the water outlet aperture 522 by the second connection 530 forms a second space 536; and the joining of the cold water inlet aperture 518 to the hot water inlet aperture 520 by the third connection 532 forms a third space 538.

[00110] It is important that the apertures 498, 500 and 502 in the fixed disk 416 are aligned with the apertures 518, 520 and 522 in the base seal 418 when the valve cartridge 400 is assembled. Accordingly, as described below, the hub 526, the first connection 528, the second connection 530, the third connection 532, the first space 534, the second space 536 and the third space 538 are used to align the base seal 418 in the lower housing 420 and, thus, with the fixed disk 418.

[00111] As shown in Figs. 21A-21D and 22B-22C, the lower housing 420 interfaces with the upper housing 402 to form the housing assembly 438 for retaining the components (e.g., the bushing 410, the carrier 412, the movable disk 414, the fixed disk 416 and the base seal 418) therein (e.g., in the cavity 426 of the upper housing 402) after assembly of the valve cartridge 400. The lower housing 420, for example, can be made of plastic or metal. The lower housing 420 can be formed from the same material as the upper housing 402.

[00112] Furthermore, the lower housing 420 functions as a support member to orient and retain the fixed disk 416 and the base seal 418 prior to assembly of the valve cartridge 400. Similar to the fixed disk 416 and the base seal 418, the lower housing 420 includes a cold water inlet aperture 540, a hot water inlet aperture 542 and a water outlet aperture 544 (see Figs. 21A-21D). As noted above, the lower housing 420 also includes the projections 512. One or more projections 512 can extend above a sidewall 546 of the lower housing 420. In one exemplary embodiment, two projections 512 extend above the sidewall 546. One or more projections 512 can have a height that is substantially the same as a height of the sidewall 546. In one exemplary embodiment, two projections 512 have a height that is substantially the same as the height of the sidewall 546.

[00113] One or more projections 512 can fit into corresponding openings 548 formed in the upper housing 402 below the keys 442 (see Figs. 13A-13C). In one exemplary embodiment, three projections 512 fit into three openings 548. These projections 512 have a

shape that is substantially the same as a shape of the keys 442, for example, a lobular shape. By fitting into the openings 548 below the keys 442, the projections 512 also function as part of the keys 442, for example, by engaging the complementary-shaped recesses in the valve body.

[00114] The size and/or shape of the projections 512 can be varied such that the lower housing 420 will interface with the fixed disk 416 and the upper housing 402 in only one orientation, thereby insuring that the fixed disk 416 will be properly oriented relative to the upper housing 402 and the lower housing 420 when the valve cartridge 400 is assembled. By engaging the notches 508 in the fixed disk 416, the projections 512 also prevent the fixed disk 416 from rotating relative to the lower housing 420 (and, thus, the upper housing 402).

[00115] The lower housing 420 includes a first recess 550, a second recess 552, a third recess 554 and a fourth recess 556. The lower housing 420 also includes a first projection 558, a second projection 560 and a third projection 562. The hub 526, the first connection 528, the second connection 530 and the third connection 532, respectively, of the base seal 418 fit into the first recess 550, the second recess 552, the third recess 554 and the fourth recess 556, respectively, of the lower housing 420. Furthermore, the first projection 558, the second projection 560 and the third projection 562, respectively, of the lower housing 420 fit into the first space 534, the second space 536 and the third space 538, respectively, of the base seal 418. Accordingly, the lower housing 420 orients, fixes and retains the base seal 418 in the lower housing 420.

[00116] The lower housing 420 also includes a pair of elastic flanges 564 that each have an angled upper portion 566. The notches 508 in the fixed disk 416 allow the elastic flanges 564 to be pressed inward (i.e., toward a central vertical axis of the valve cartridge 400), such that the angled upper portions 566 can enter the cavity 426 in the upper housing 402. When the angled upper portions 566 are aligned with corresponding openings 568

formed in the upper housing 402 (see Figs. 13A-13C), the elastic flanges 564 press outward and the angled upper portions 566 are received in the openings 568. In this manner, the lower housing 420 (including the fixed disk 416 and the base seal 418 interfaced therewith) can be secured to the upper housing 402 (see Figs. 22B-22C).

[00117] It should be noted that although the notches 508 of the fixed disk 416 interface with the projections 512 of the lower housing 420 to prevent the fixed disk 416 from rotating within the lower housing 420 (and, thus, the upper housing 402), the fixed disk 416 is nonetheless allowed to move axially within the housing assembly 438 (i.e., the upper housing 402 and the lower housing 420). In this manner, compression of the base seal 418 exerts a loading force on the movable disk 414 and the fixed disk 416. Accordingly, the movable disk 414 and the fixed disk 416 are kept in water-tight engagement with one another, after installation of the valve cartridge 400.

[00118] The position and the orientation of the movable disk 414 relative to the fixed disk 416 are controlled by the stem portion 432 of the ball-stem 404 projecting out of the upper housing 402 through the upper opening 430. For example, pivoting the stem portion 432 of the ball-stem 404 about a pivot (e.g., the pin 406) changes the position of the movable disk 414 relative to the fixed disk 416, which changes the flow rate of the water. Rotating the stem portion 432 of the ball-stem 404 changes the orientation of the movable disk 414 relative to the fixed disk 416, which changes the temperature of the water.

[00119] An operating member (e.g., the operating member 330 shown in Fig. 11) such as a handle, knob or the like can be connected to the stem portion 432 of the ball-stem 404 to facilitate manipulation of the stem portion 432 by a user. Accordingly, after the valve cartridge 400 is installed in the valve body, the user can manipulate the operating member which moves the stem portion 432 of the ball-stem 404 to change the position and/or orientation of the movable disk 414 relative to the fixed disk 416, thereby controlling the

flow rate and temperature of the water flowing through the valve cartridge 400 and out a plumbing fixture (e.g., the plumbing fixture 332 shown in Fig. 11).

[00120] Pivoting of the stem portion 432 of the ball-stem 404 about the pin 406 can be limited by the stem portion 432 contacting opposing surfaces of the upper opening 430 of the upper housing 402. Thus, the stem portion 432 of the ball-stem 404 contacts a first surface 570 of the upper opening 430 of the upper housing 402 when the valve cartridge 400 is in a fully closed position corresponding to a flow rate of zero (see Fig. 22C). The stem portion 432 of the ball-stem 404 contacts a second surface 572 of the upper opening 430 of the upper housing 402 when the valve cartridge 400 is in a fully open position corresponding to a maximum flow rate.

[00121] Rotation of the stem portion 432 of the ball-stem 404 can be limited by the distal ends of the pin 406 contacting end portions 574 of the slots 444 (see Fig. 22A). Accordingly, the length of the slots 444, which function as temperature limit stops, define the range of temperatures for which the valve cartridge 400 can deliver the water.

[00122] The valve cartridge 400 has a low point of contact (i.e., the installation ledge 440 formed on the upper housing 402) on which the retention nut bears down. The installation ledge 440 is a circular ledge that extends around the upper housing 402 where the domed portion 422 of the upper housing 402 meets the cylindrical portion 424 of the upper housing 402. The installation ledge 440 is the highest point on the housing assembly 438 that contacts the retention nut.

[00123] In an exemplary embodiment of the exemplary valve cartridge 400, one or more installation ledges (e.g., the installation ledge 440 are formed on the housing assembly 438 of the valve cartridge 400. The highest of the installation ledges is a low point of contact on the housing assembly 438 for installing the valve cartridge 400 in the valve body.

[00124] A ratio R_1 of a height h_1 of the highest installation ledge on the housing assembly 438 to a largest outer diameter d of the housing assembly 438 is less than or equal to 0.53 (see Fig. 22C), which can be expressed as $h_1/d \leq 0.53$. In another exemplary embodiment of the exemplary valve cartridge 400, the ratio R_1 of the height h_1 to the largest outer diameter d is less than or equal to 0.52. In still another exemplary embodiment, the ratio R_1 of the height h_1 to the largest outer diameter d is approximately equal to 0.53.

[00125] According to still another exemplary embodiment of the exemplary valve cartridge 400, a ratio R_2 of the height h_1 to a height h_2 of the housing assembly 438 is less than or equal to 0.49 (see Fig. 22C), which can be expressed as $h_1/h_2 \leq 0.49$ In another exemplary embodiment, the ratio R_2 of the height h_1 to the height h_2 is less than or equal to 0.47. In still another exemplary embodiment, the ratio R_2 of the height h_1 to the height h_2 is approximately equal to 0.48.

[00126] According to yet another exemplary embodiment of the exemplary valve cartridge 400, a ratio R_3 of the height h_1 to a height h_3 of the pin 406 (e.g., from a bottom of the housing assembly 438 to a centerline of the pin 406) is less than or equal to 0.67 (see Fig. 22C), which can be expressed as $h_1/h_3 \leq 0.67$. In another exemplary embodiment, ratio R_3 of the height h_1 to the height h_3 is less than or equal to 0.65. In still another exemplary embodiment, ratio R_3 of the height h_1 to the height h_3 is approximately equal to 0.66.

[00127] According to another exemplary embodiment of the exemplary valve cartridge 400, the highest installation ledge on the housing assembly 438 is below an actuating mechanism (e.g., the ball-stem 404) of the valve cartridge 400 (see Fig. 22C). In still another exemplary embodiment of the exemplary valve cartridge 400, the highest installation ledge on the housing assembly 438 is below the actuating mechanism and above a mixing chamber (e.g., the mixing chamber 496) of the valve cartridge 400. In yet another exemplary embodiment of the exemplary valve cartridge 400, the highest installation ledge on the

housing assembly 438 is below the actuating mechanism and above a fixed disk (e.g., the fixed disk 416) of the valve cartridge 400.

[00128] According to an exemplary embodiment of the exemplary valve cartridge 400, the height h_1 of the highest installation ledge on the housing assembly 438 is between 0.641 and 0.651 inches. In one exemplary embodiment, the height h_1 of the highest installation ledge on the housing assembly 438 is approximately equal to 0.646 inches.

[00129] According to another exemplary embodiment of the exemplary valve cartridge 400, the height h_2 of the housing assembly 438 is between 1.339 and 1.369 inches. In one exemplary embodiment, the height h_2 of the housing assembly 438 is approximately equal to 1.354 inches.

[00130] According to still another exemplary embodiment of the exemplary valve cartridge 400, the height h_3 of the pin 406 is between 0.973 and 0.993 inches. In one exemplary embodiment, the height h_3 of the pin 406 is approximately equal to 0.983 inches.

[00131] According to yet another exemplary embodiment of the exemplary valve cartridge 400, the outer diameter d of the housing assembly 438 is between 1.220 and 1.228 inches. In one exemplary embodiment, the outer diameter d of the housing assembly 438 is approximately equal to 1.224 inches.

[00132] As illustrated by way of the exemplary embodiments described herein, the installation ledge 440 (as a highest installation ledge on the housing assembly 438) is a low point of contact on the housing assembly 438 on which the retention nut can bear down during installation of the valve cartridge 400 in the valve body. Accordingly, the valve cartridge 400 has a compact structure that provides increased flexibility in the design of plumbing fixtures (e.g., the plumbing fixture 332 shown in Fig. 11) that will accommodate the valve cartridge 400. Furthermore, the low installation ledge 440 allows less material to

be used in forming the valve body, since sidewalls of the valve body can be made shorter (see Fig. 11). As a result, the low installation ledge 440 provides a cost savings.

[00133] The above description of specific embodiments has been given by way of example. From the disclosure given, those skilled in the art will not only understand the general inventive concept and its attendant advantages, but will also find apparent various changes and modifications to the structures and methods disclosed. It is sought, therefore, to cover all such changes and modifications as fall within the spirit and scope of the general inventive concept, as defined herein, and equivalents thereof.

CLAIMS

1. A valve cartridge for controlling a flow rate of a fluid and operable to be secured in a valve body by a retaining member, the valve cartridge comprising:

a housing;

an actuating mechanism; and

a fluid control member,

wherein the fluid control member is disposed in the housing,

wherein a portion of the actuating mechanism extends through an upper opening in the housing,

wherein movement of the actuating mechanism moves the fluid control member to vary the flow rate of the fluid,

wherein a highest point on the housing for contacting the retaining member forms an installation ledge, and

wherein the installation ledge is substantially below the upper opening in the housing.

2. The valve cartridge of claim 1, wherein a ratio of a height of the installation ledge on the housing to a largest outer diameter of the housing is less than or equal to 0.50.

3. The valve cartridge of claim 2, wherein the height of the installation ledge is between 0.486 and 0.494 inches.

4. The valve cartridge of claim 1, wherein a ratio of a height of the installation ledge on the housing to a height of the housing is less than or equal to 0.39.

5. The valve cartridge of claim 4, wherein the height of the installation ledge is between 0.486 and 0.494 inches.

6. The valve cartridge of claim 1, wherein a pin secures the actuating mechanism in the housing so that the actuating mechanism is operable to pivot about the pin, and

wherein a ratio of a height of the installation ledge on the housing to a height of a center of the pin is less than or equal to 0.55.

7. The valve cartridge of claim 8, wherein the height of the installation ledge is between 0.486 and 0.494 inches.

8. The valve cartridge of claim 1, wherein a ratio of a height of the installation ledge on the housing to a largest outer diameter of the housing is less than or equal to 0.53.

9. The valve cartridge of claim 8, wherein the height of the installation ledge is between 0.641 and 0.651 inches.

10. The valve cartridge of claim 1, wherein a ratio of a height of the installation ledge on the housing to a height of the housing is less than or equal to 0.49.

11. The valve cartridge of claim 10, wherein the height of the installation ledge is between 0.641 and 0.651 inches.

12. The valve cartridge of claim 1, wherein a pin secures the actuating mechanism in the housing so that the actuating mechanism is operable to pivot about the pin, and

wherein a ratio of a height of the installation ledge on the housing to a height of a center of the pin is less than or equal to 0.67.

13. The valve cartridge of claim 12, wherein the height of the installation ledge is between 0.641 and 0.651 inches.

14. The valve cartridge of claim 1, wherein the installation ledge is located below the actuating mechanism.

15. The valve cartridge of claim 14, wherein the installation ledge is located above the fluid control member.

16. The valve cartridge of claim 1, wherein the installation ledge extends around an outer circumference of the housing.

17. A valve cartridge for controlling a flow rate and a mixture ratio of cold water and hot water and operable to be secured in a valve body by a retaining member, the valve cartridge comprising:

a housing;

an actuating mechanism;

a movable control member; and

a fixed control member,

wherein the movable control member and the fixed control member are disposed in the housing,

wherein a portion of the actuating mechanism extends through an upper opening in the housing,

wherein movement of the actuating mechanism about a first axis is operable to move the movable control member relative to the fixed control member to vary the flow rate of at least one of the cold water and the hot water,

wherein movement of the actuating mechanism about a second axis is operable to move the movable control member relative to the fixed control member to vary the mixture ratio of the cold water and the hot water,

wherein a highest point on the housing for contacting the retaining member forms an installation ledge, and

wherein the installation ledge is substantially below the upper opening in the housing.

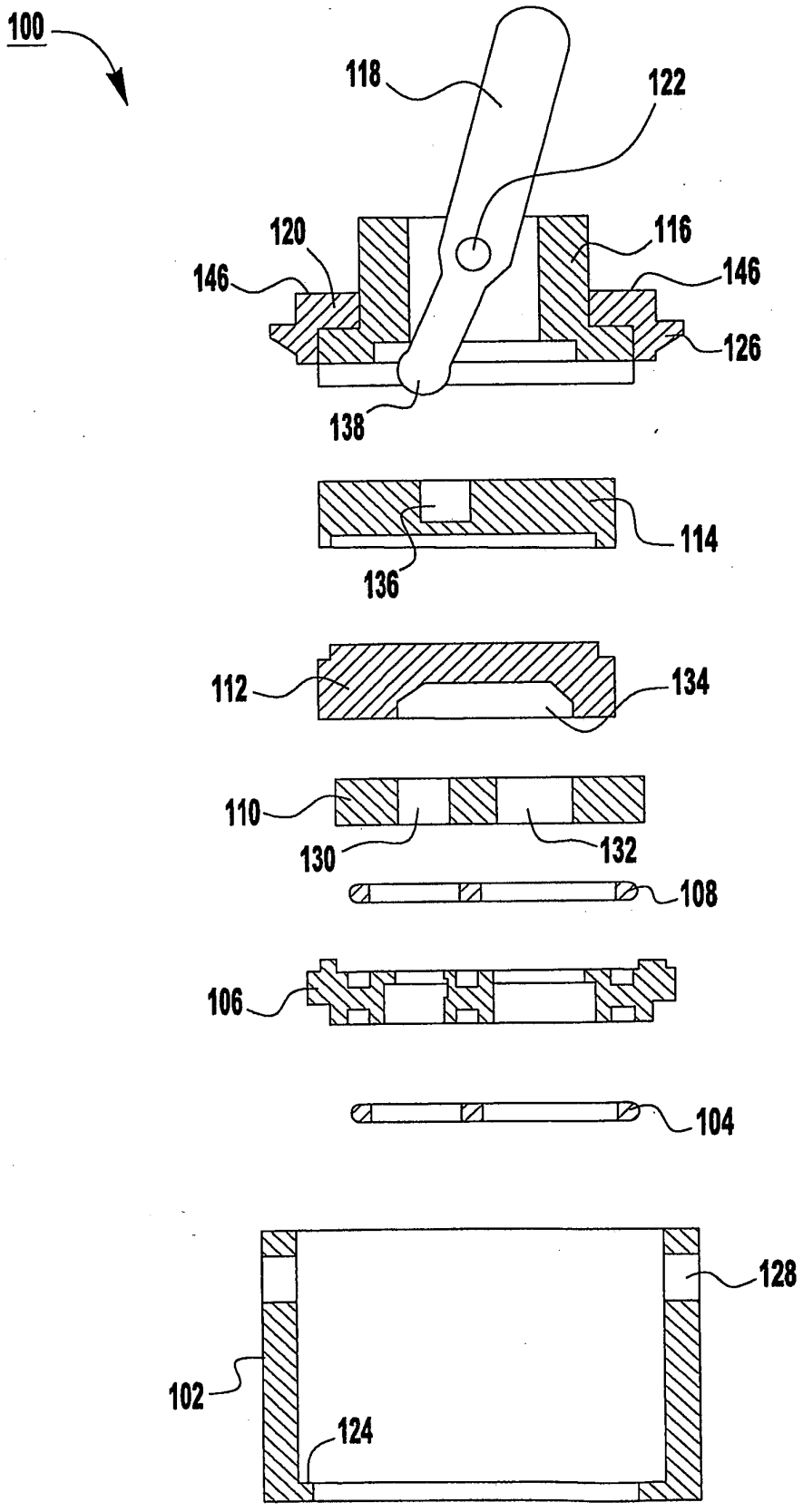
18. The valve cartridge of claim 17, wherein the installation ledge is located below the actuating mechanism.

19. The valve cartridge of claim 18, wherein the installation ledge is above the fixed control member.

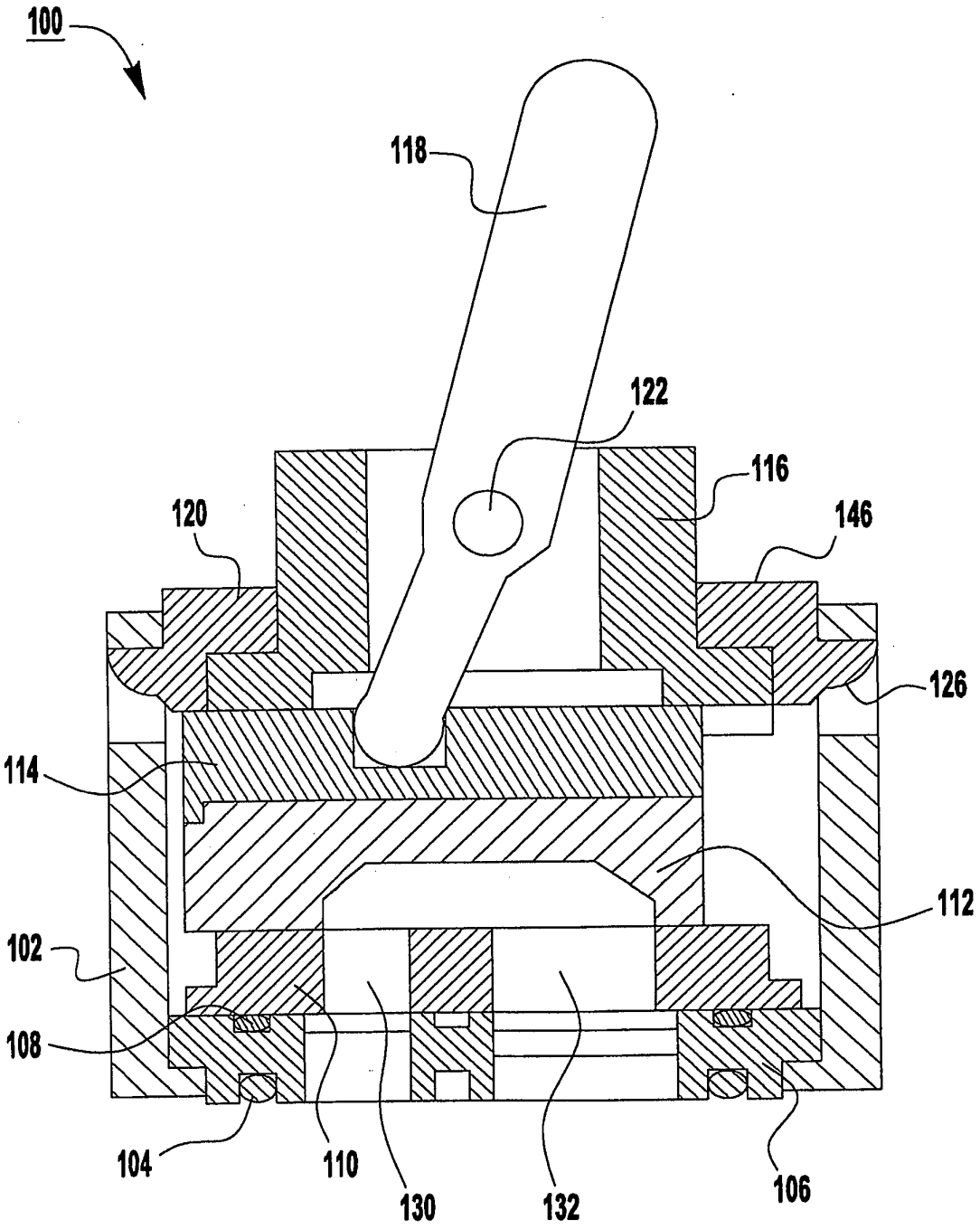
20. The valve cartridge of claim 18, further comprising a mixing chamber within the housing for mixing the cold water and the hot water, and

wherein the installation ledge is located above the mixing chamber.

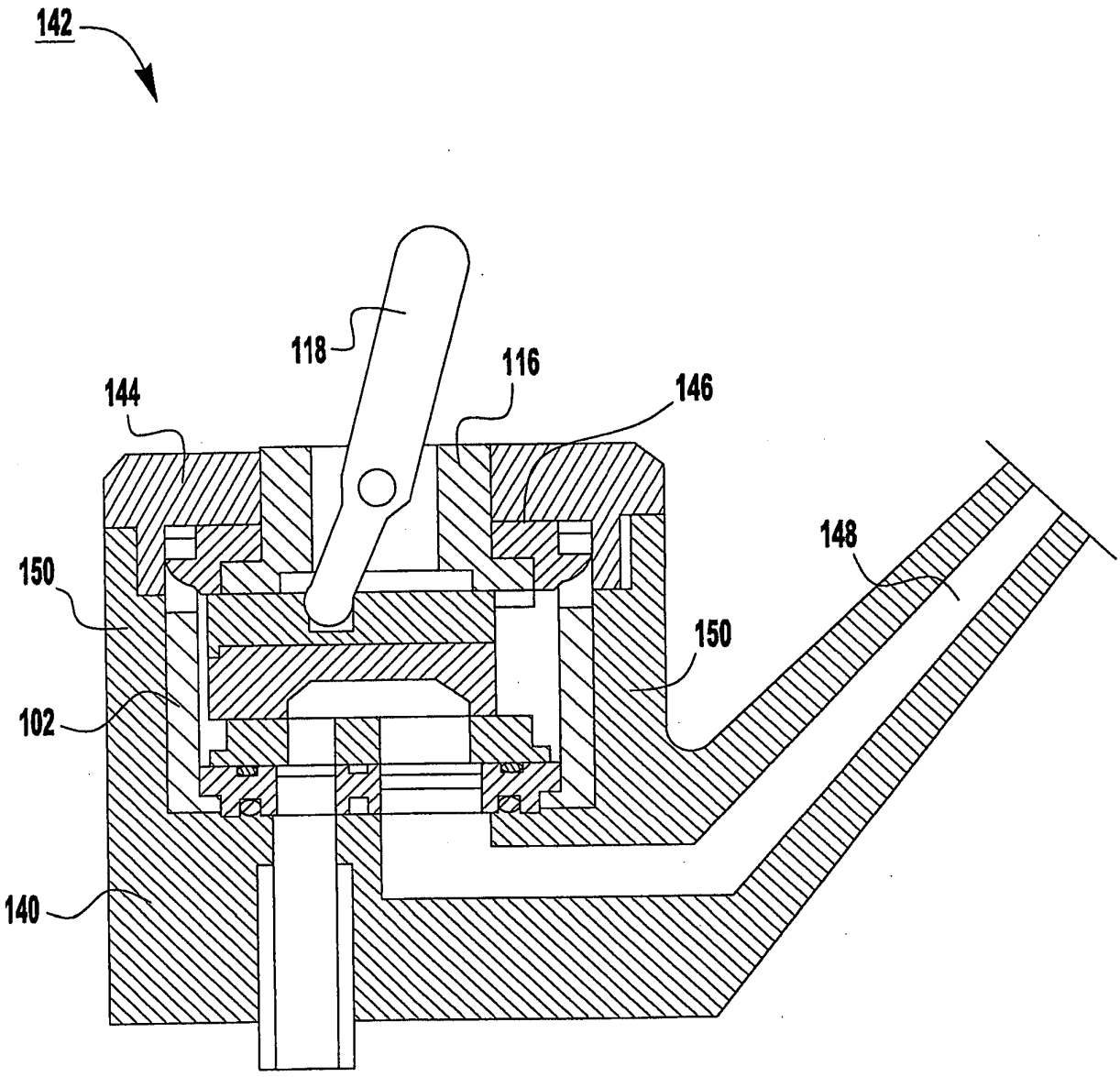
21. The valve cartridge of claim 17, wherein the installation ledge extends around an outer circumference of the housing.



PRIOR ART
FIG. 1A



PRIOR ART
FIG. 1B



PRIOR ART
FIG. 1C

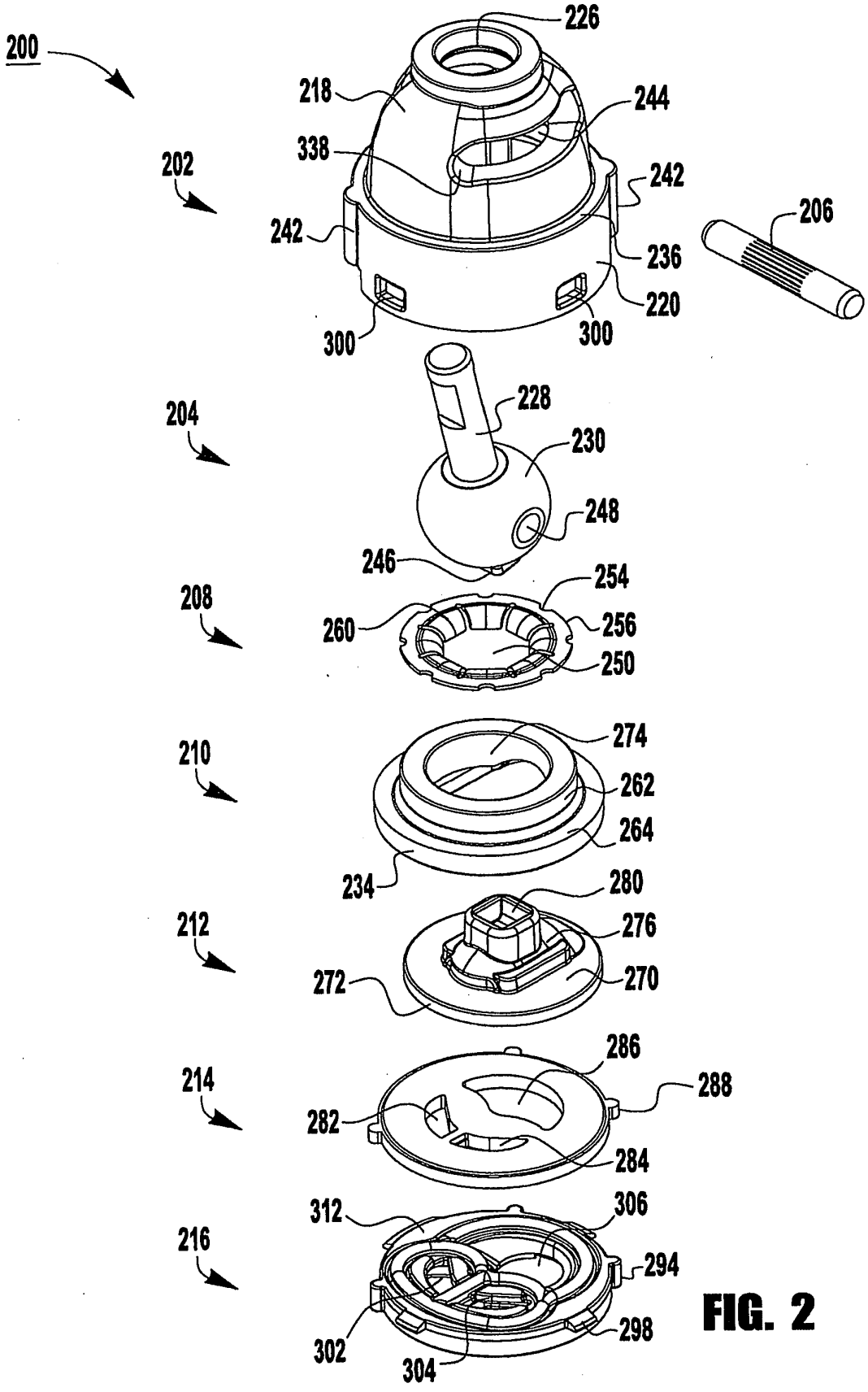

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FIG. 2

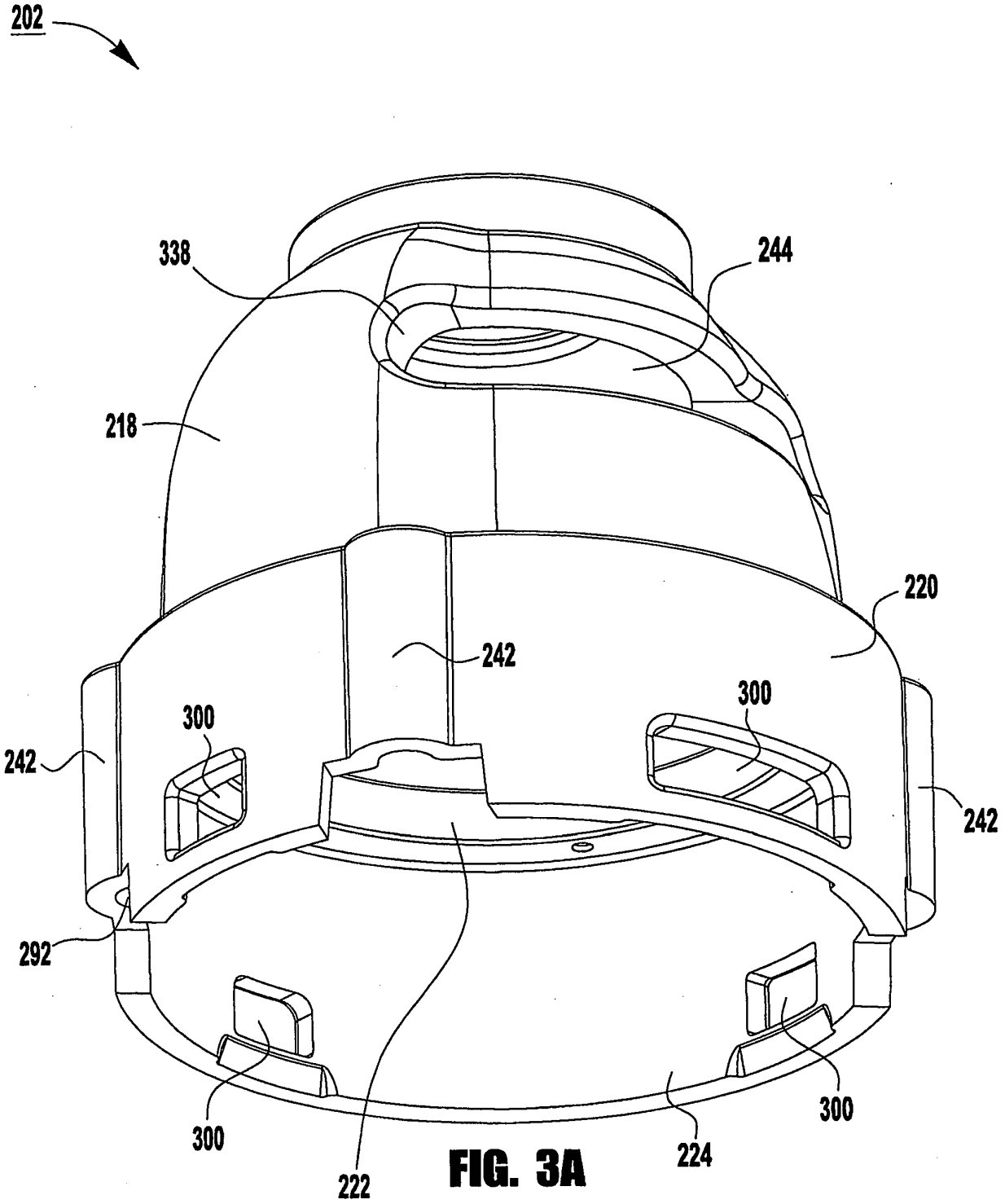


FIG. 3A

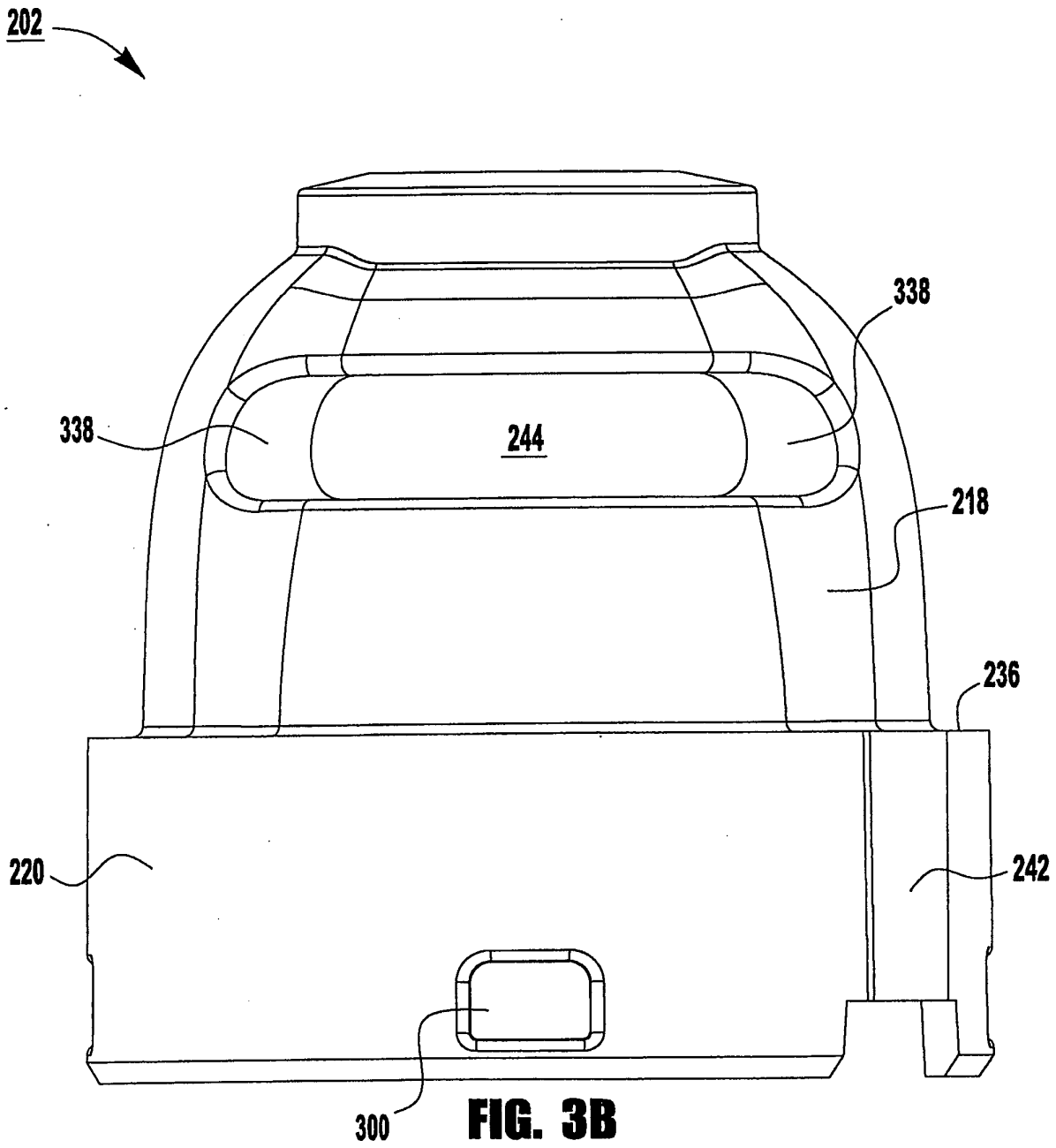
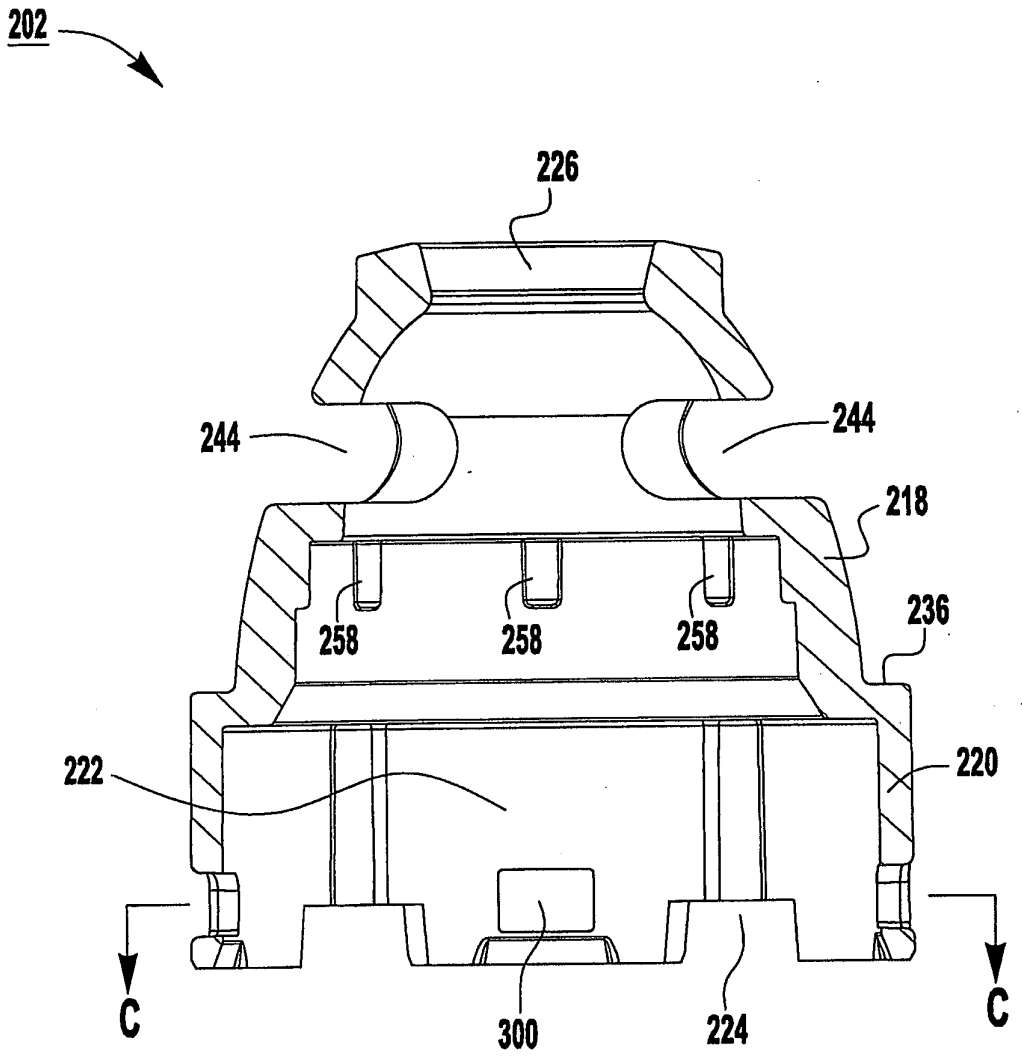
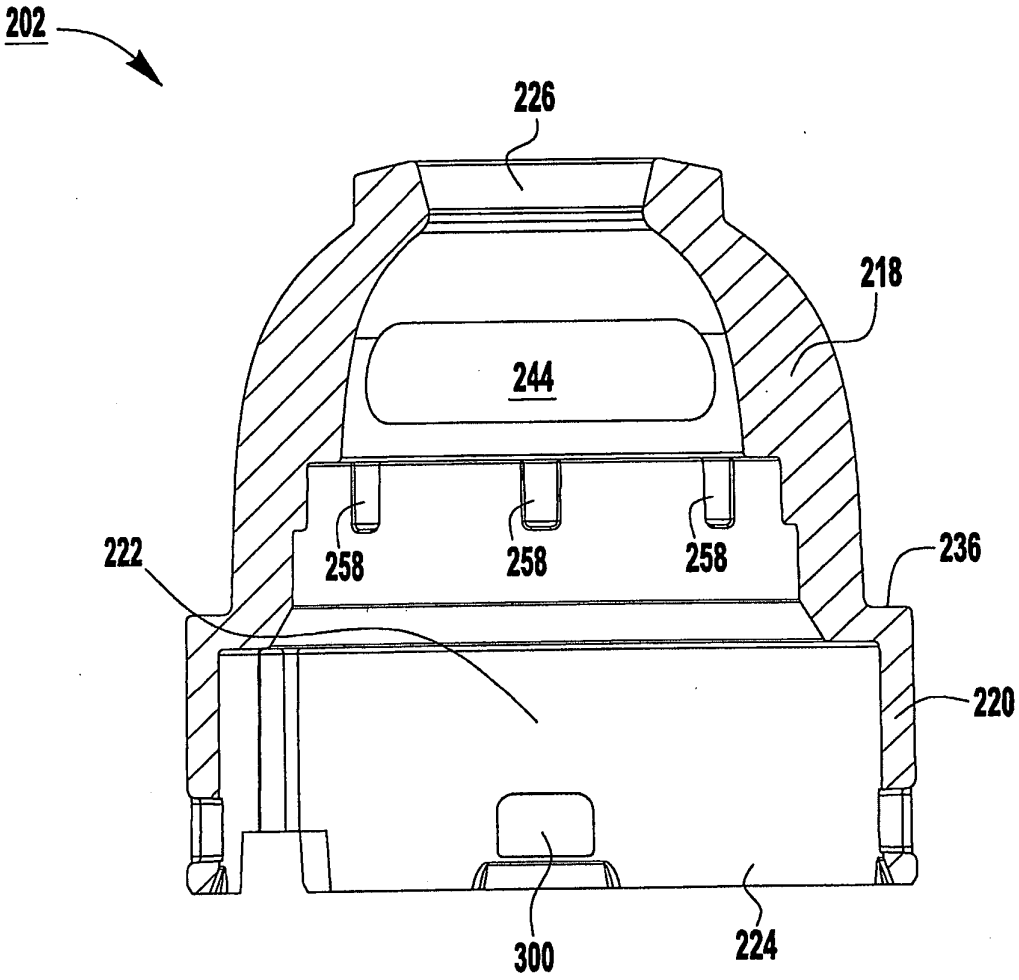


FIG. 3B



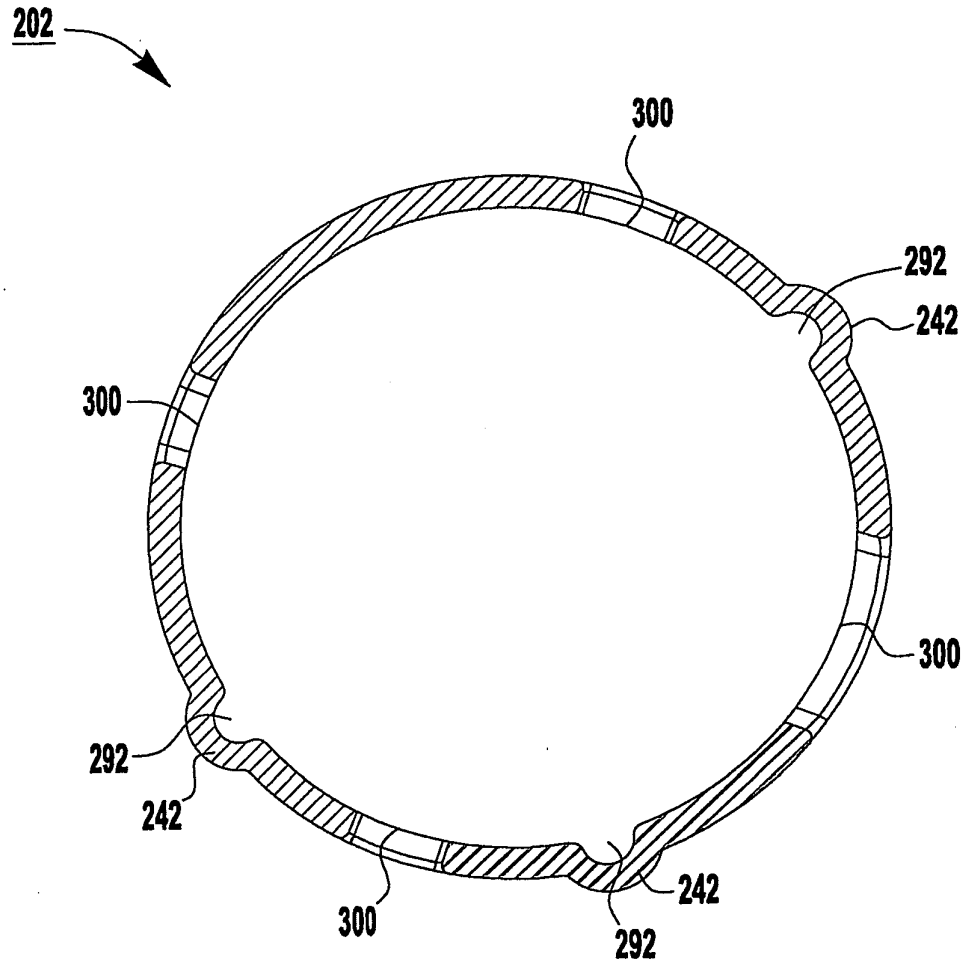
SECTION A-A

FIG. 3C



SECTION B-B

FIG. 3D



SECTION C-C

FIG. 3E

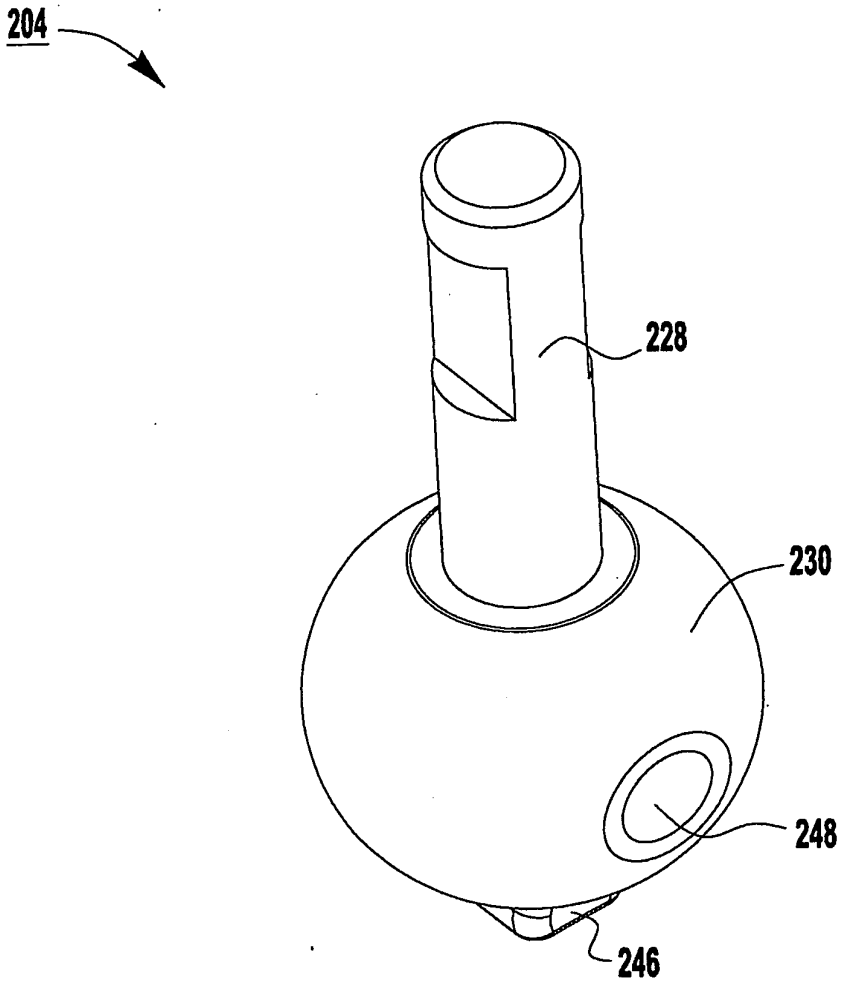


FIG. 4

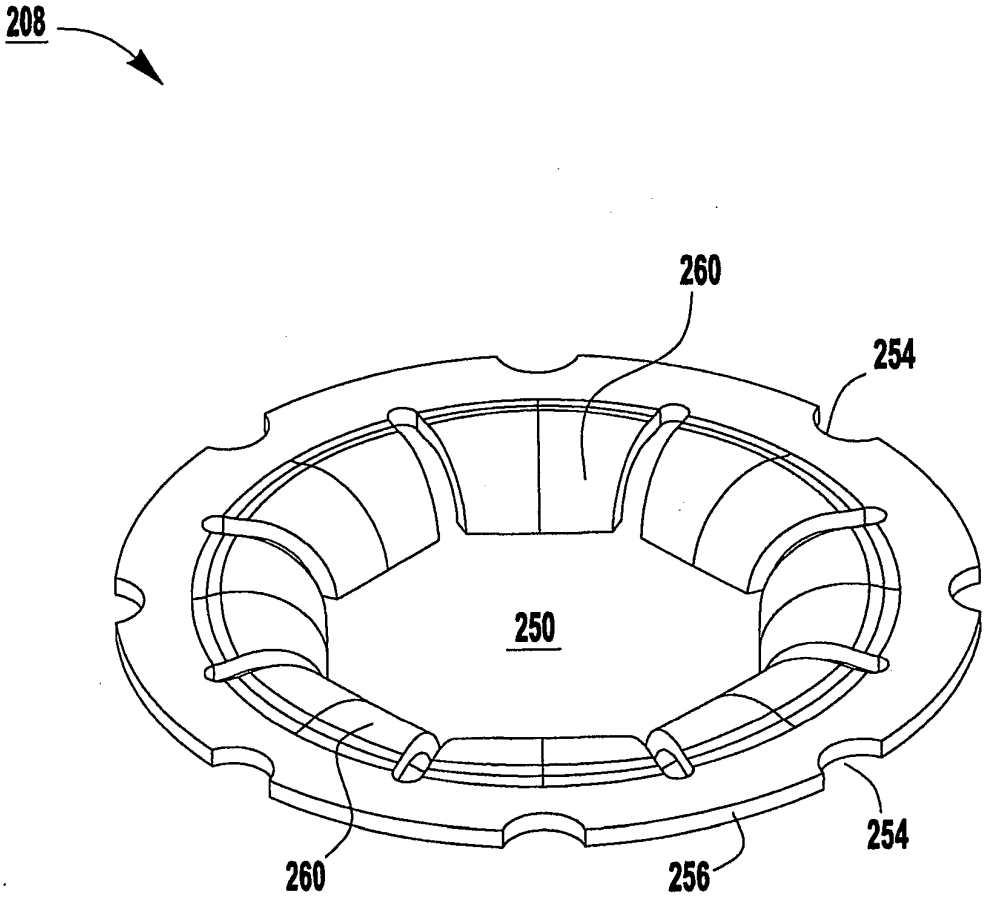


FIG. 5A

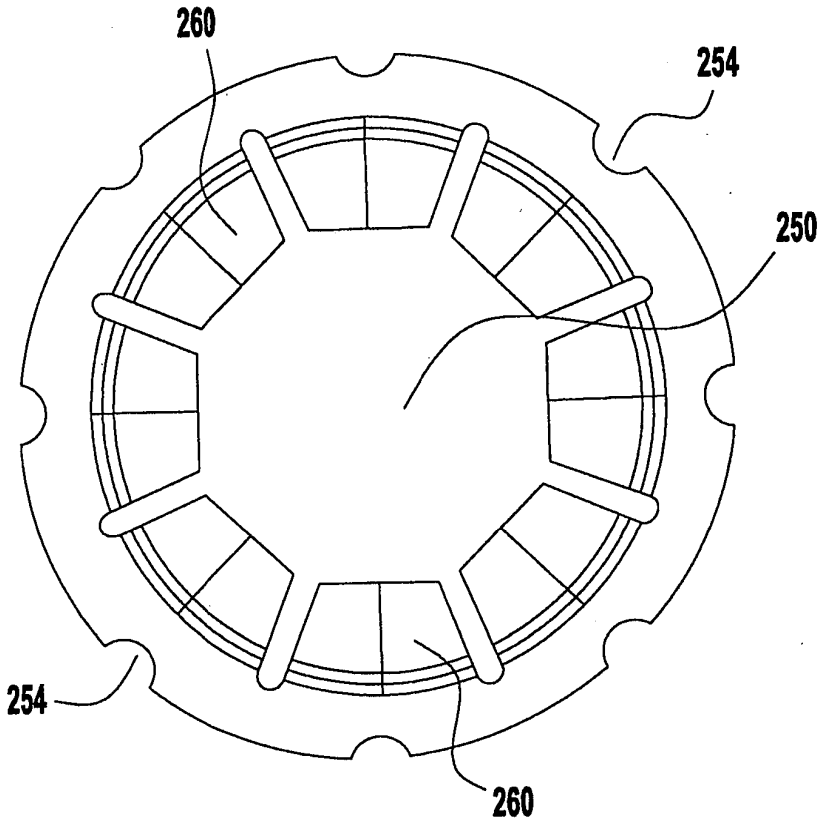


FIG. 5B

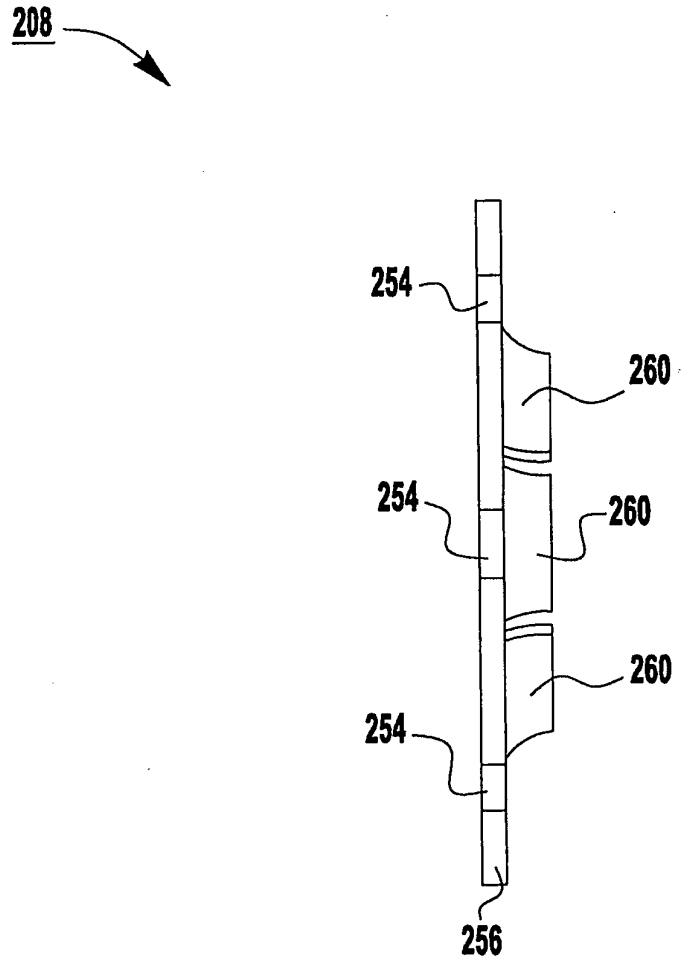


FIG. 5C

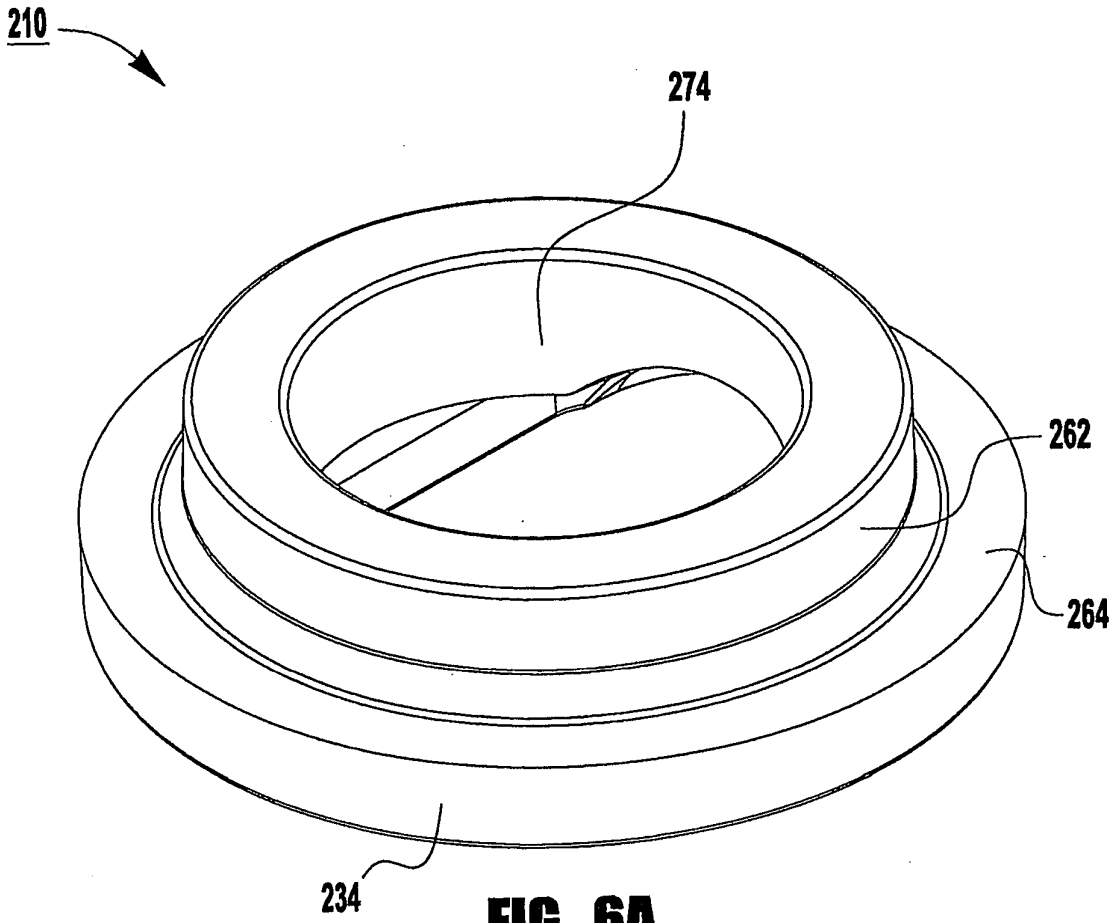


FIG. 6A

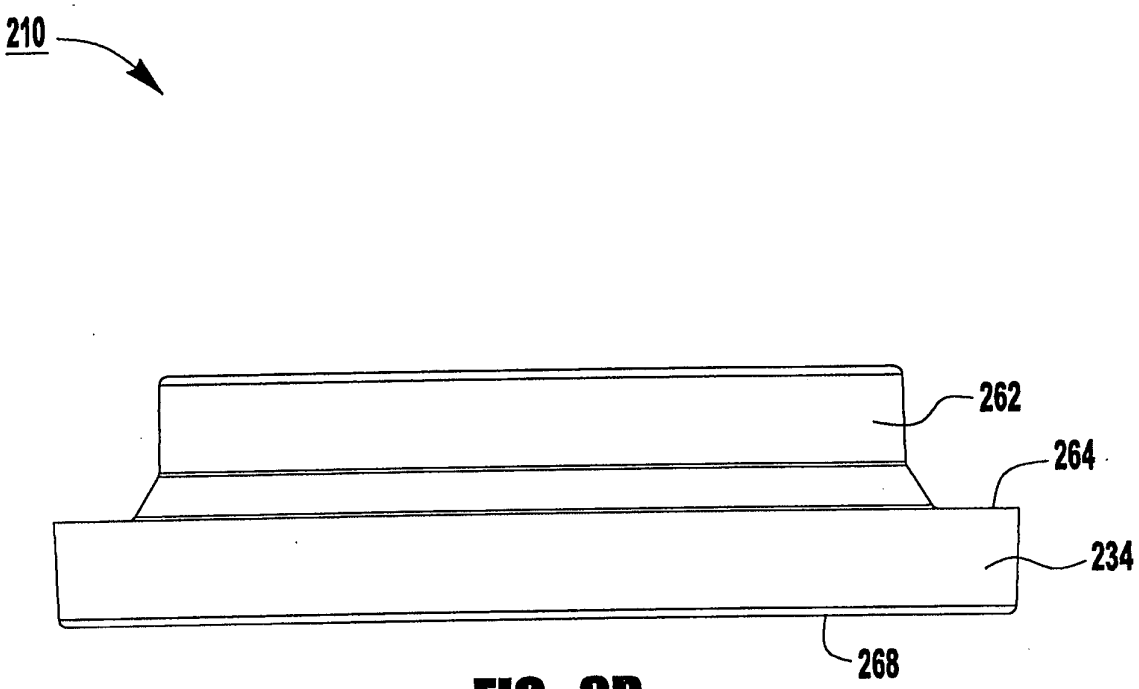


FIG. 6B

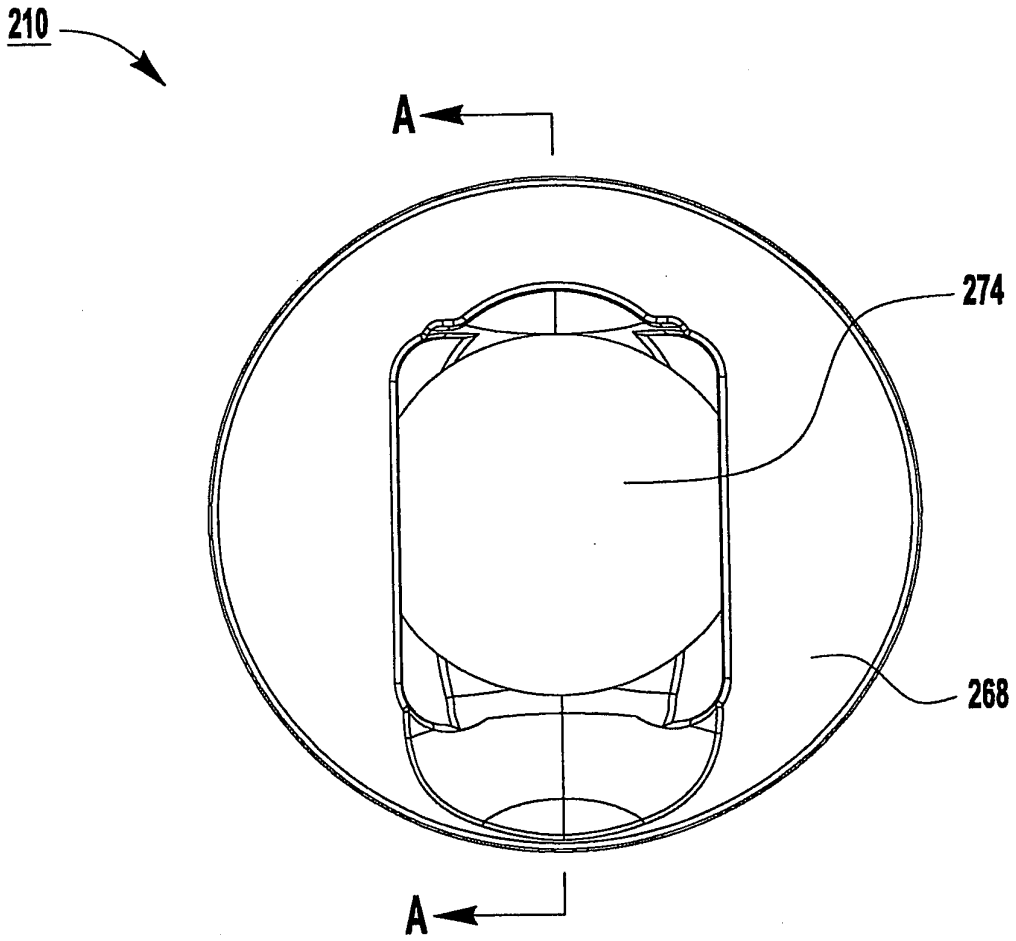
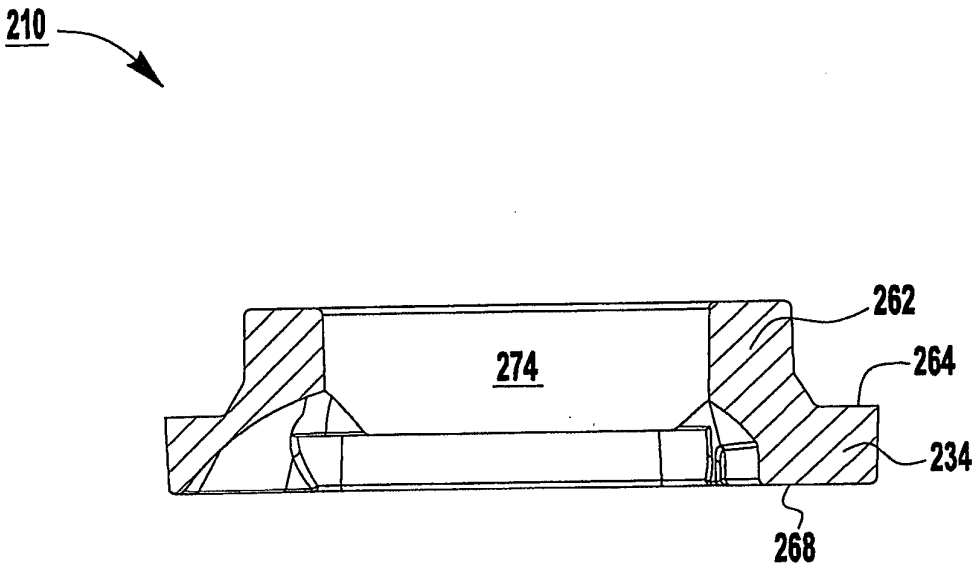


FIG. 6C



SECTION A-A

FIG. 6D

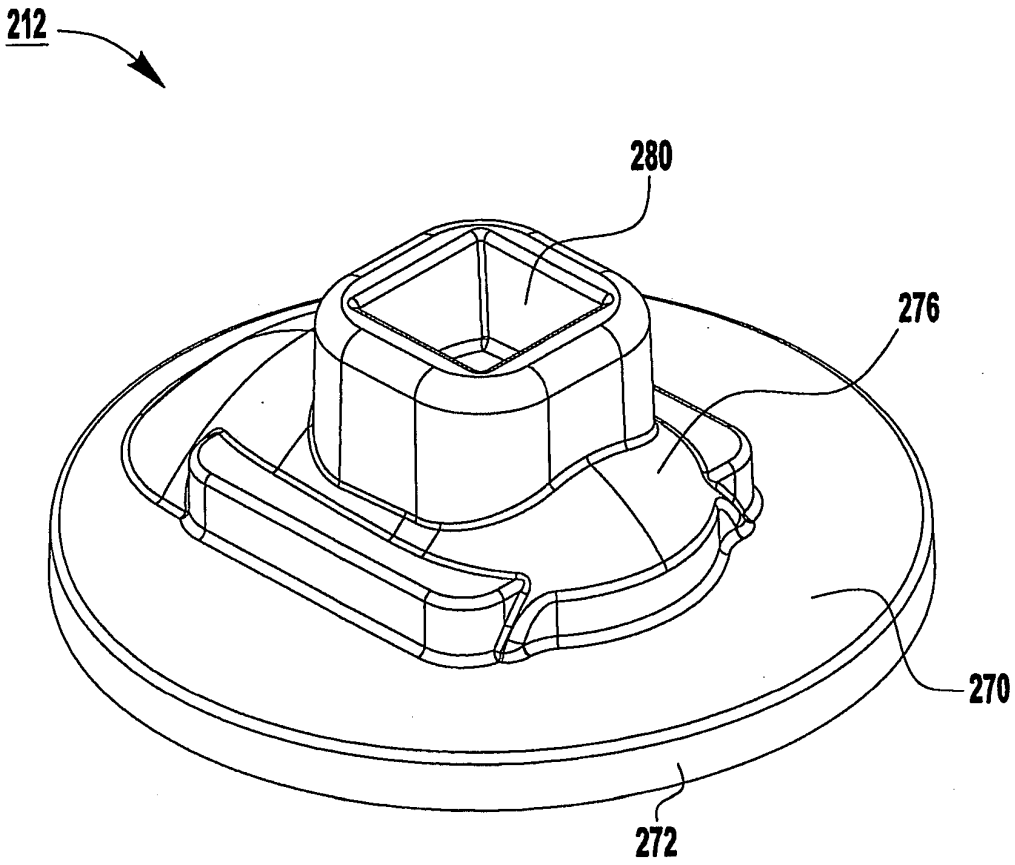


FIG. 7A

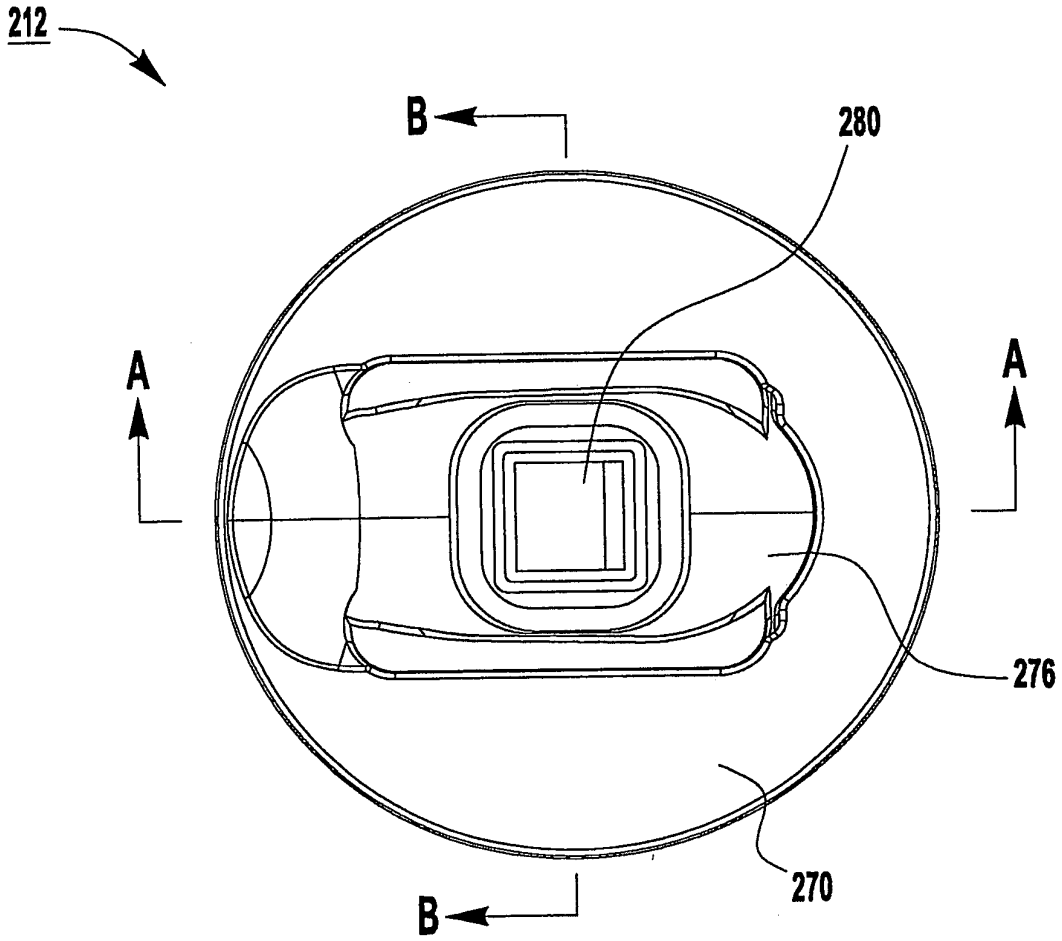
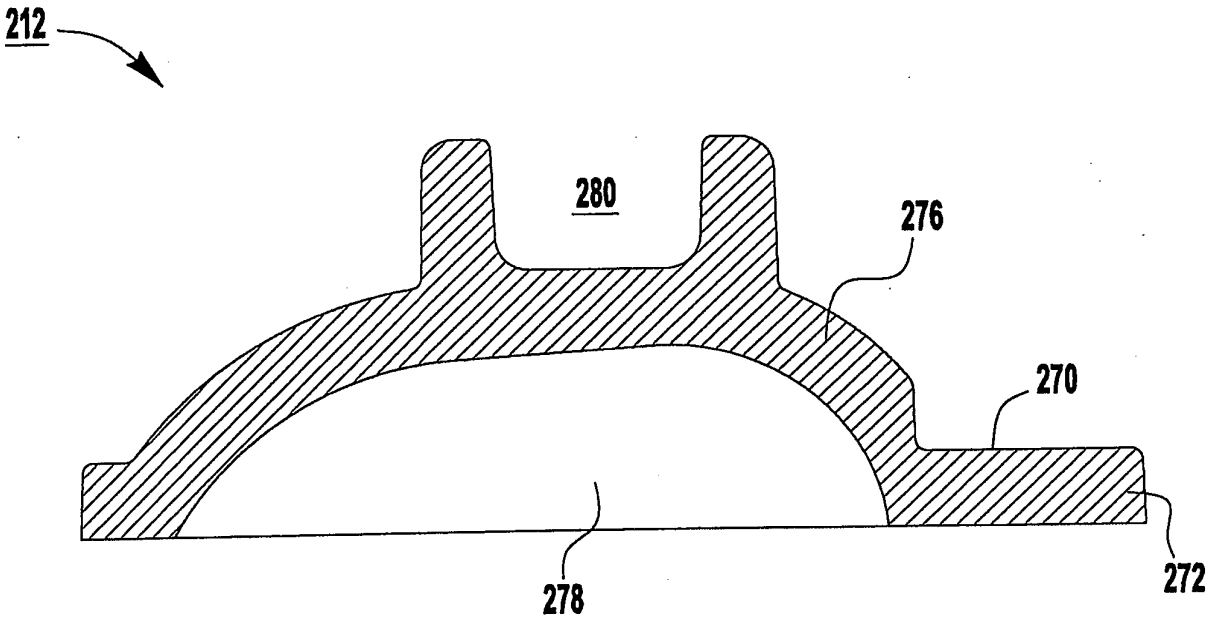
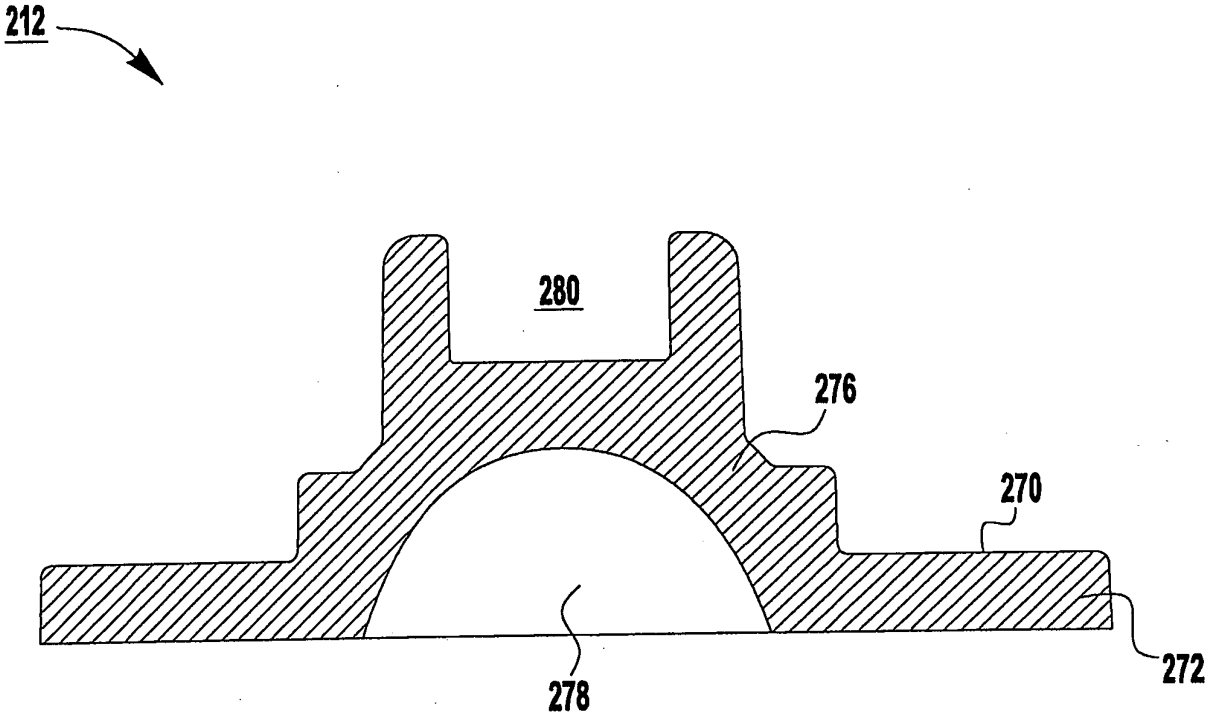


FIG. 7B



SECTION A-A

FIG. 7C



SECTION B-B

FIG. 7D

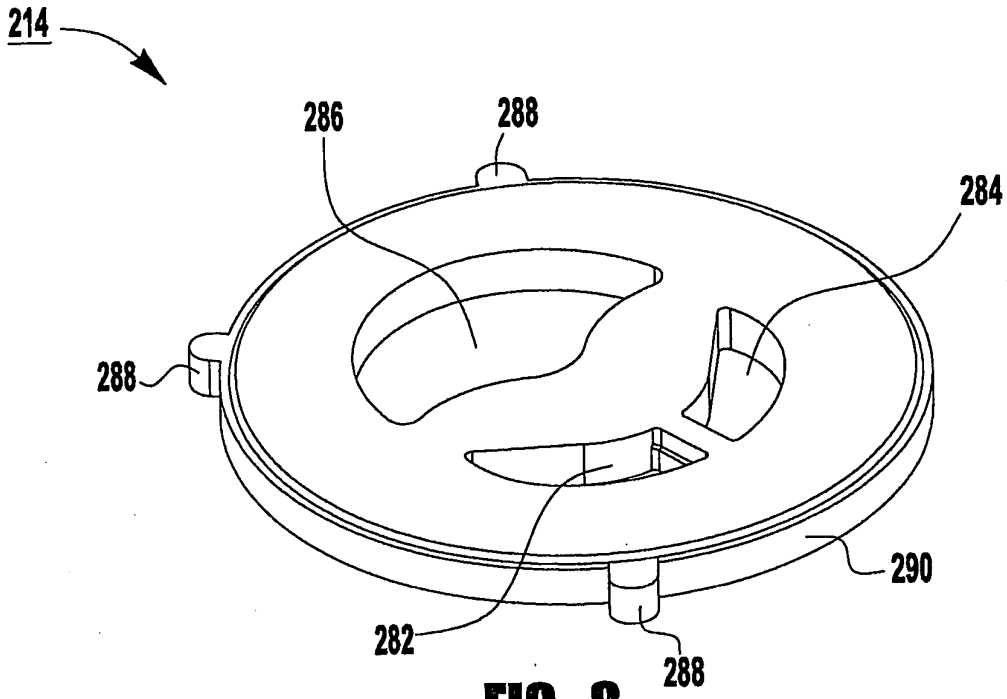


FIG. 8

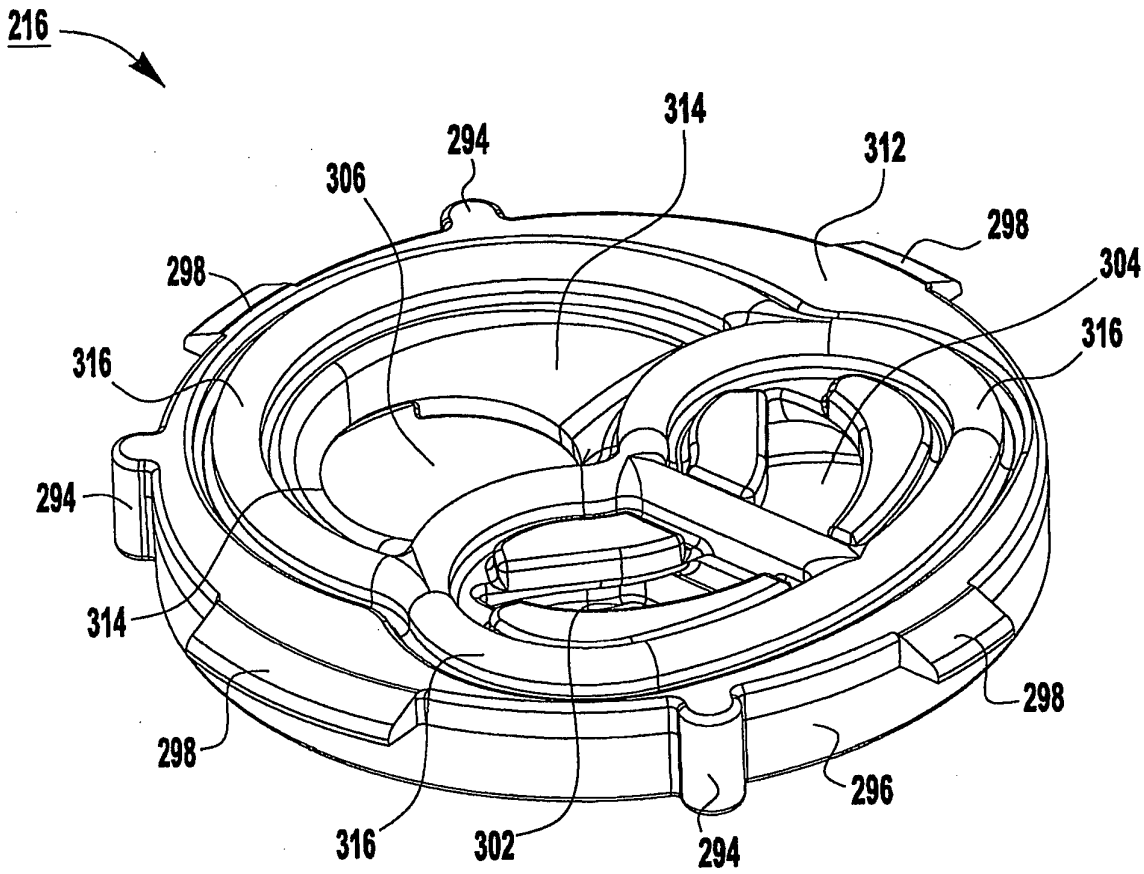

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FIG. 9A

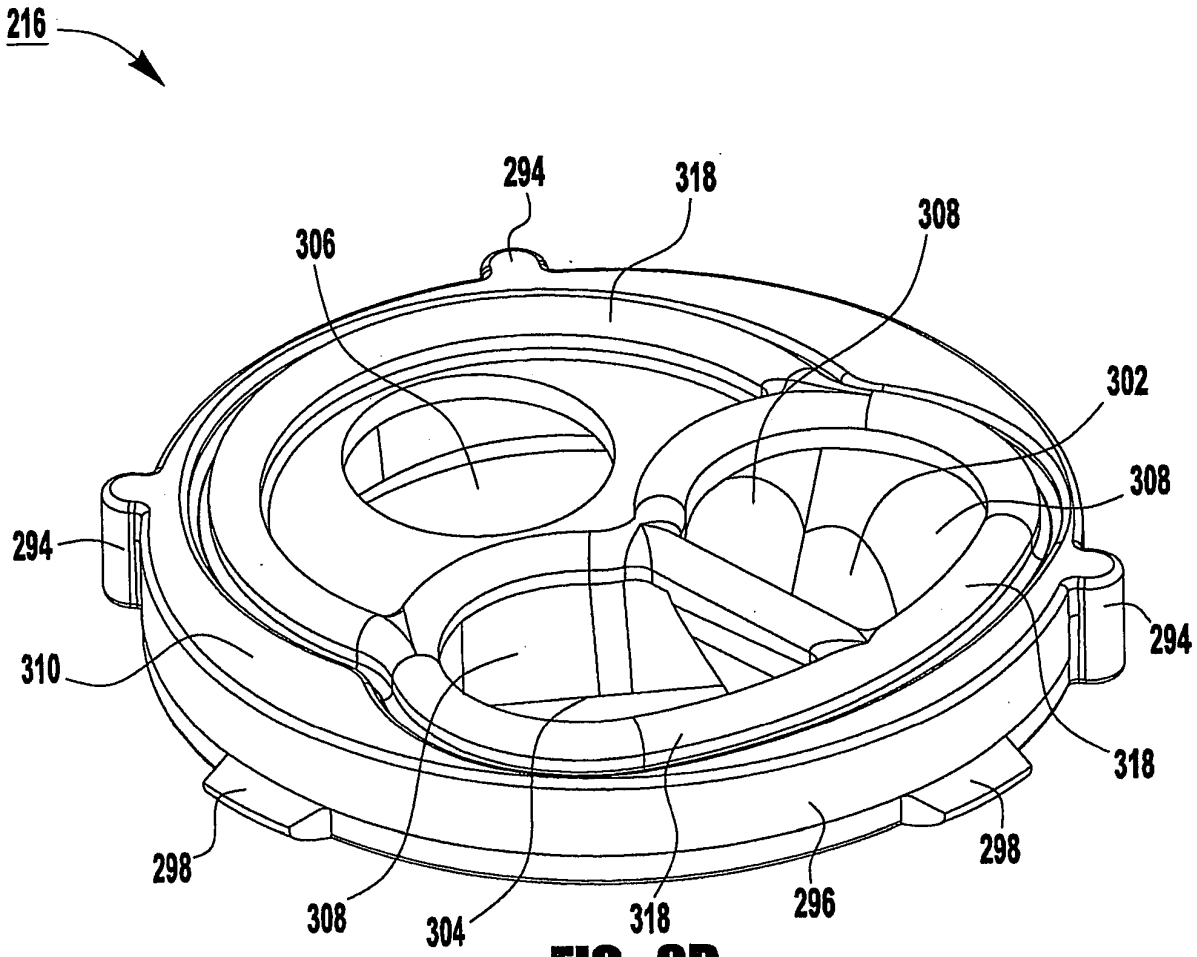
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FIG. 9B

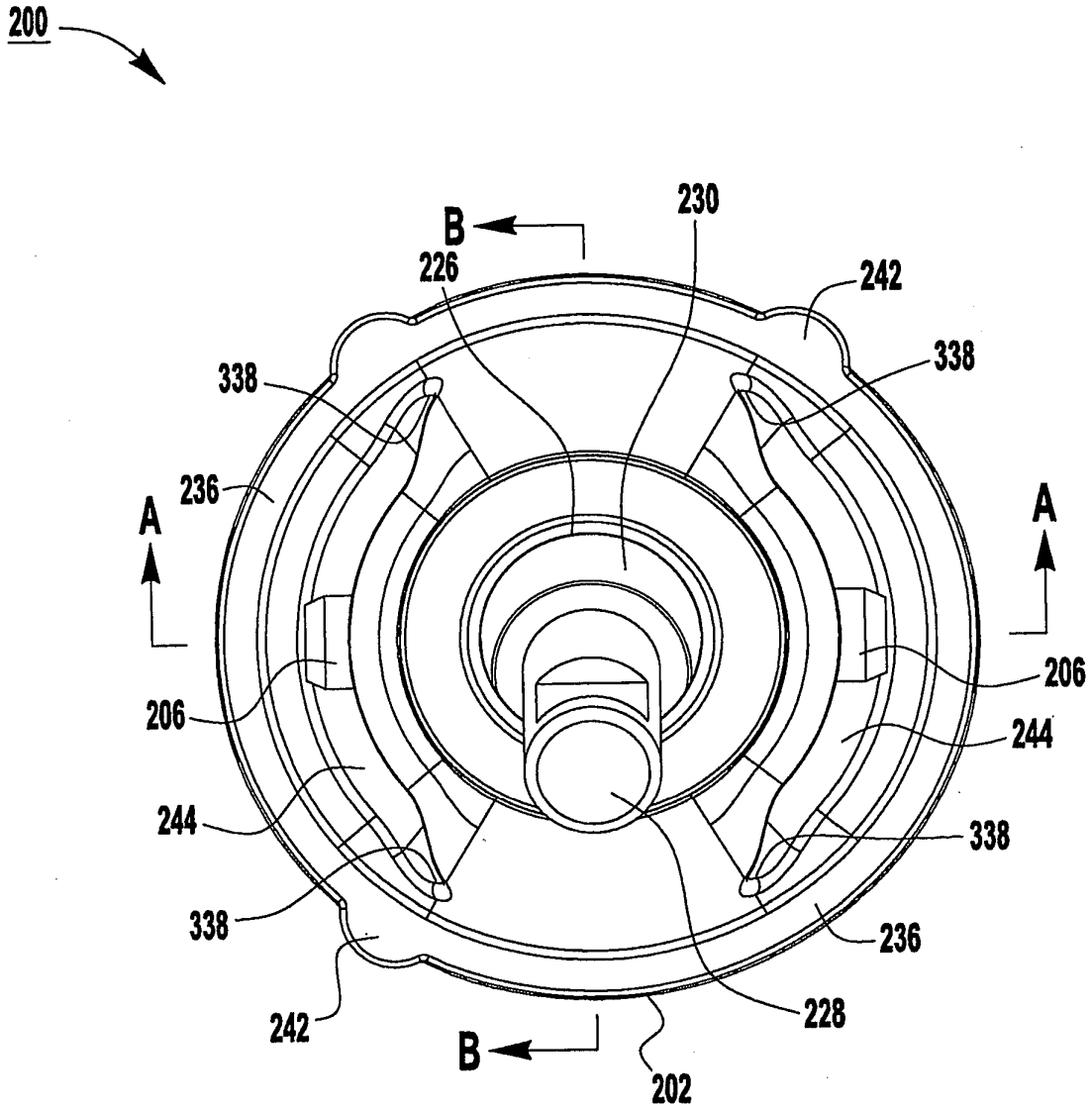
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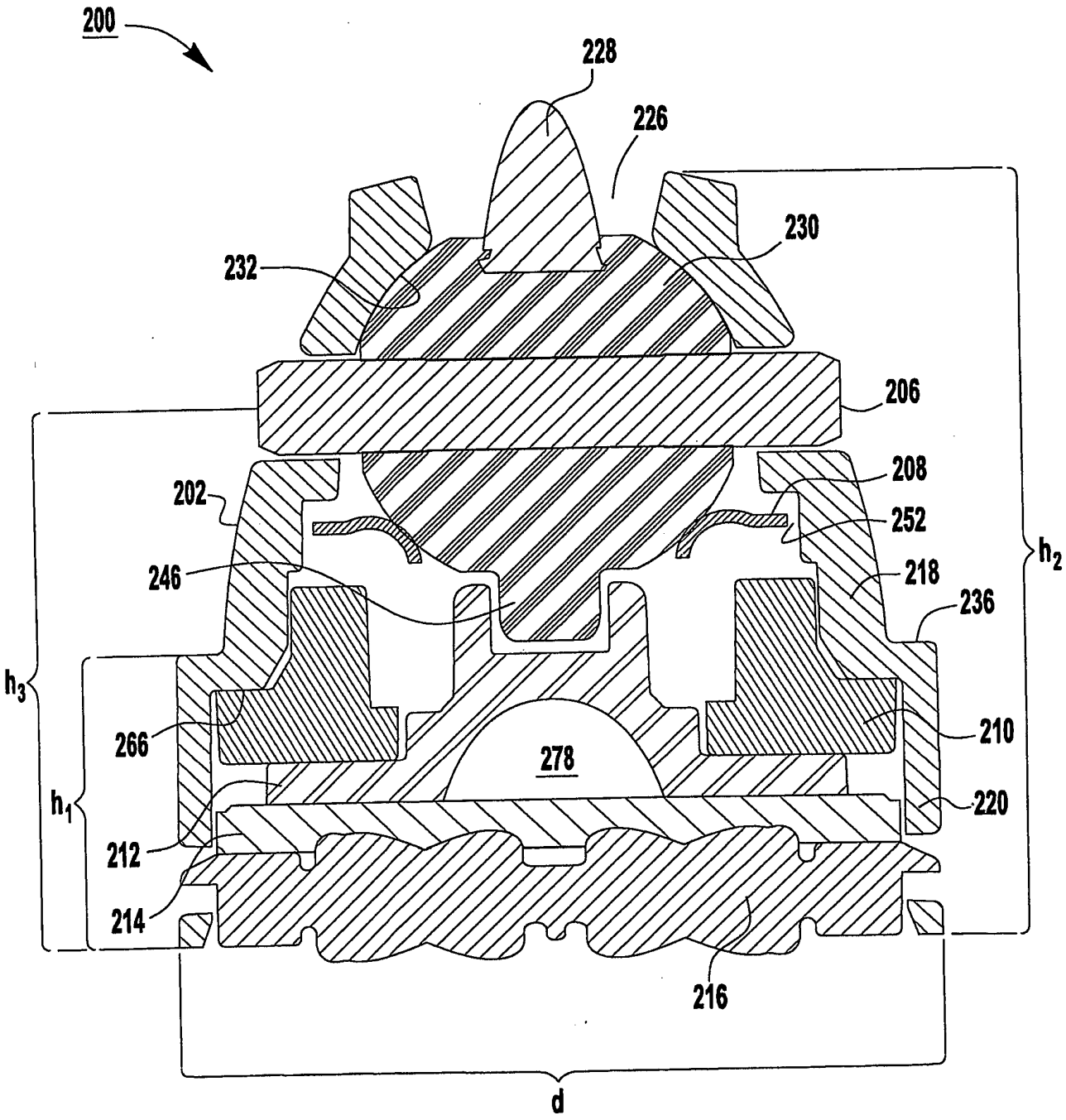
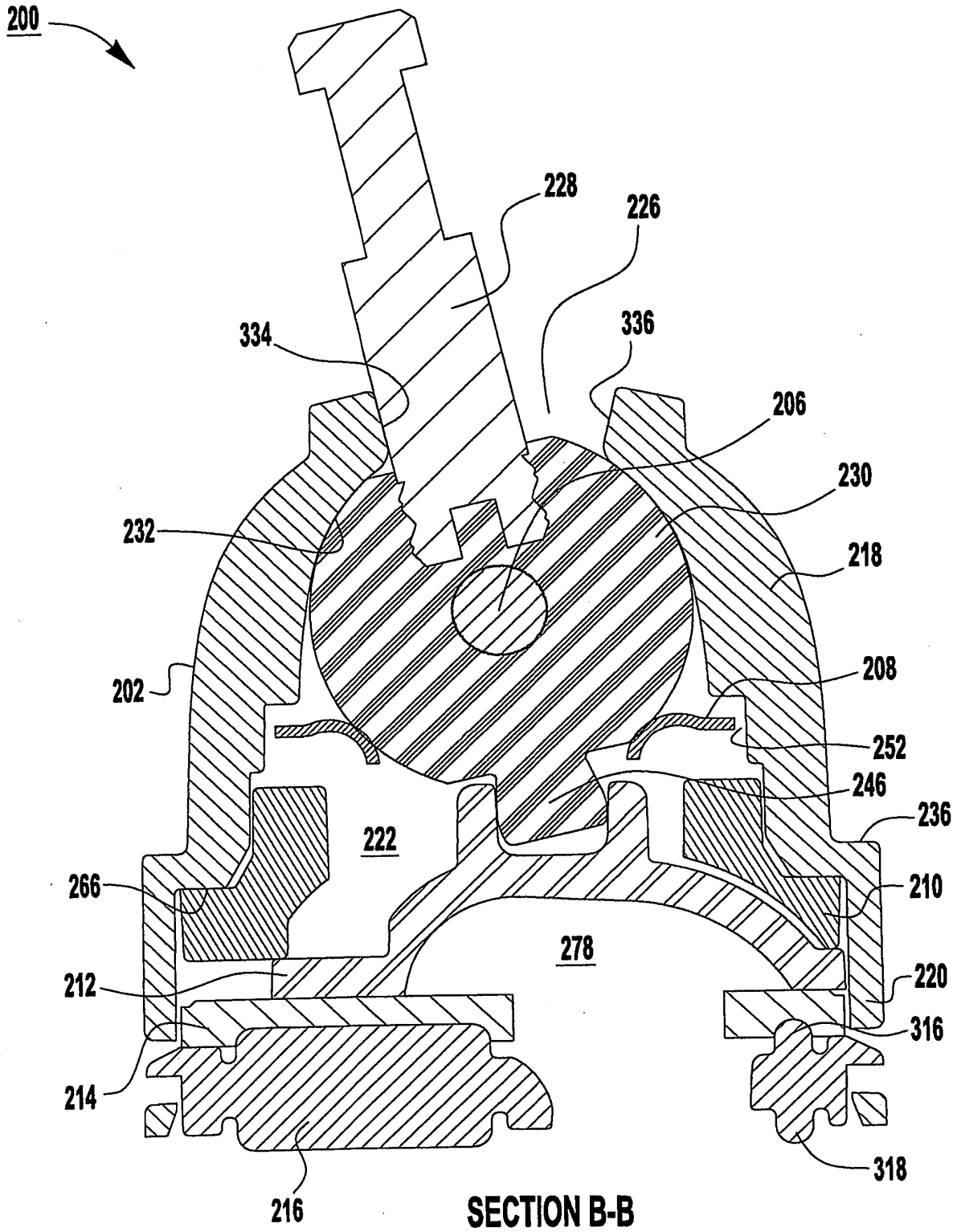
FIG. 10A



SECTION A-A

FIG. 10B



SECTION B-B

FIG. 10C

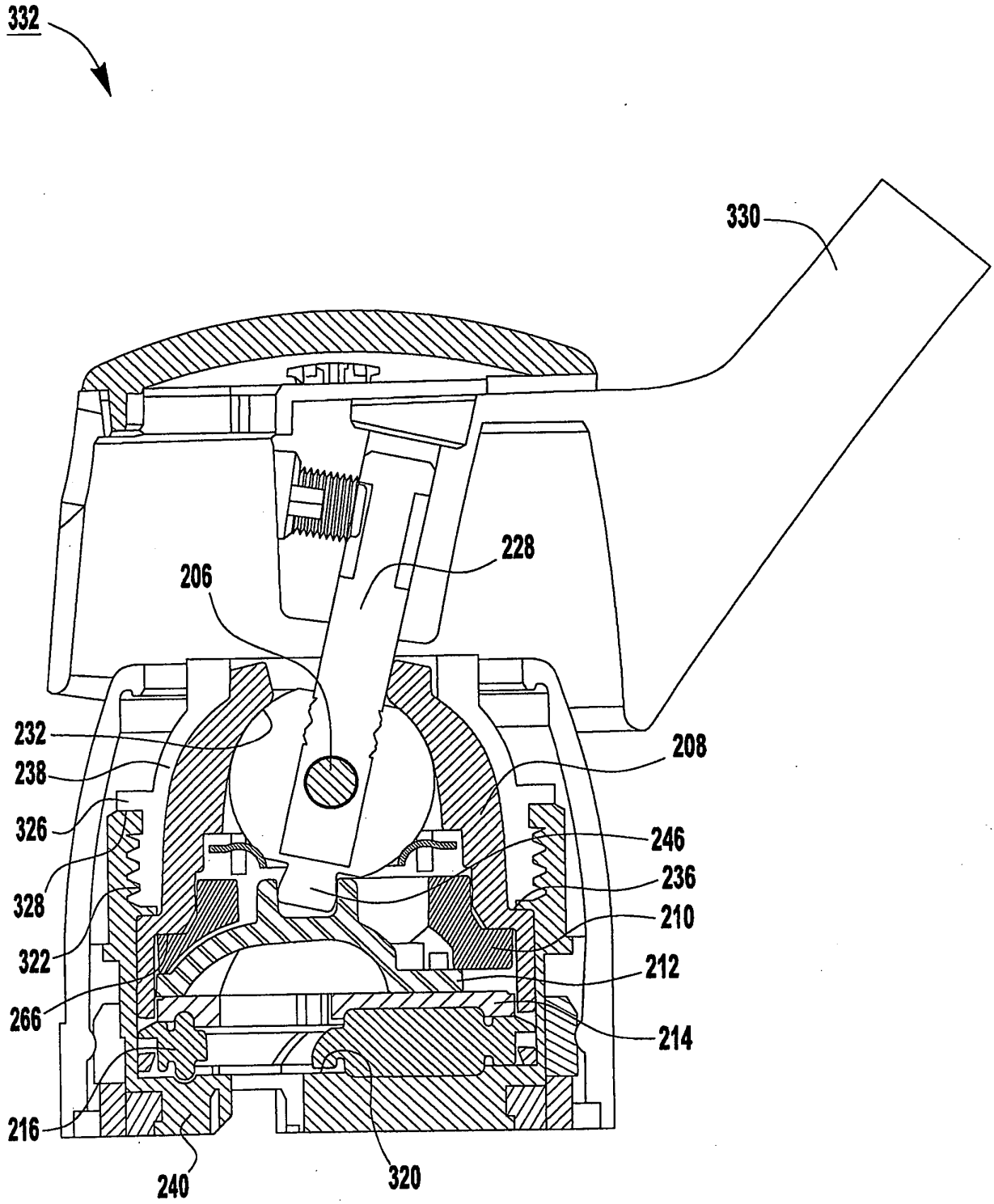

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FIG. 11

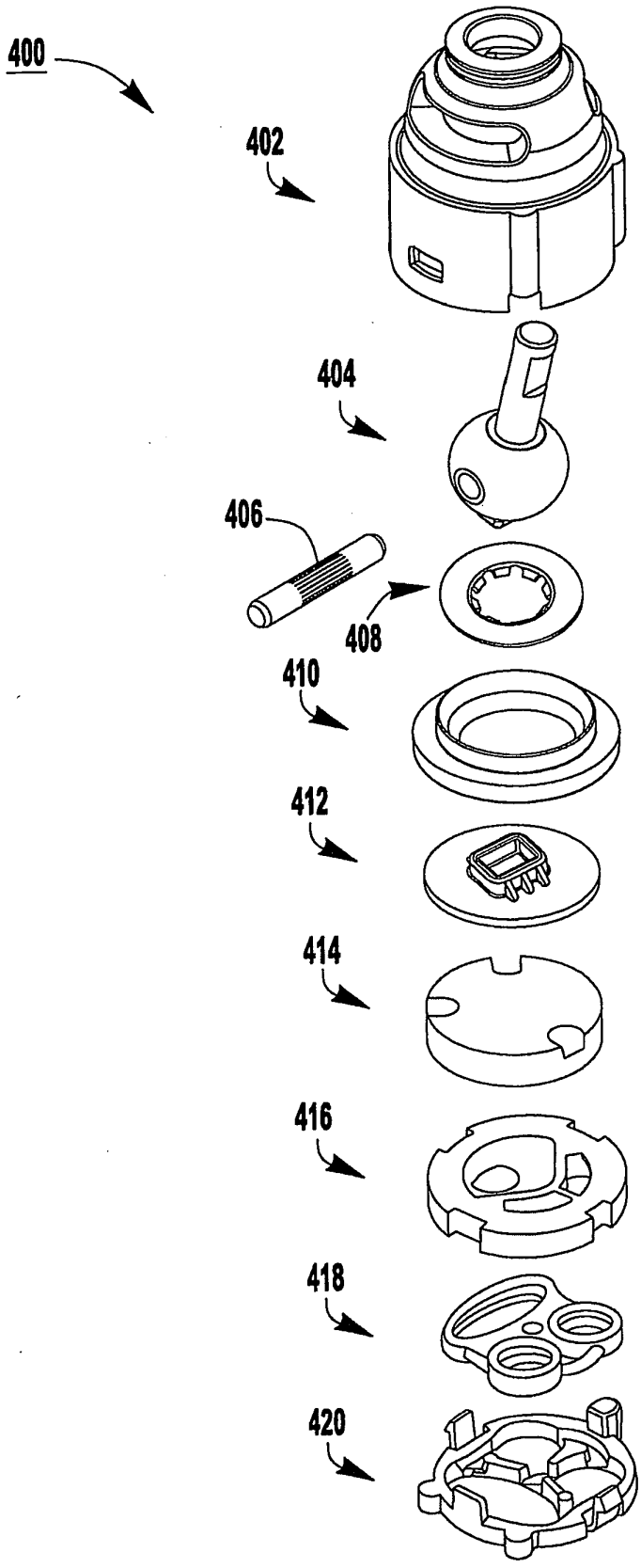

FIG. 12

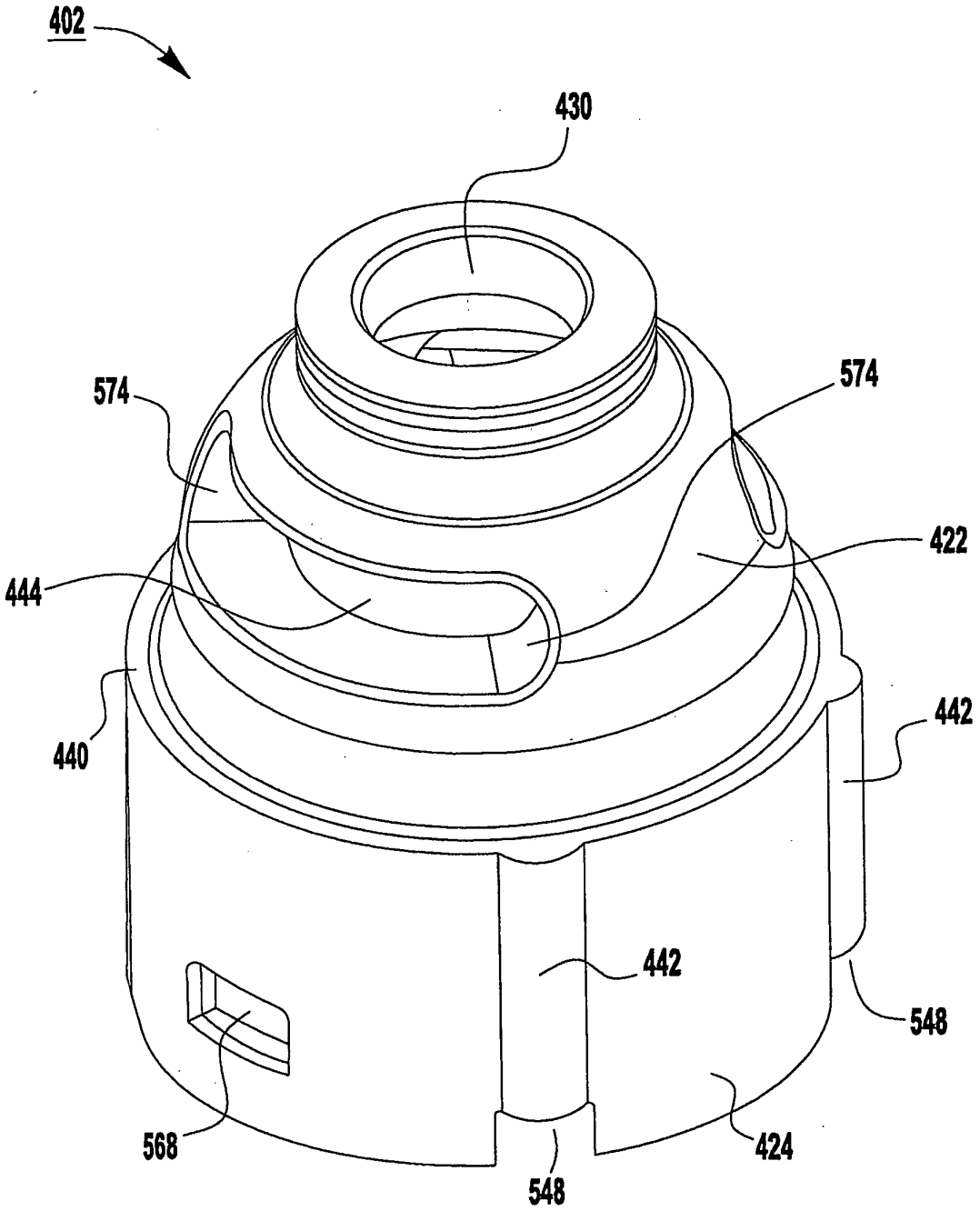

FIG. 13A

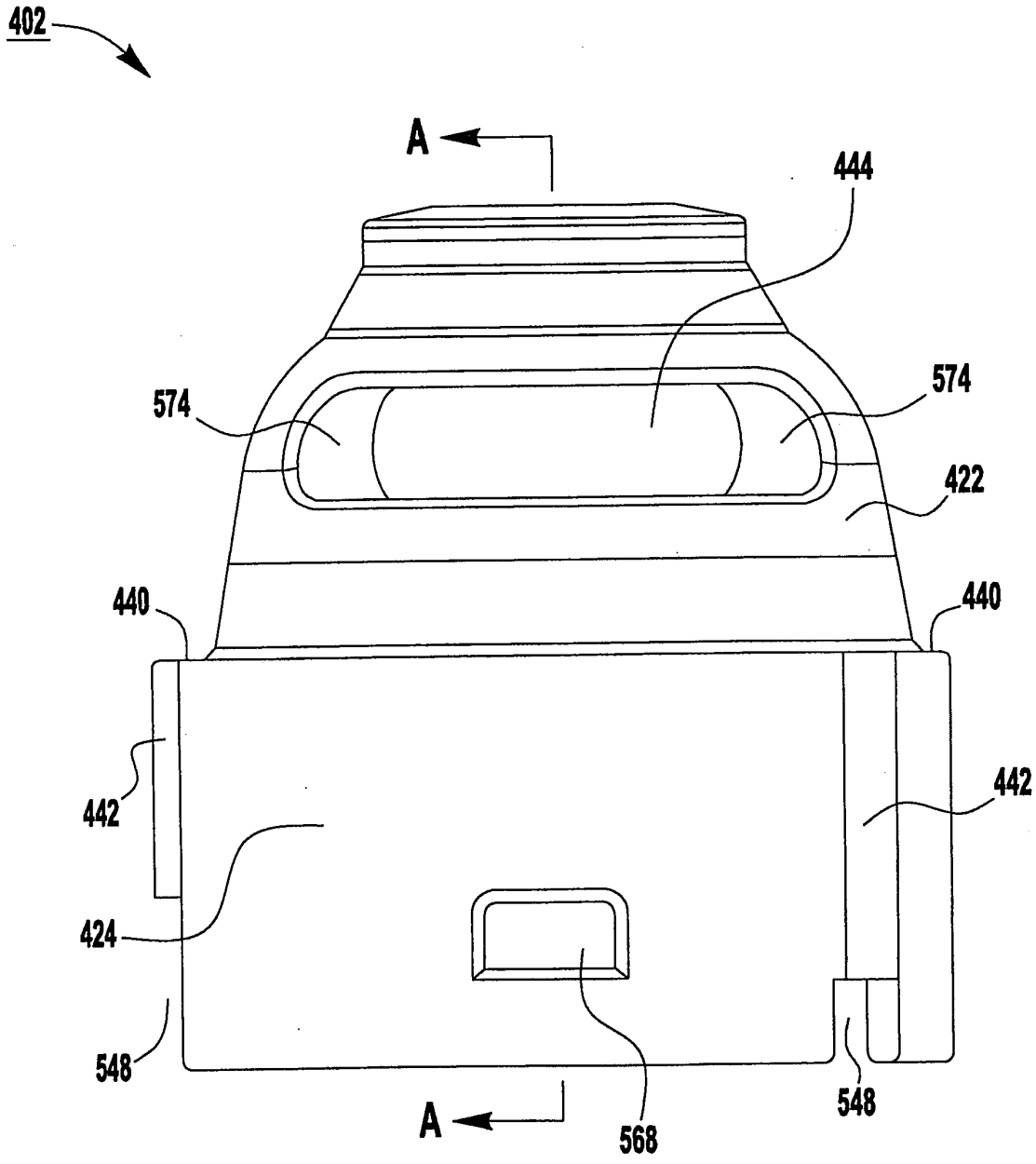

FIG. 13B

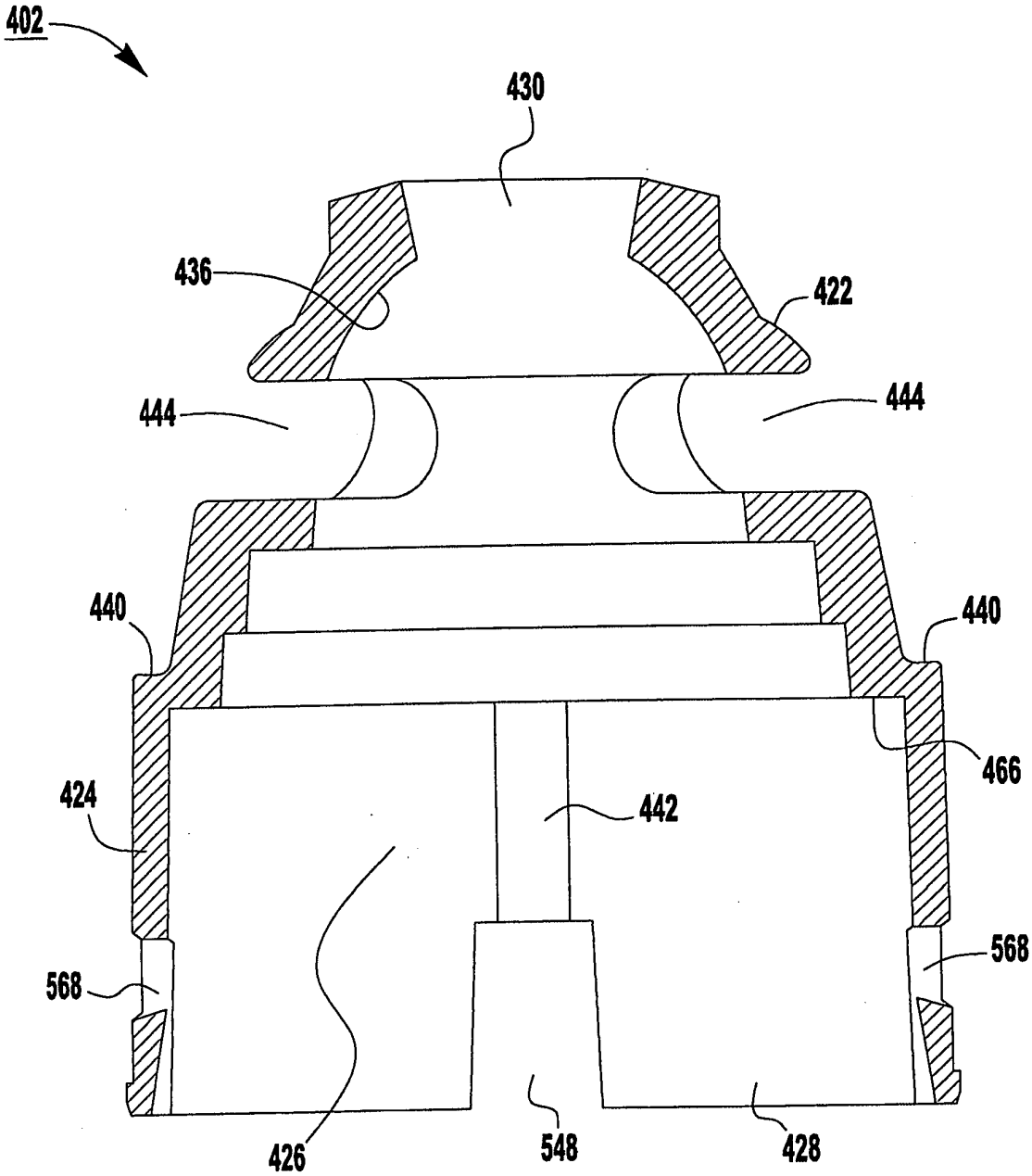

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FIG. 13C

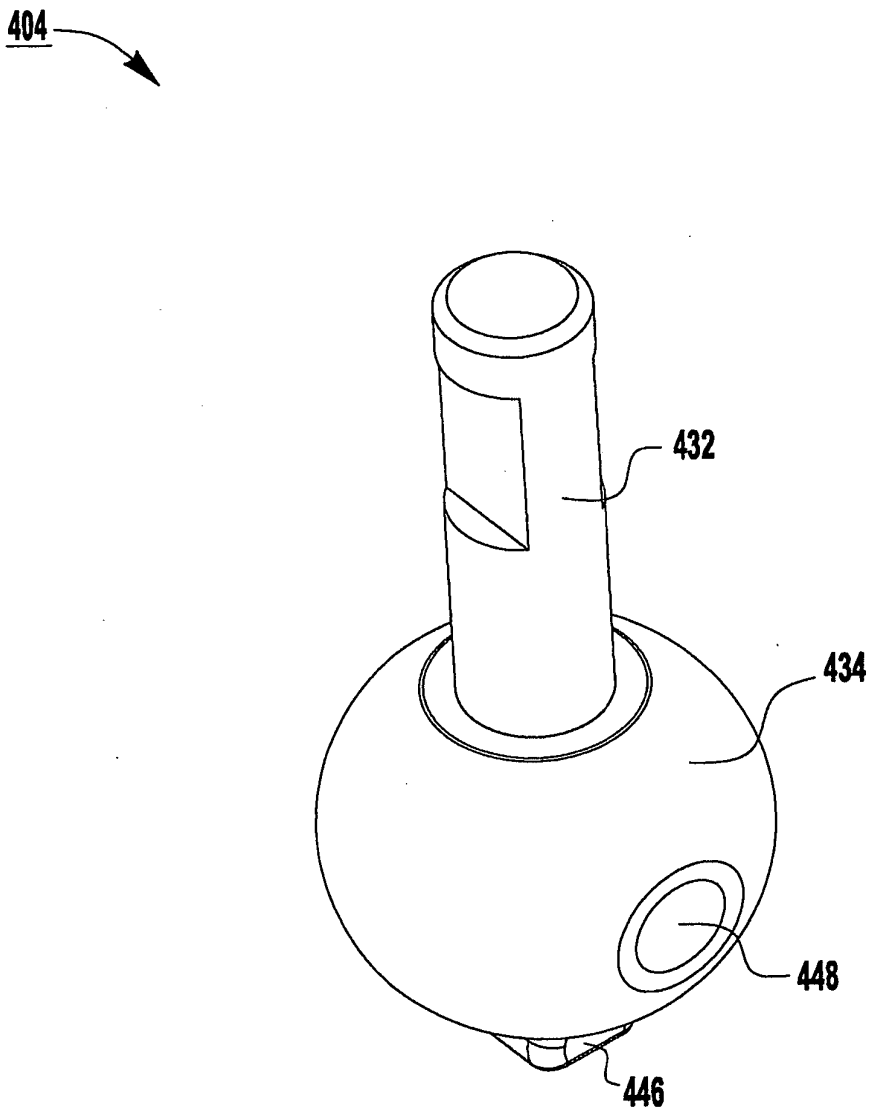


FIG. 14

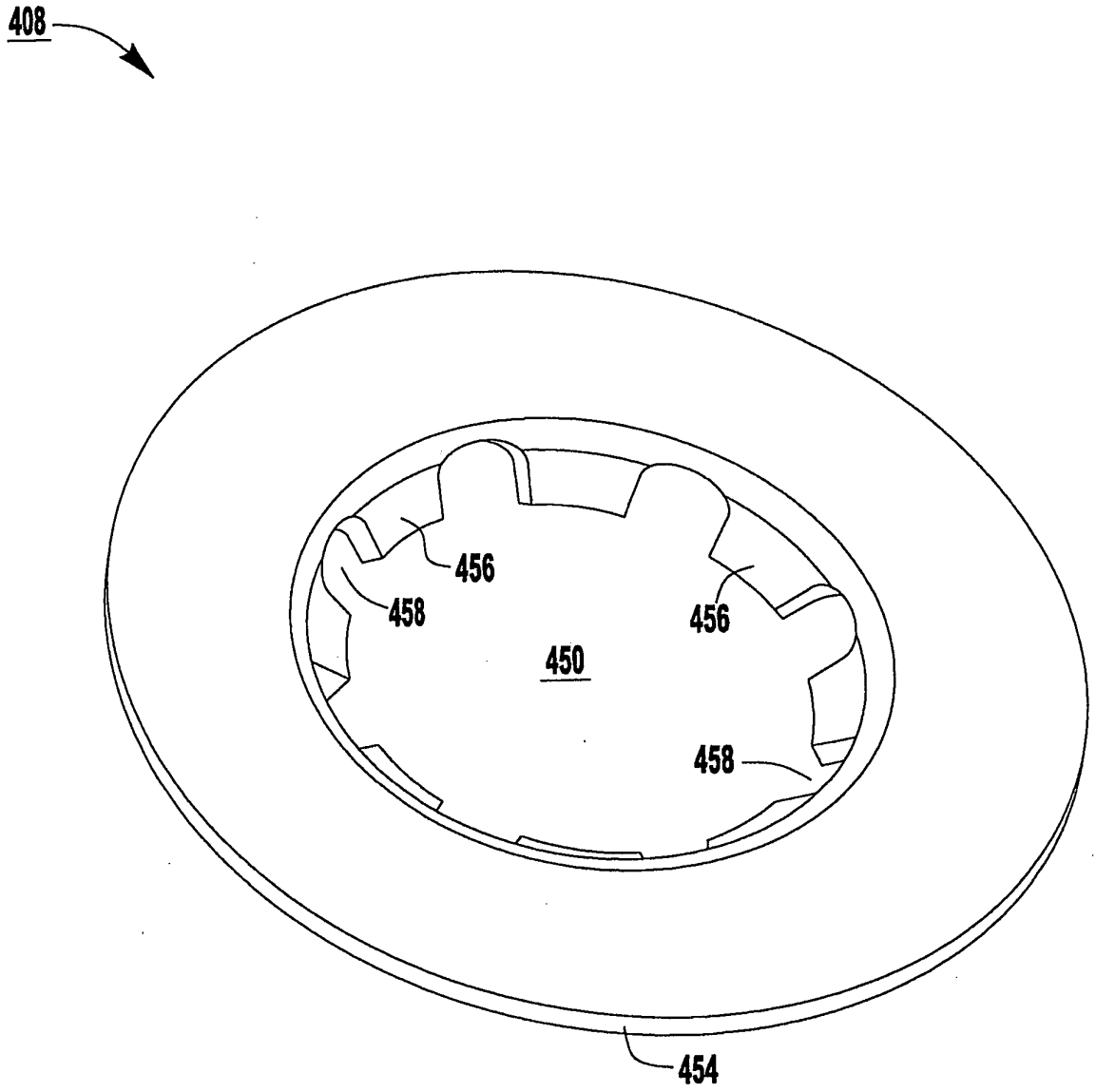


FIG. 15A

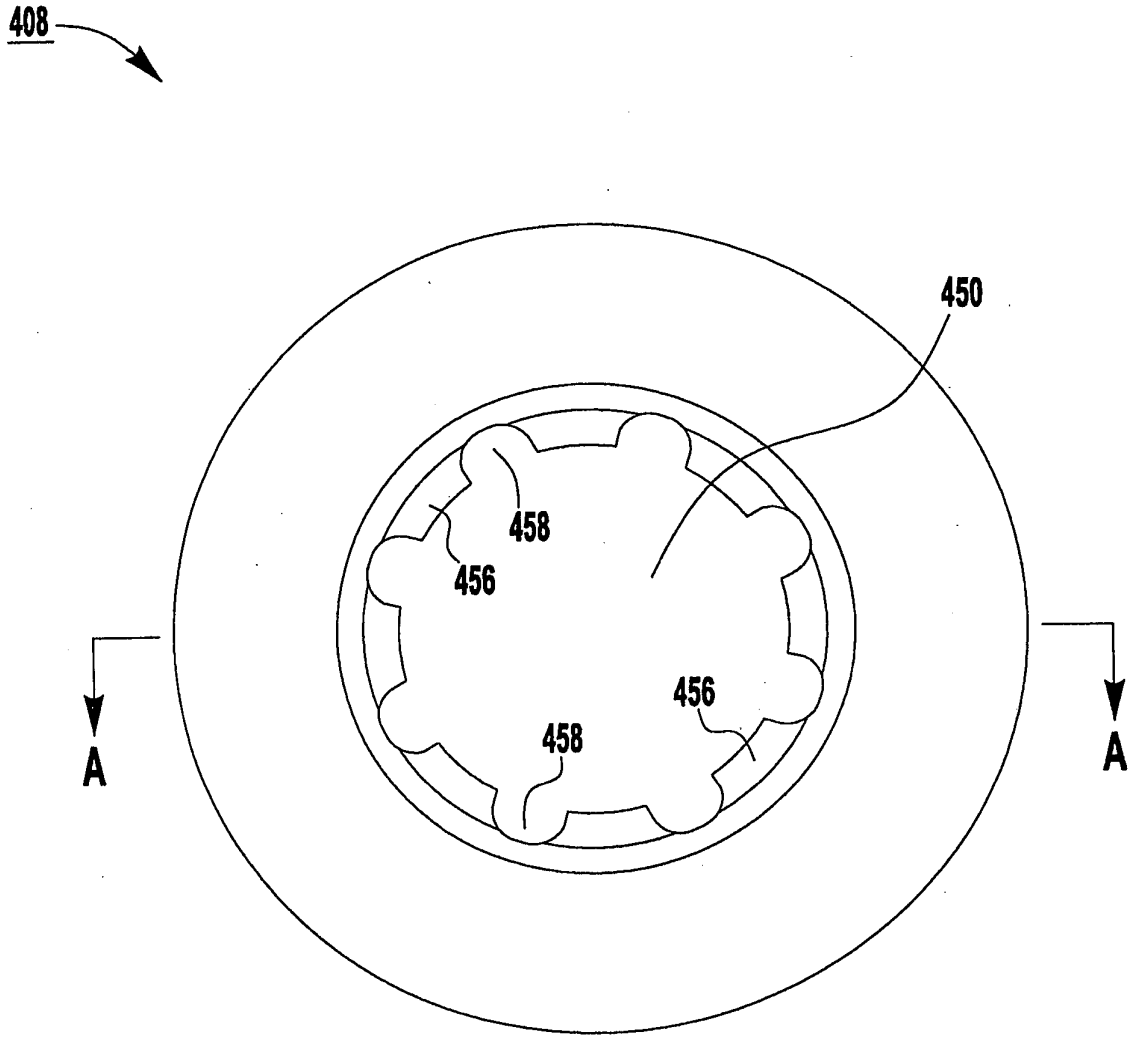
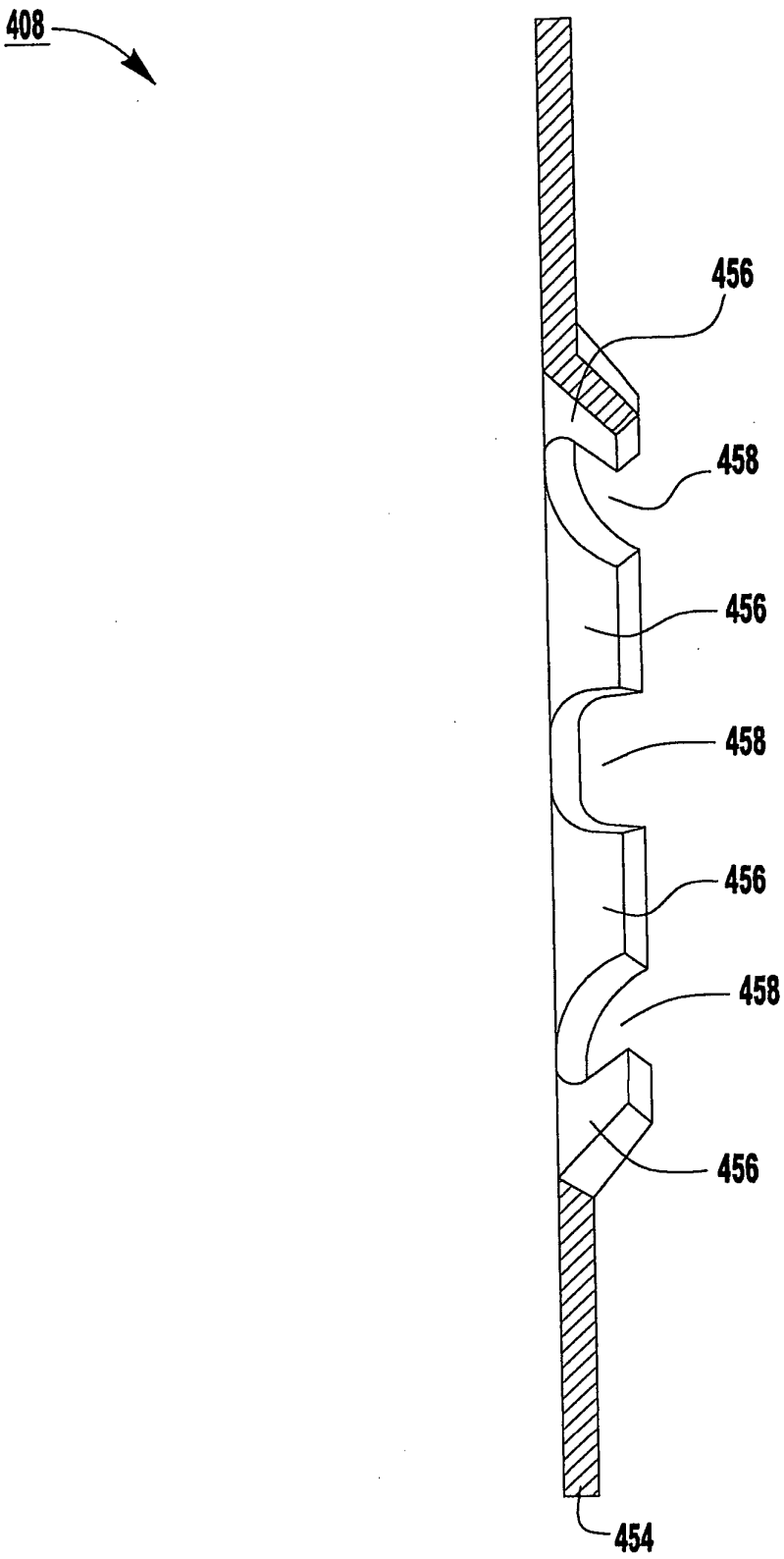


FIG. 15B



SECTION A-A

FIG. 15C

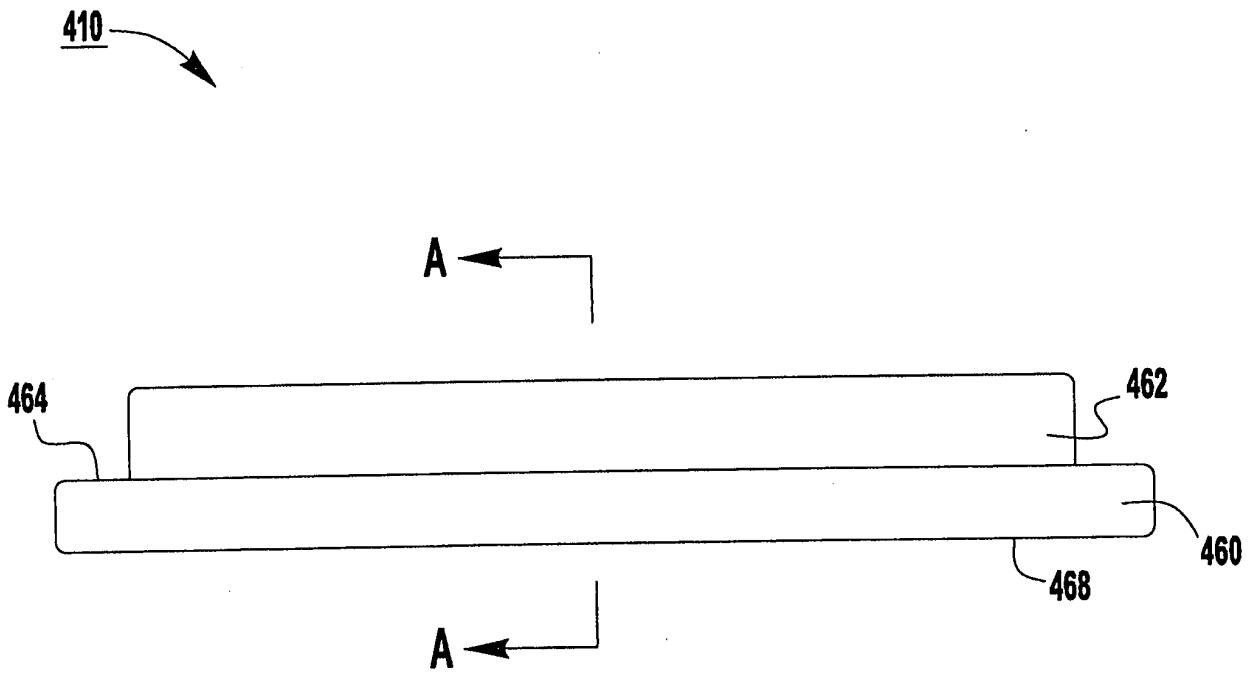
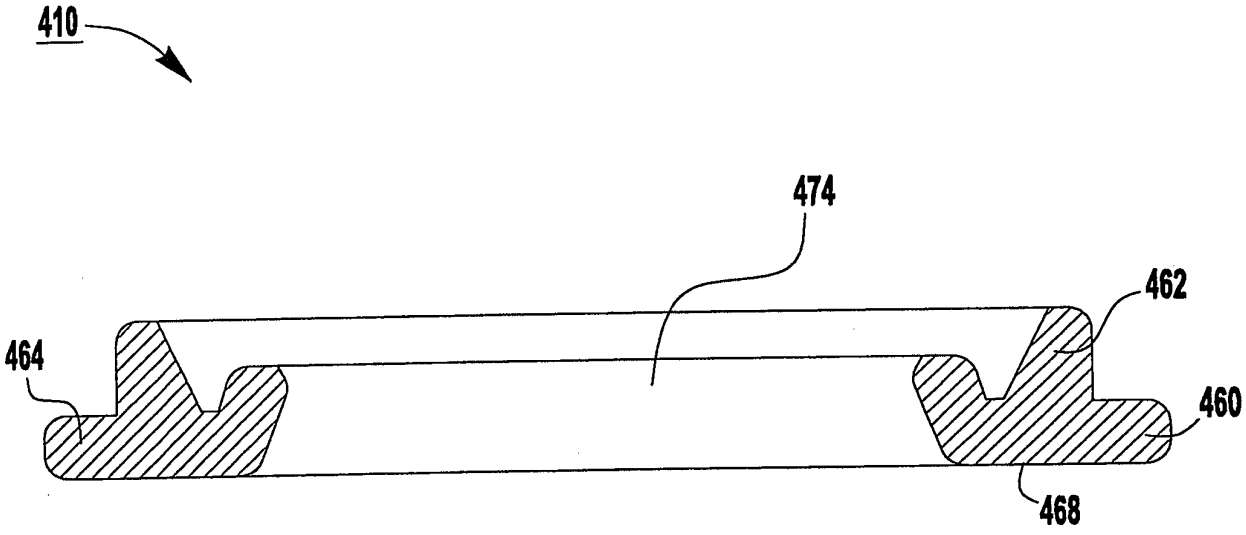


FIG. 16A



SECTION A-A

FIG. 16B

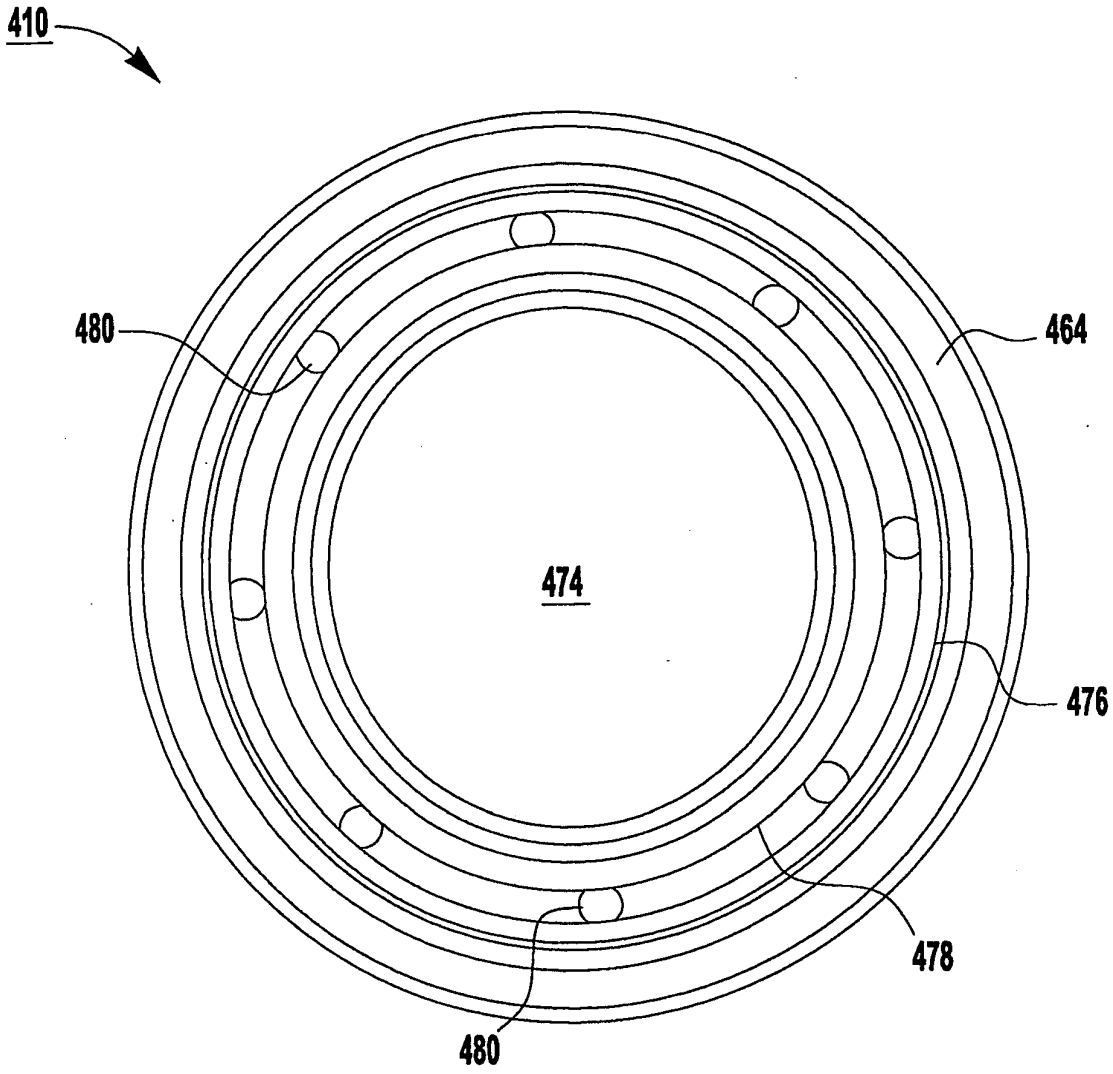


FIG. 16C

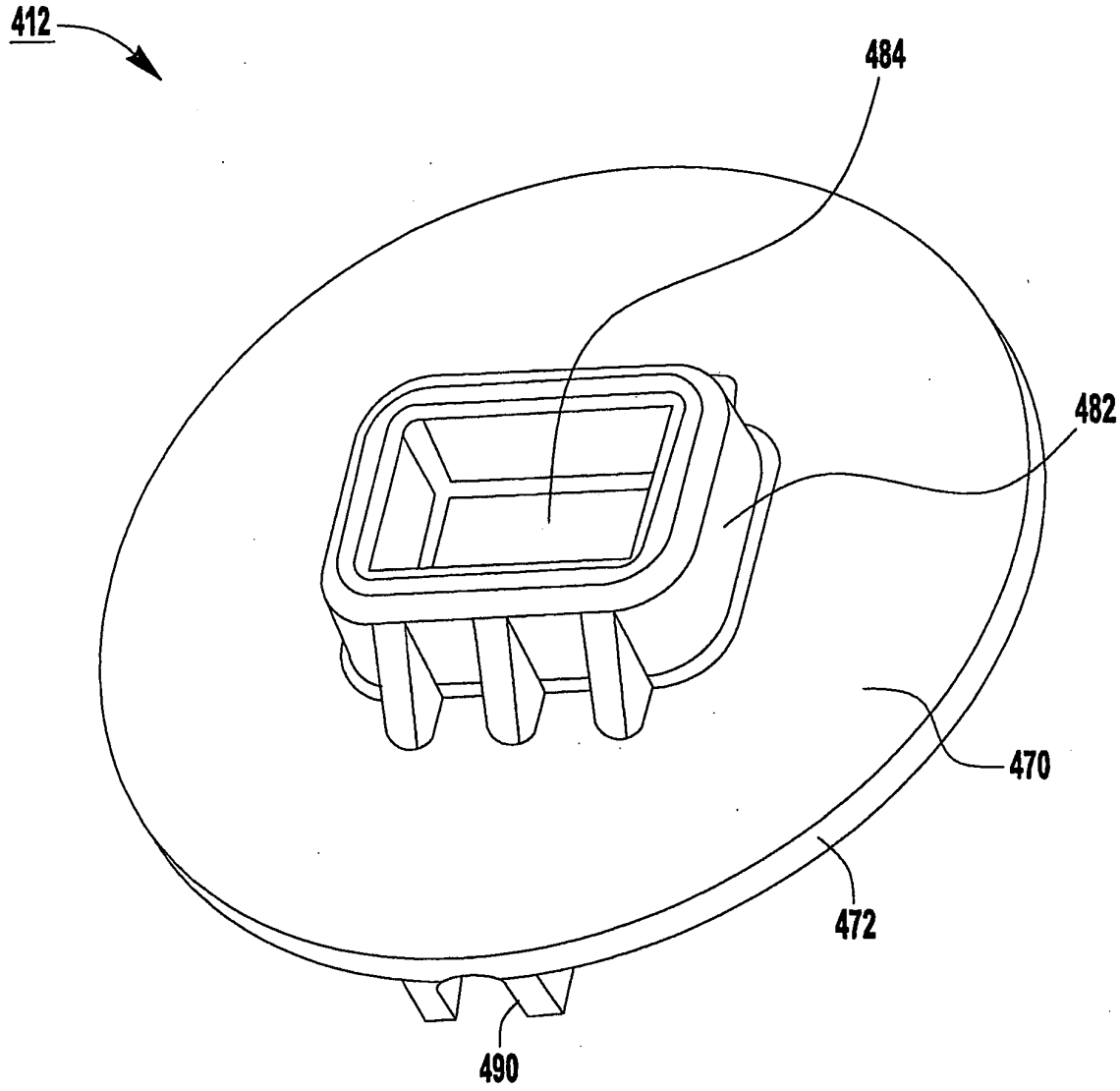


FIG. 17A

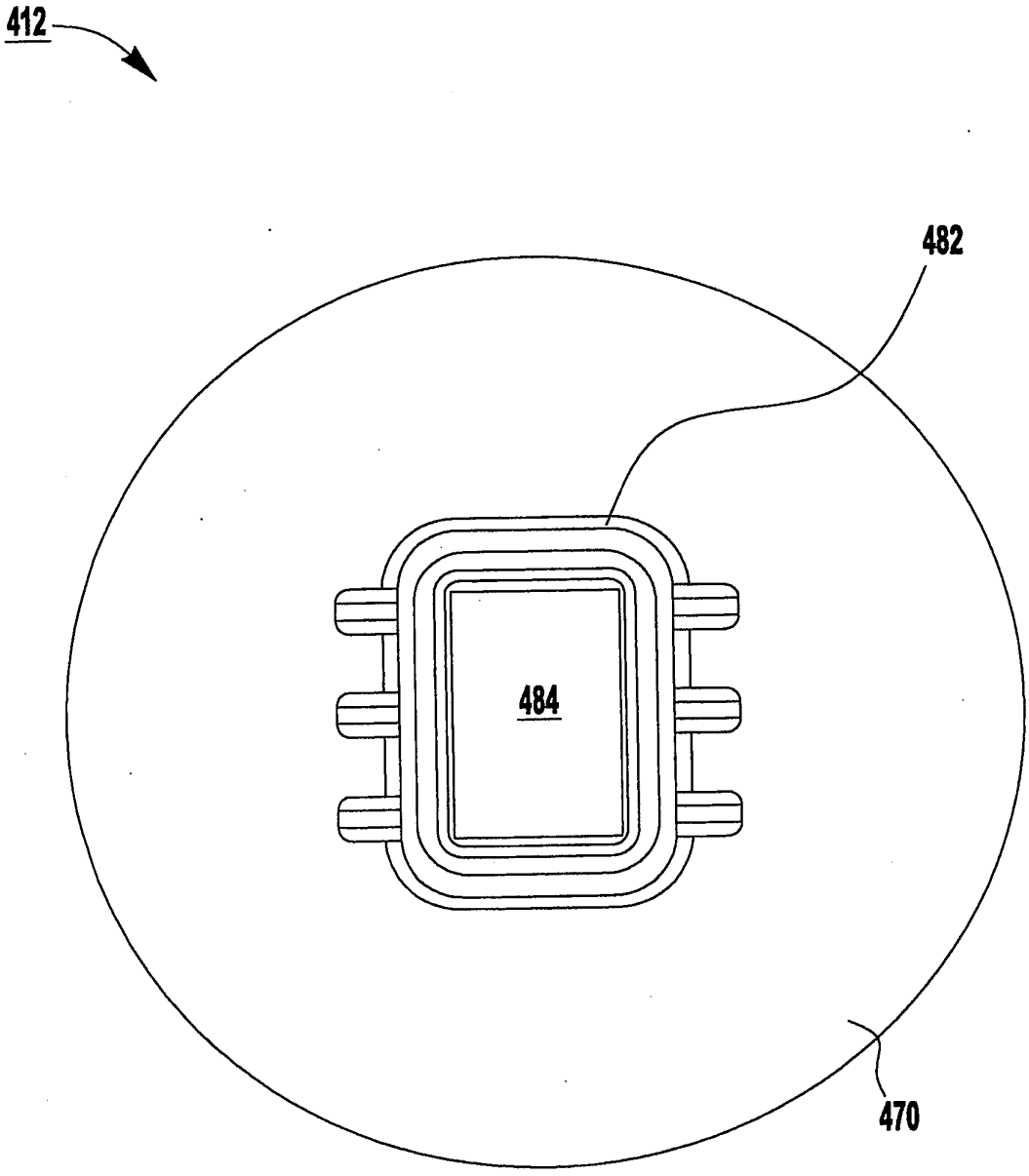


FIG. 17B

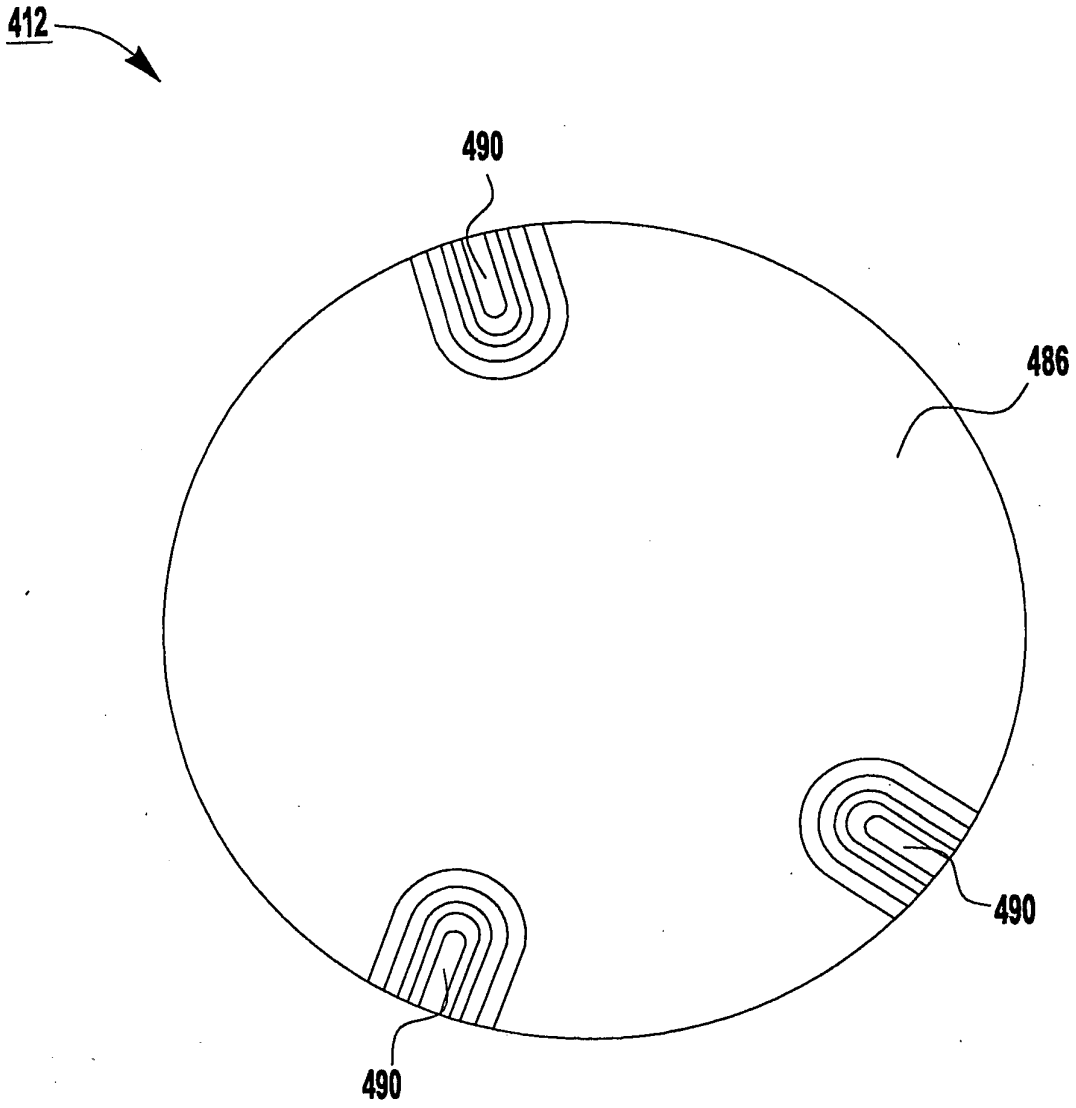


FIG. 17C

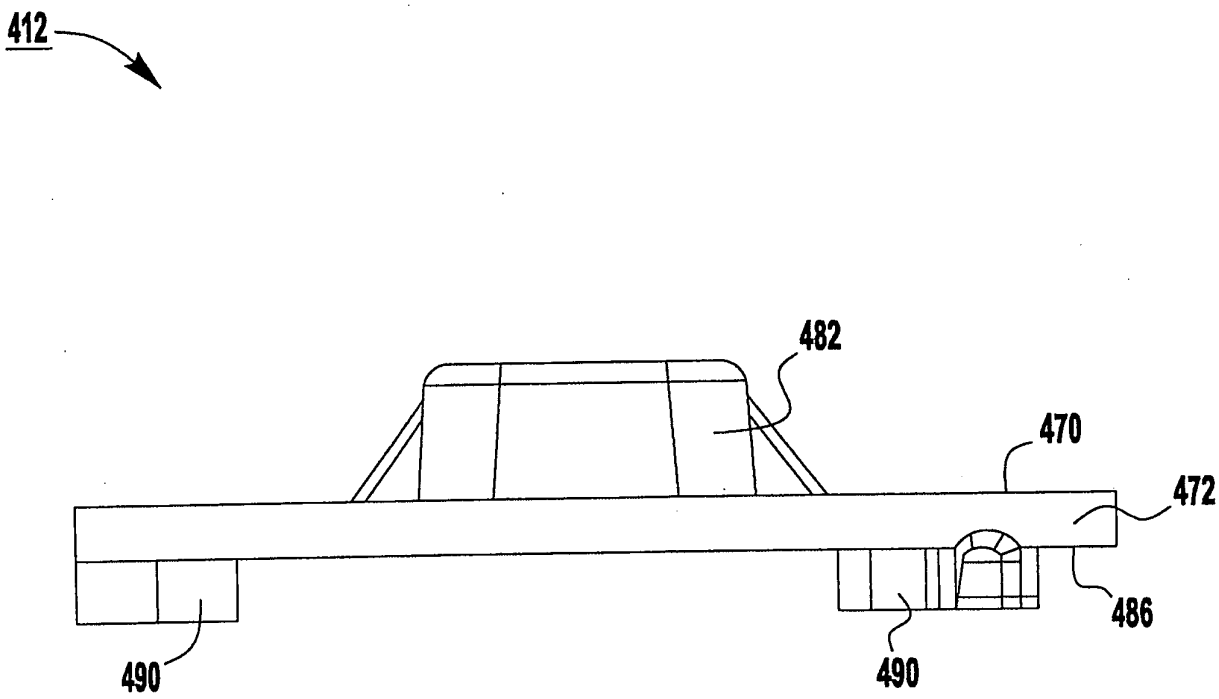


FIG. 17D

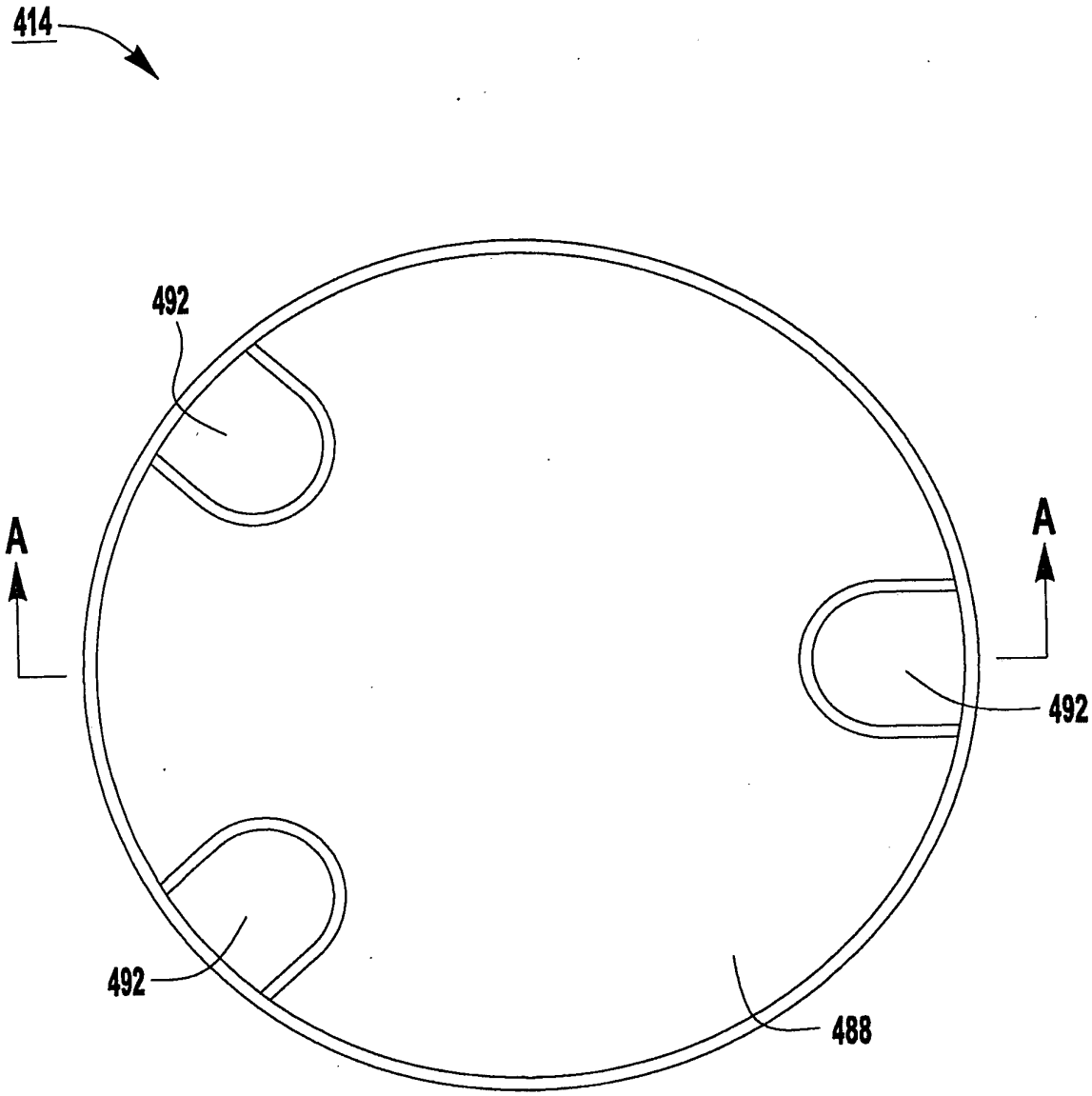
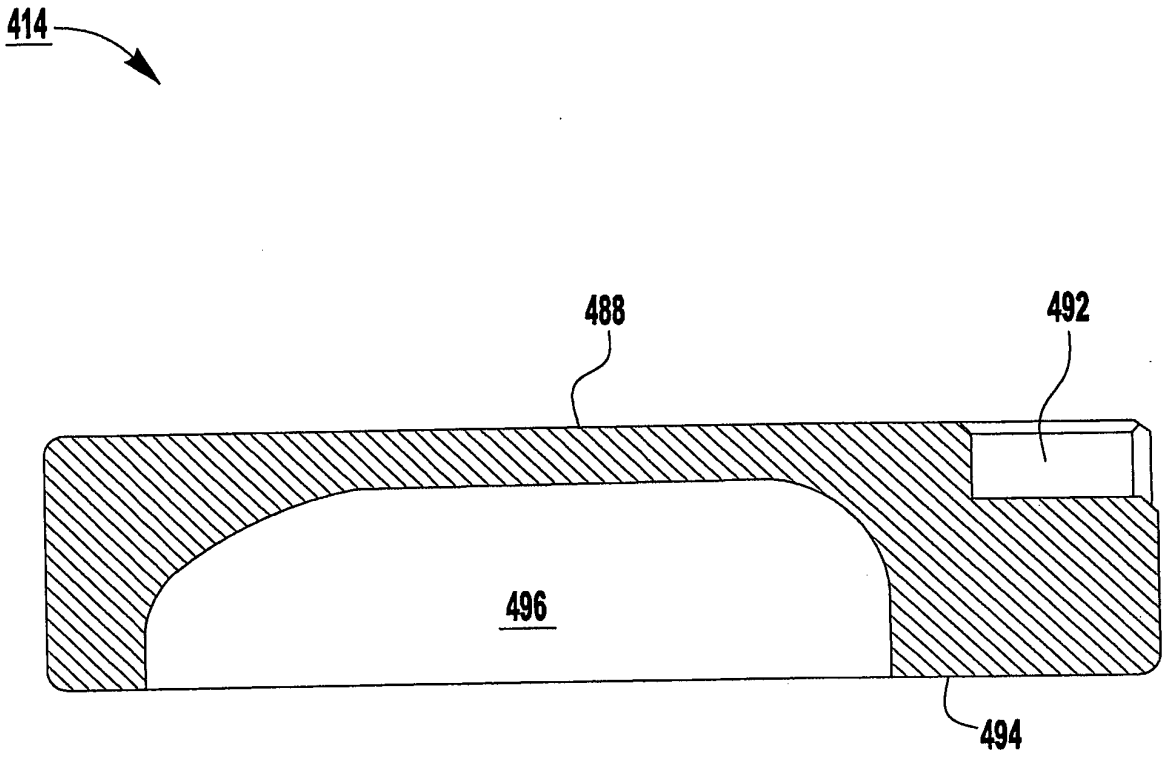


FIG. 18A



SECTION A-A

FIG. 18B

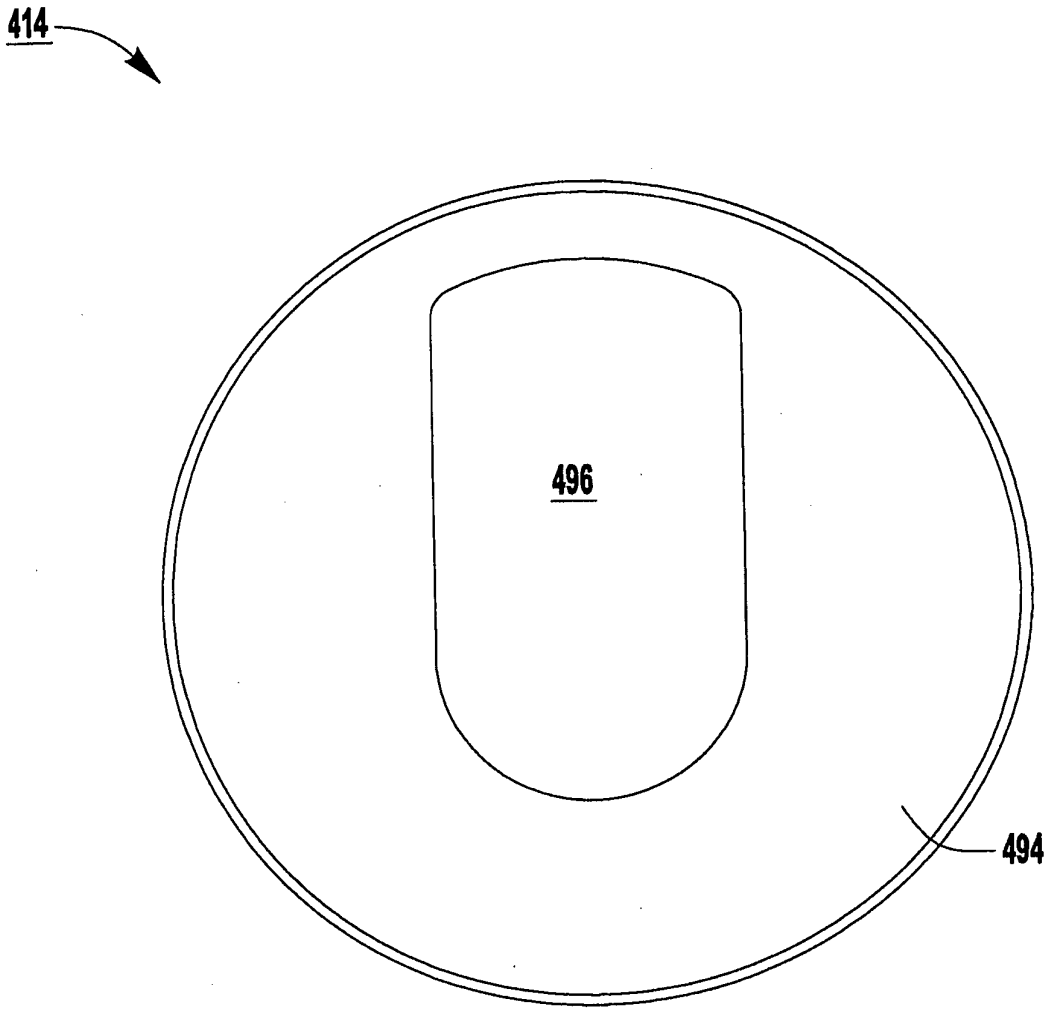


FIG. 18C

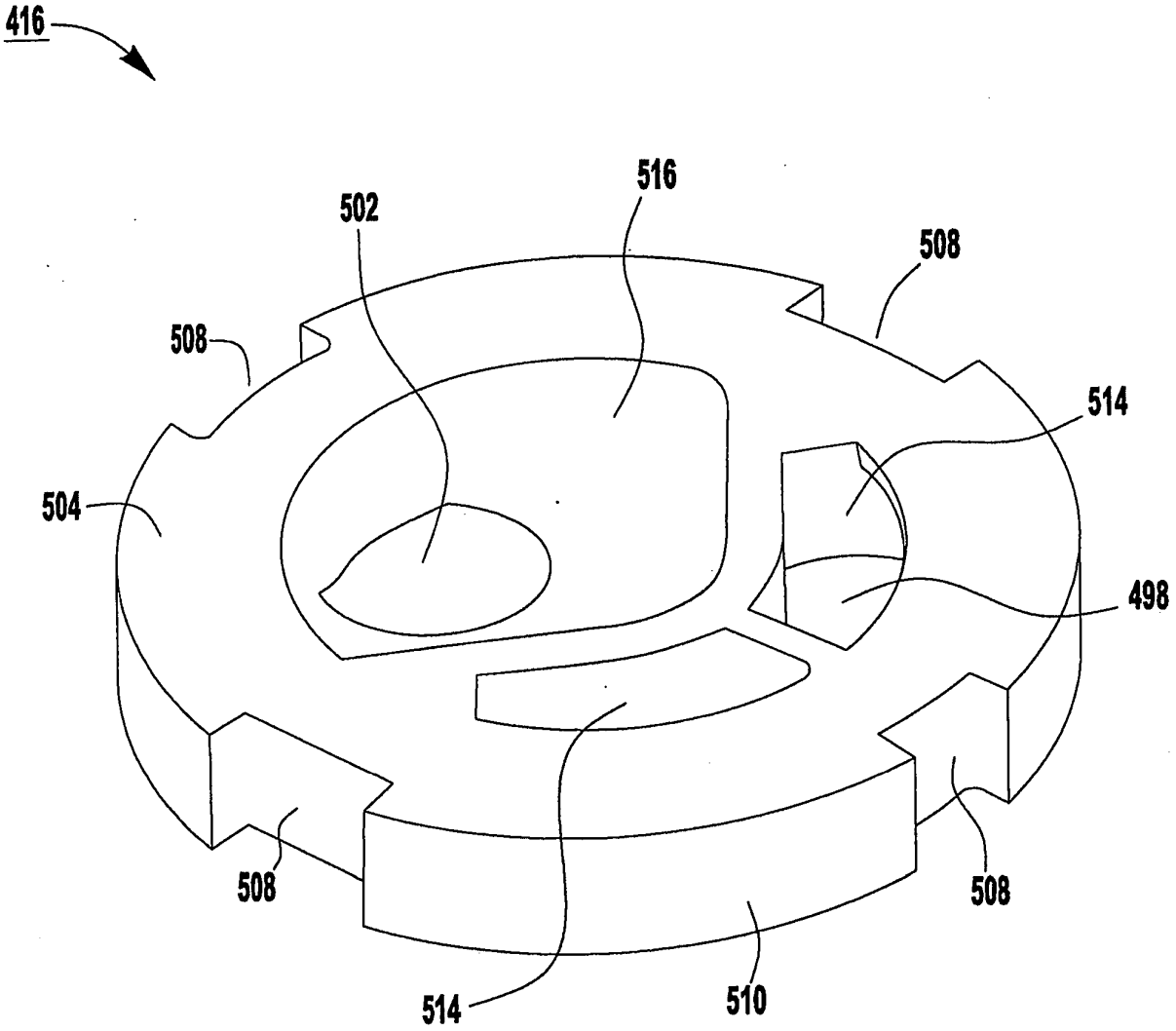


FIG. 19A

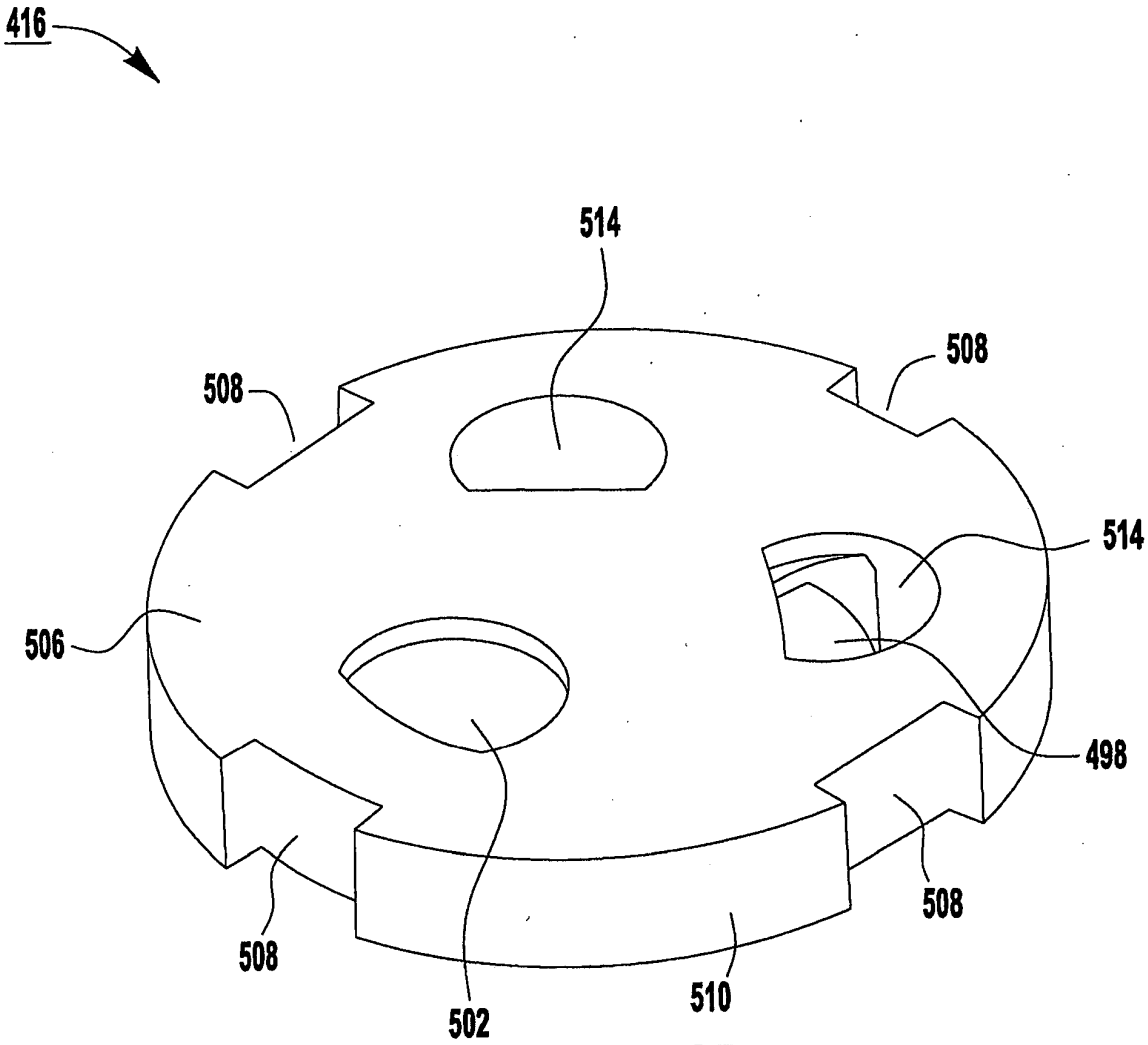


FIG. 19B

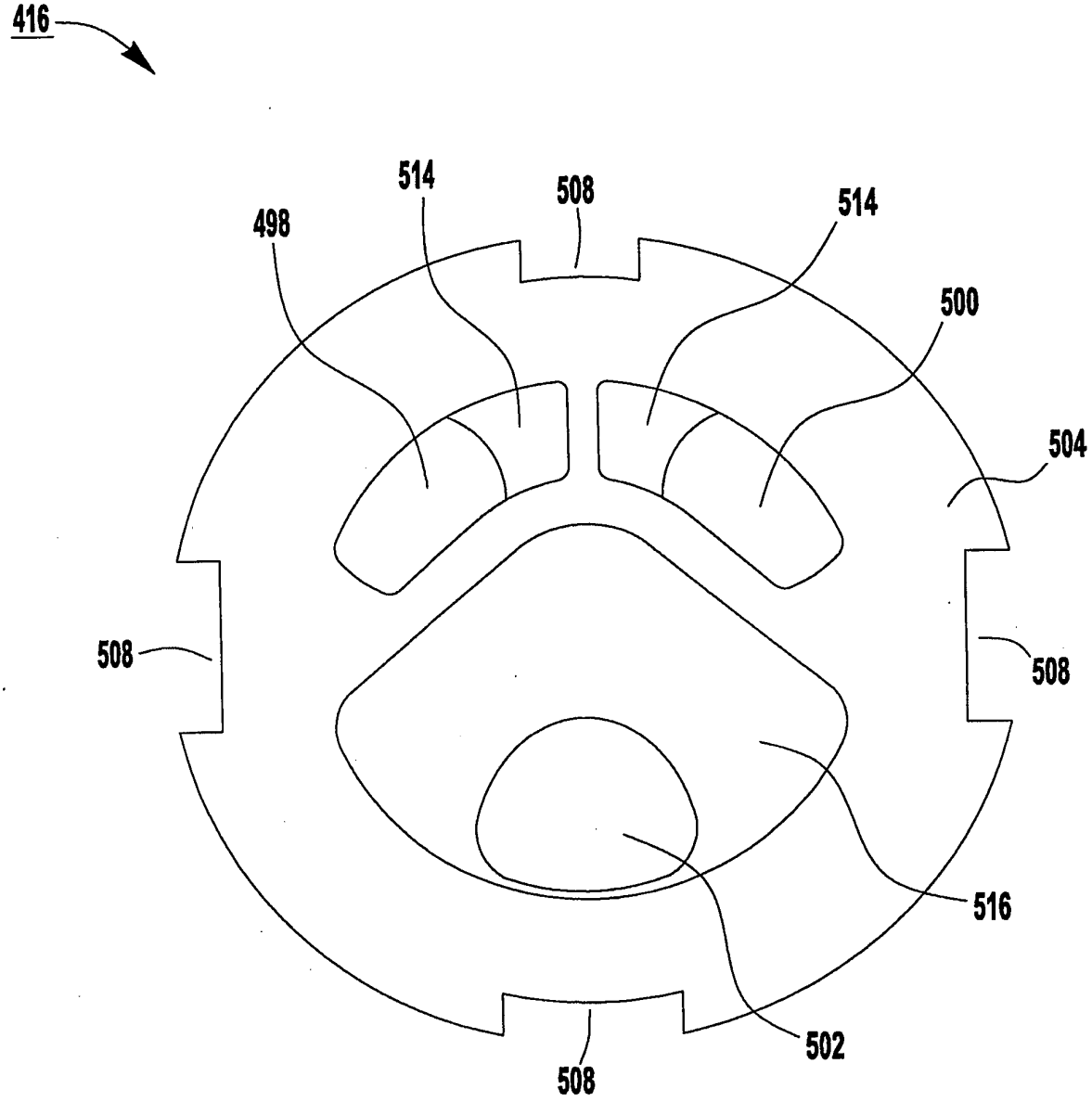


FIG. 19C

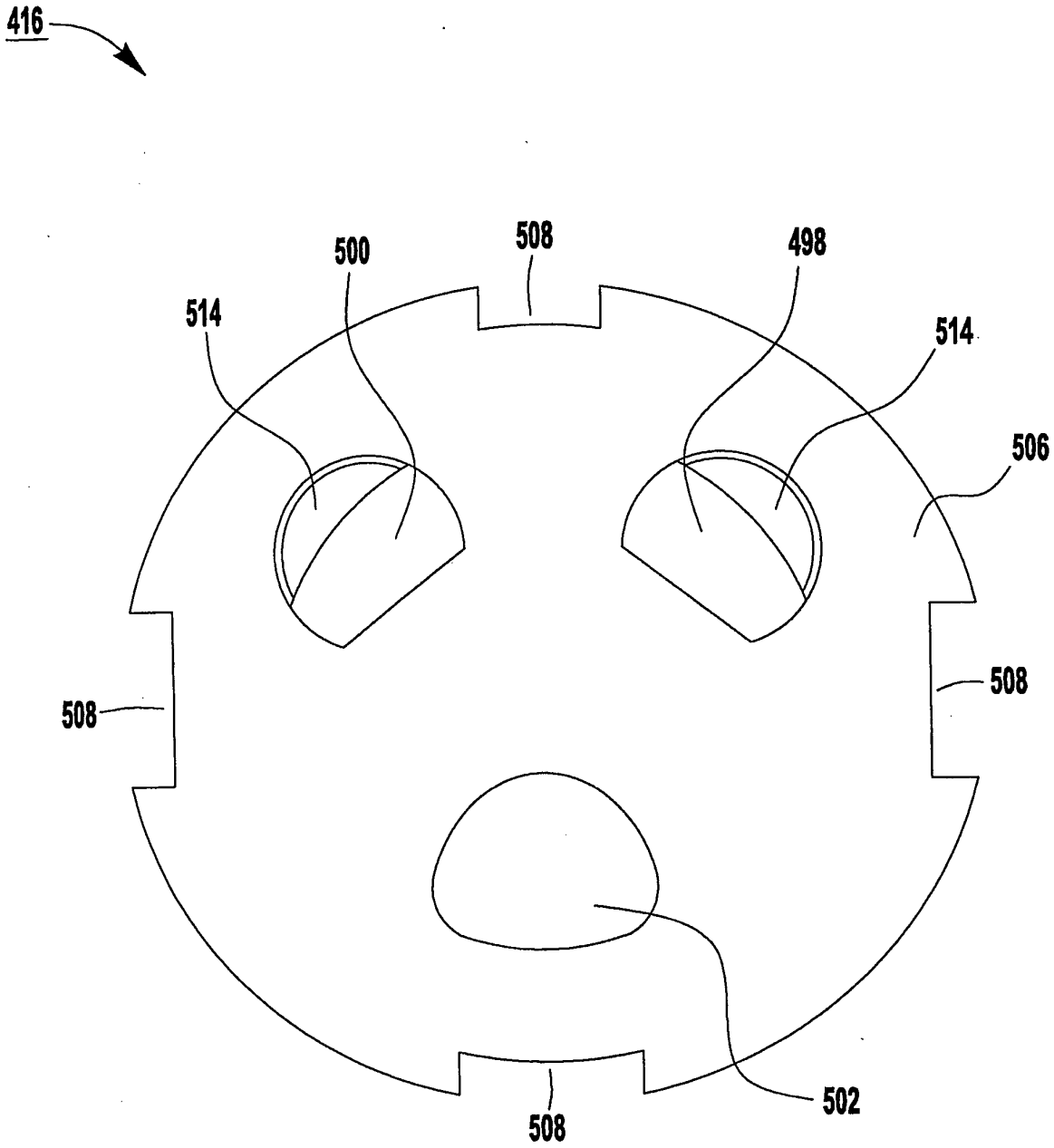


FIG. 19D

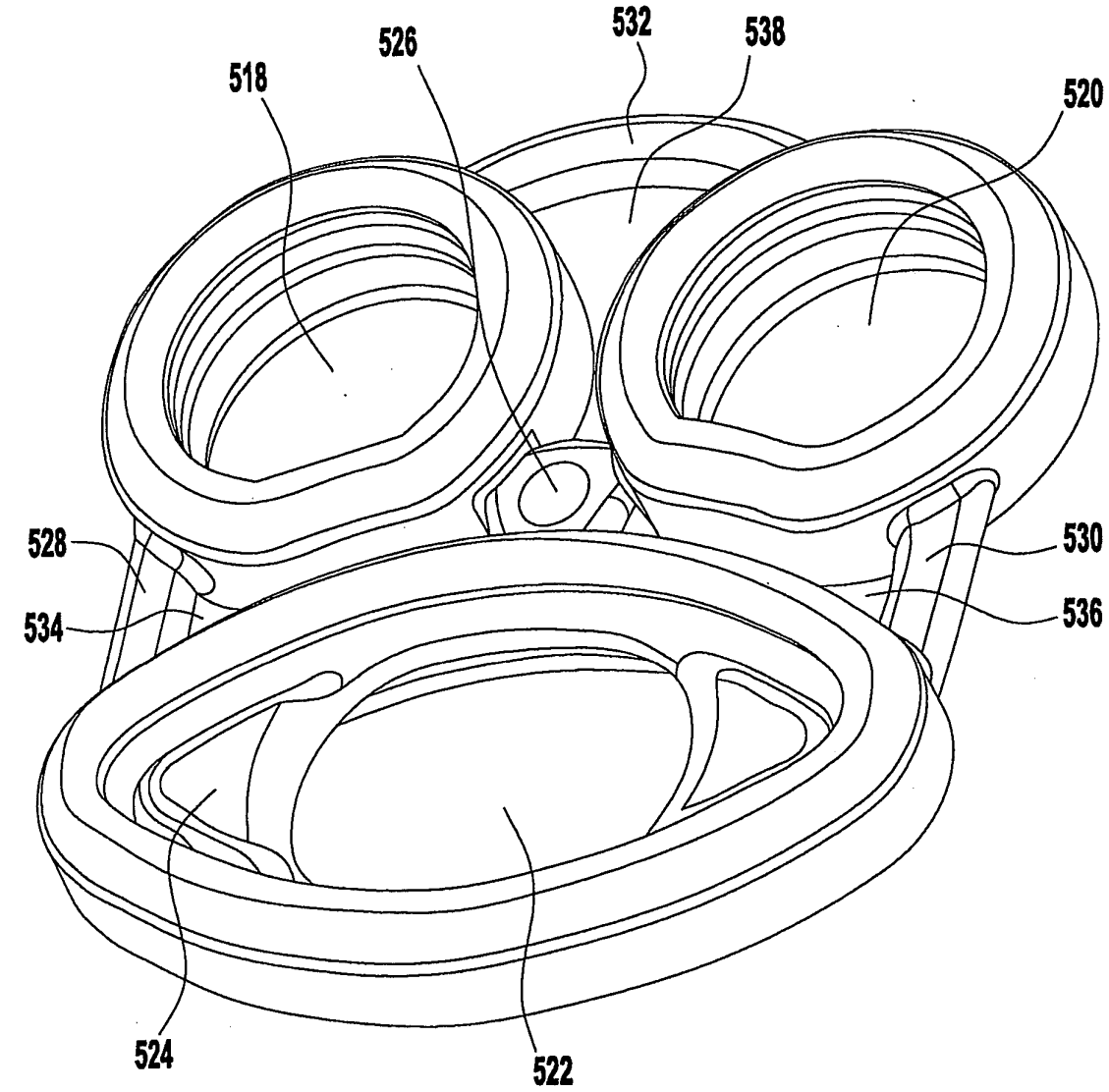


FIG. 20A

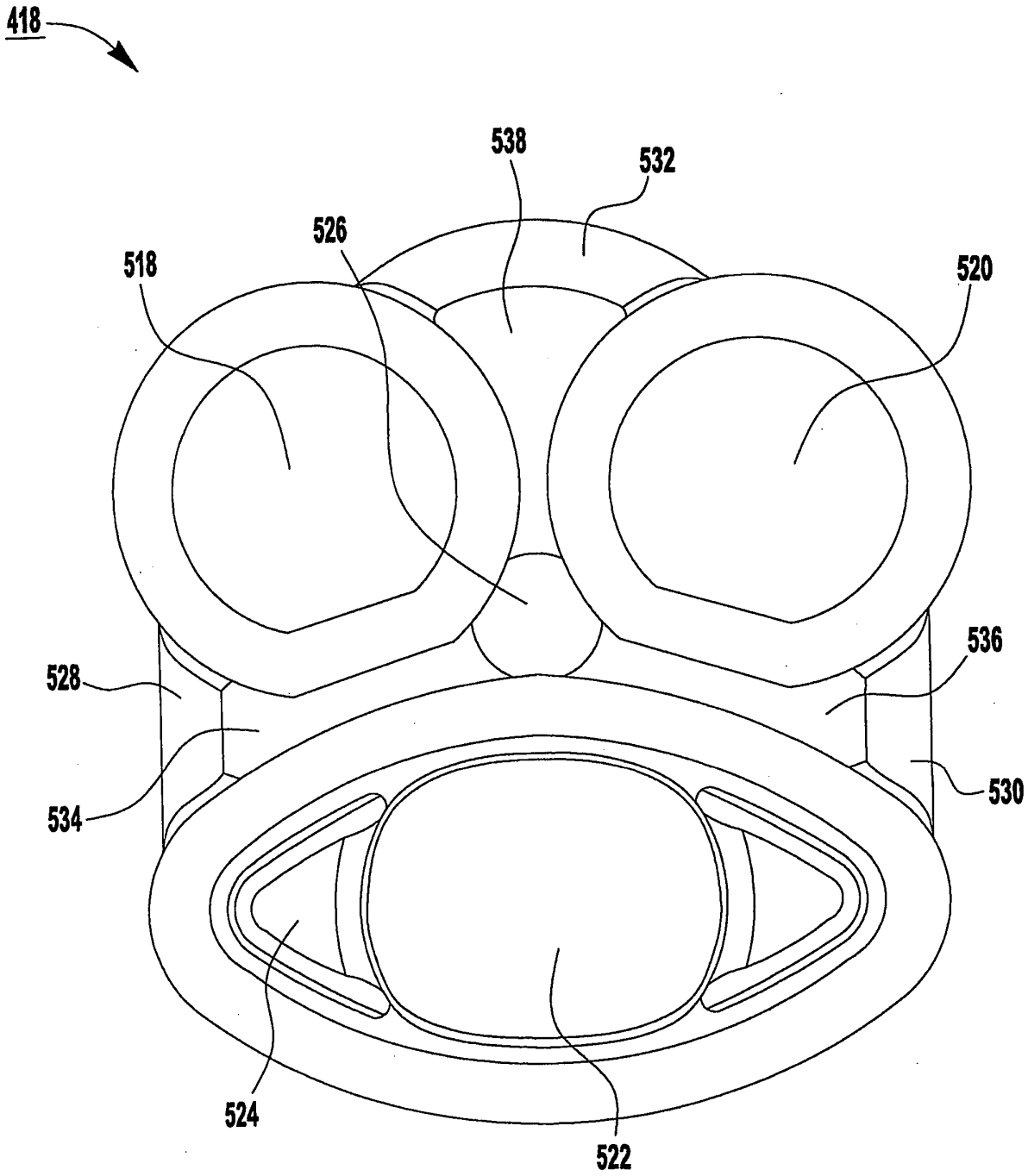


FIG. 20B

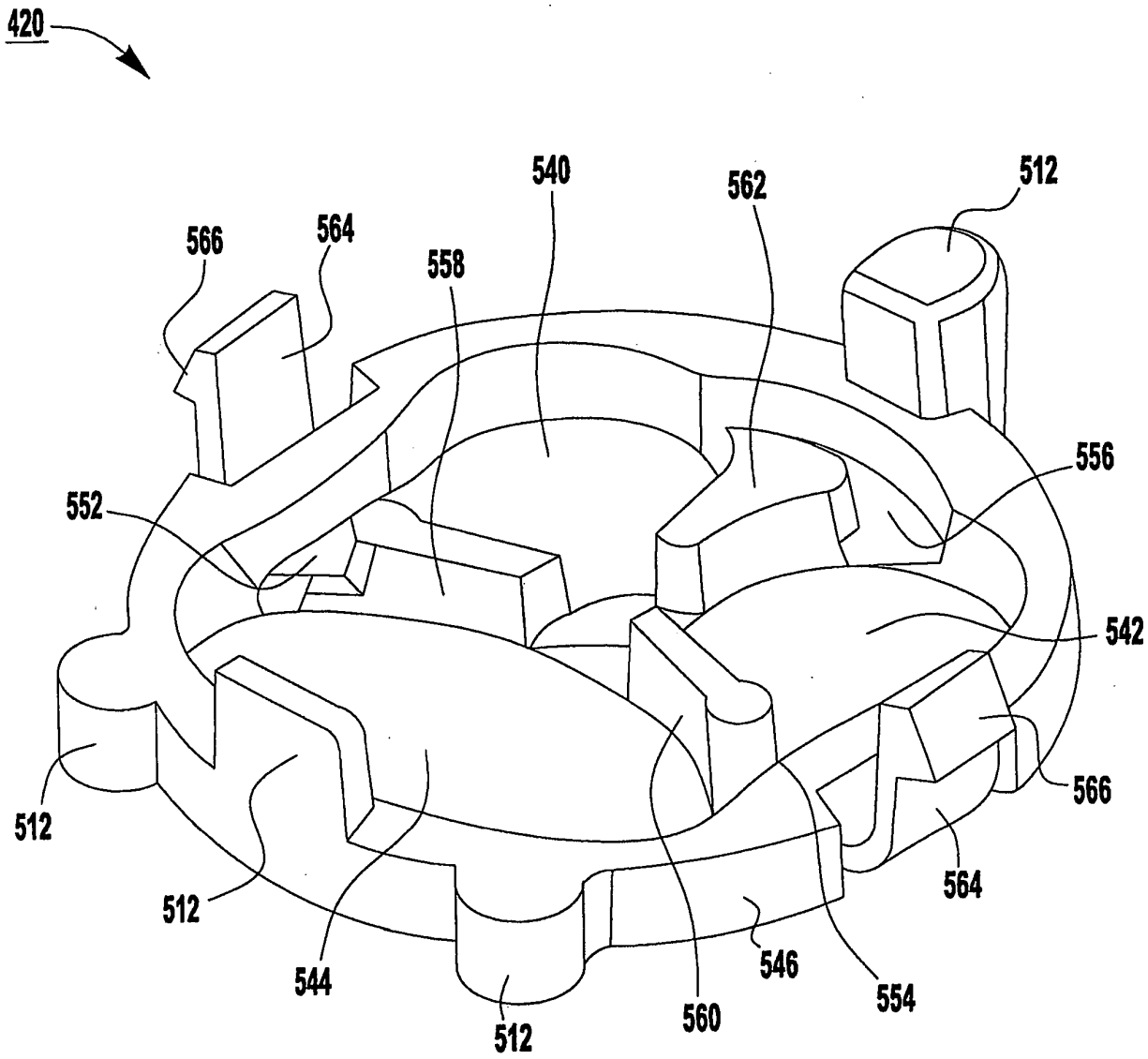

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FIG. 21A

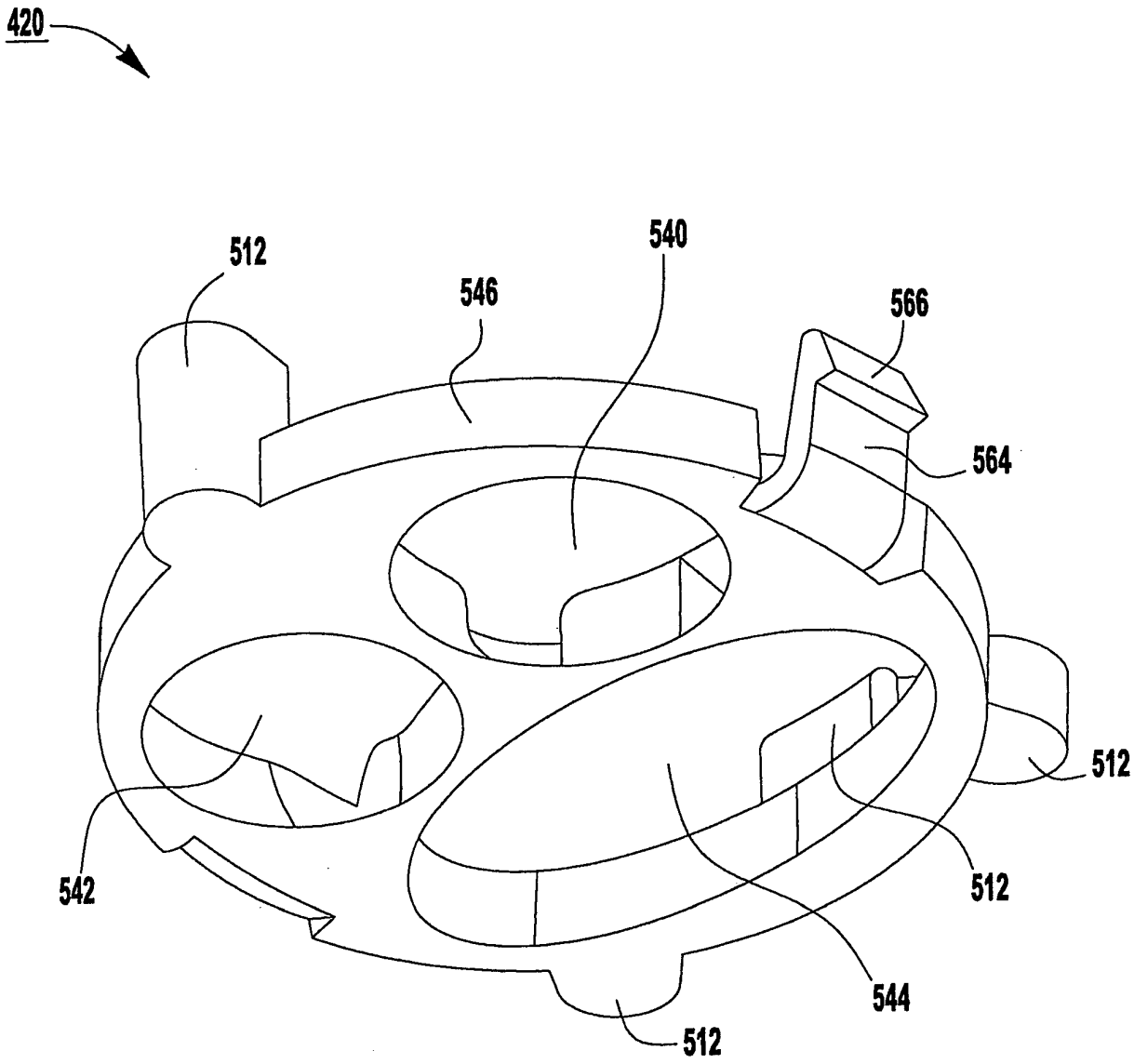

FIG. 21B

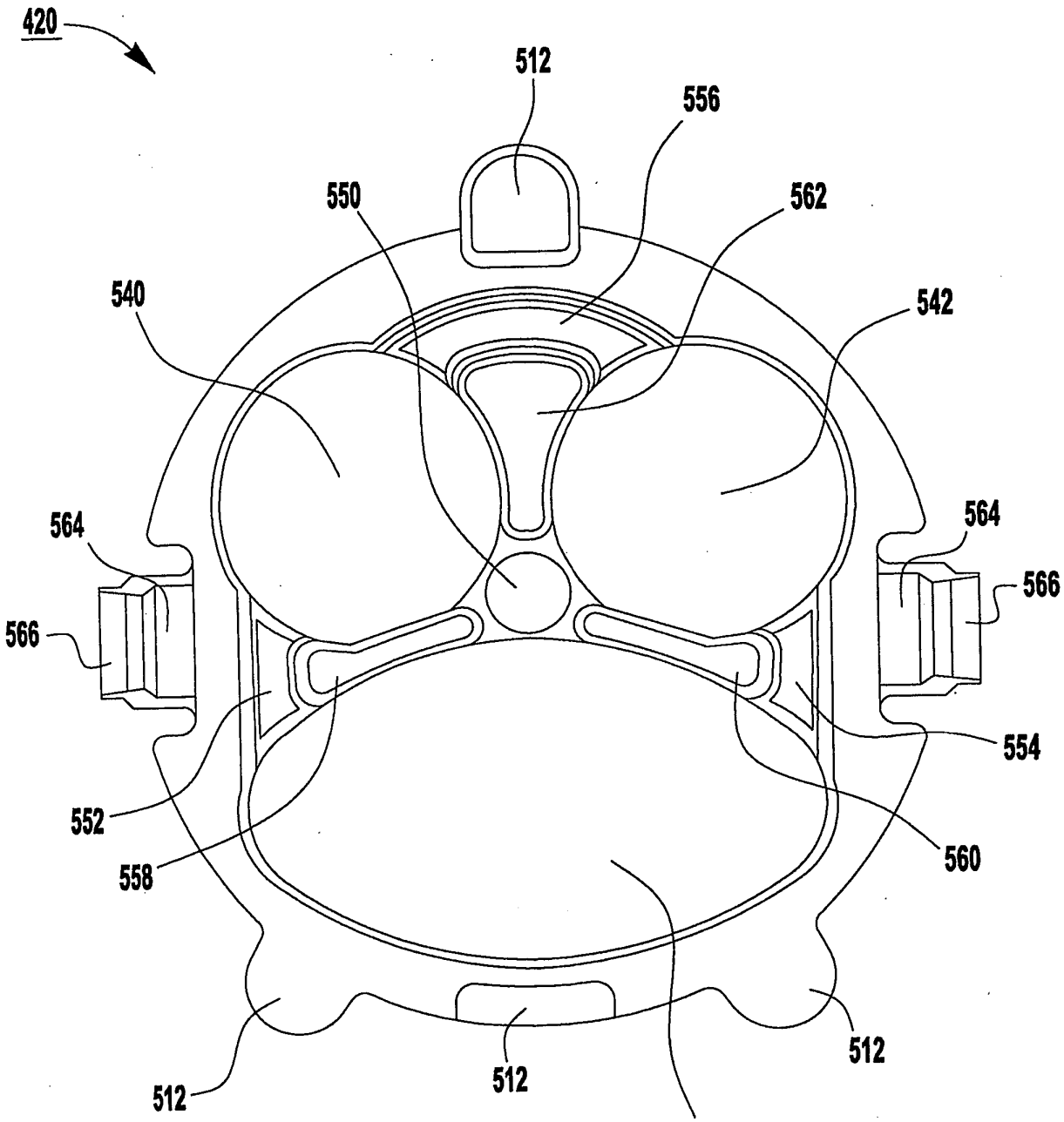
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FIG. 21C

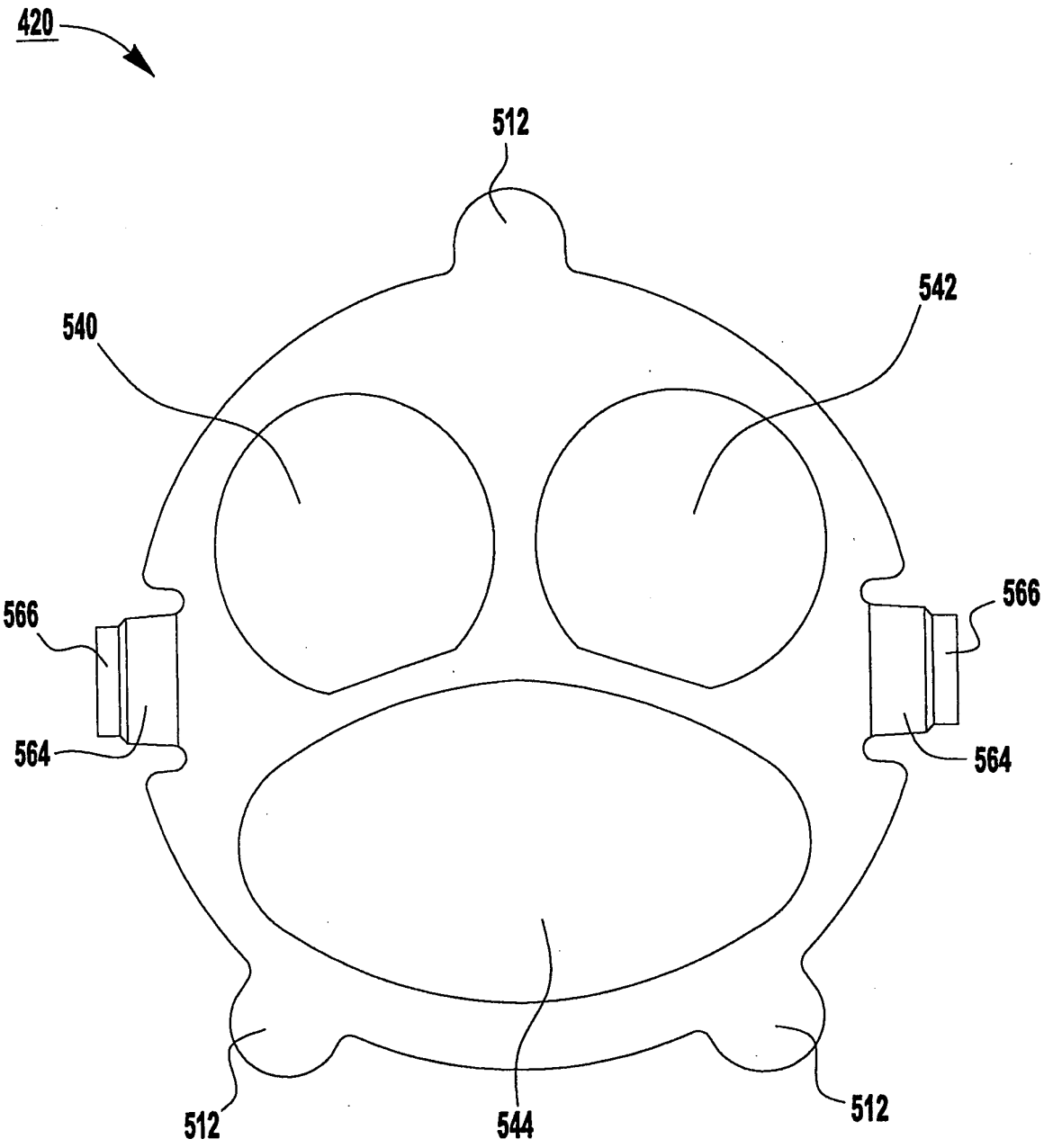


FIG. 21D

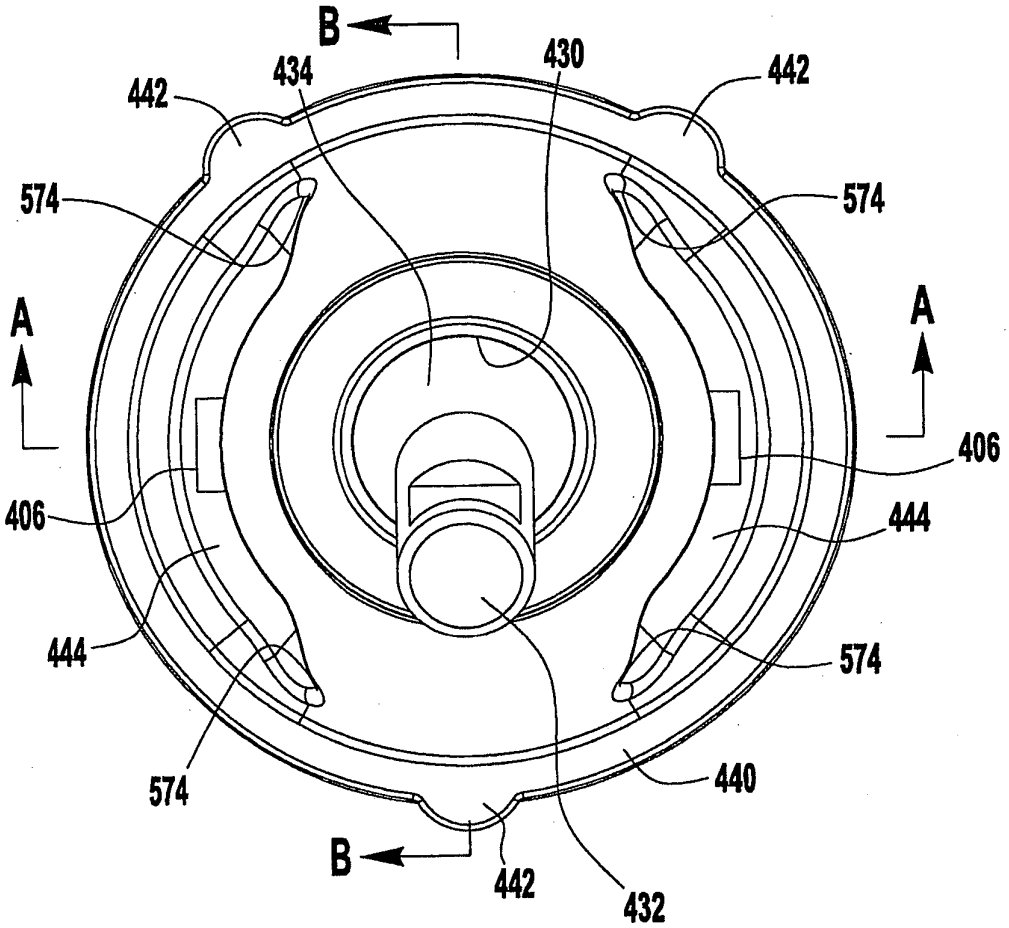
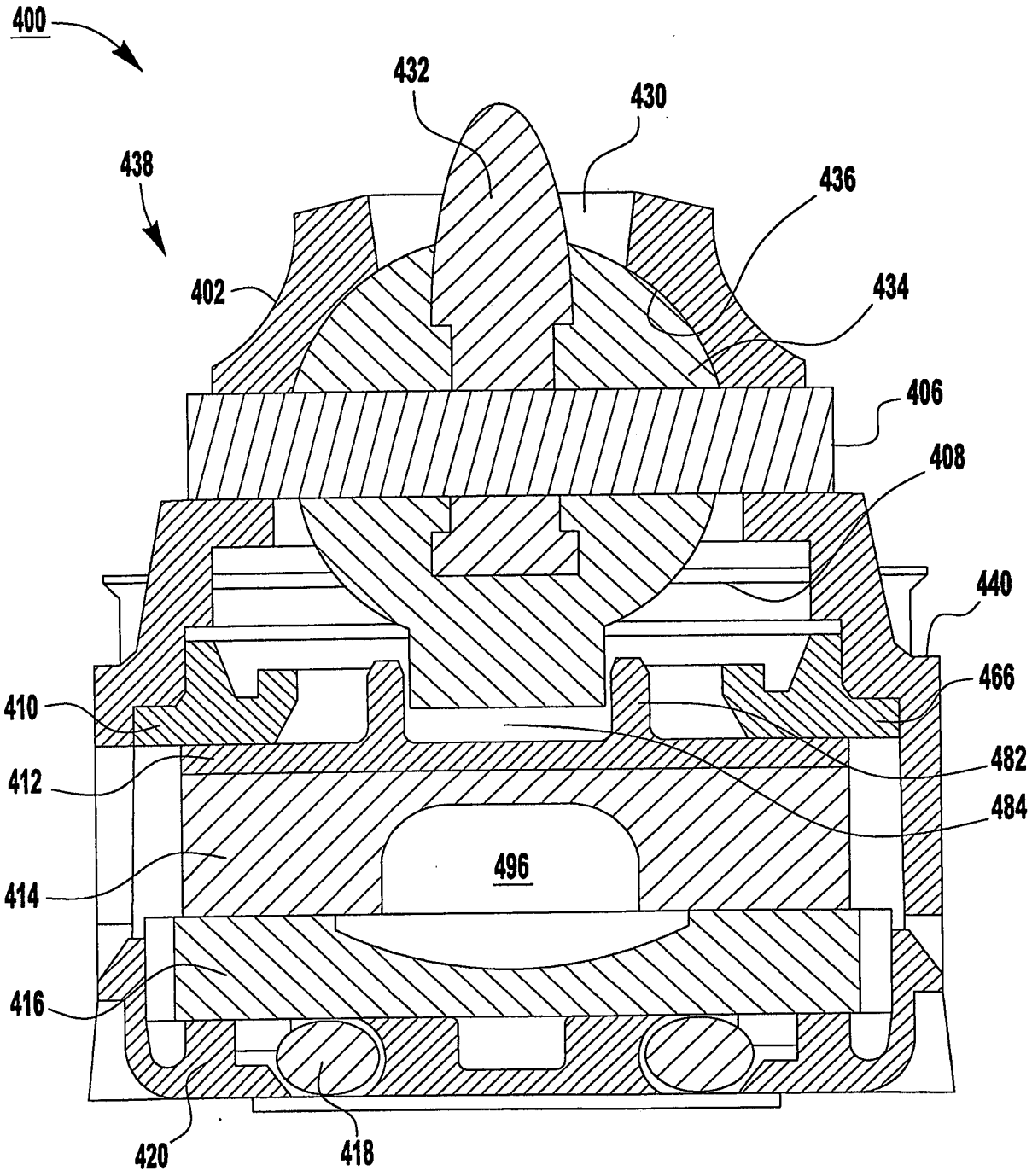
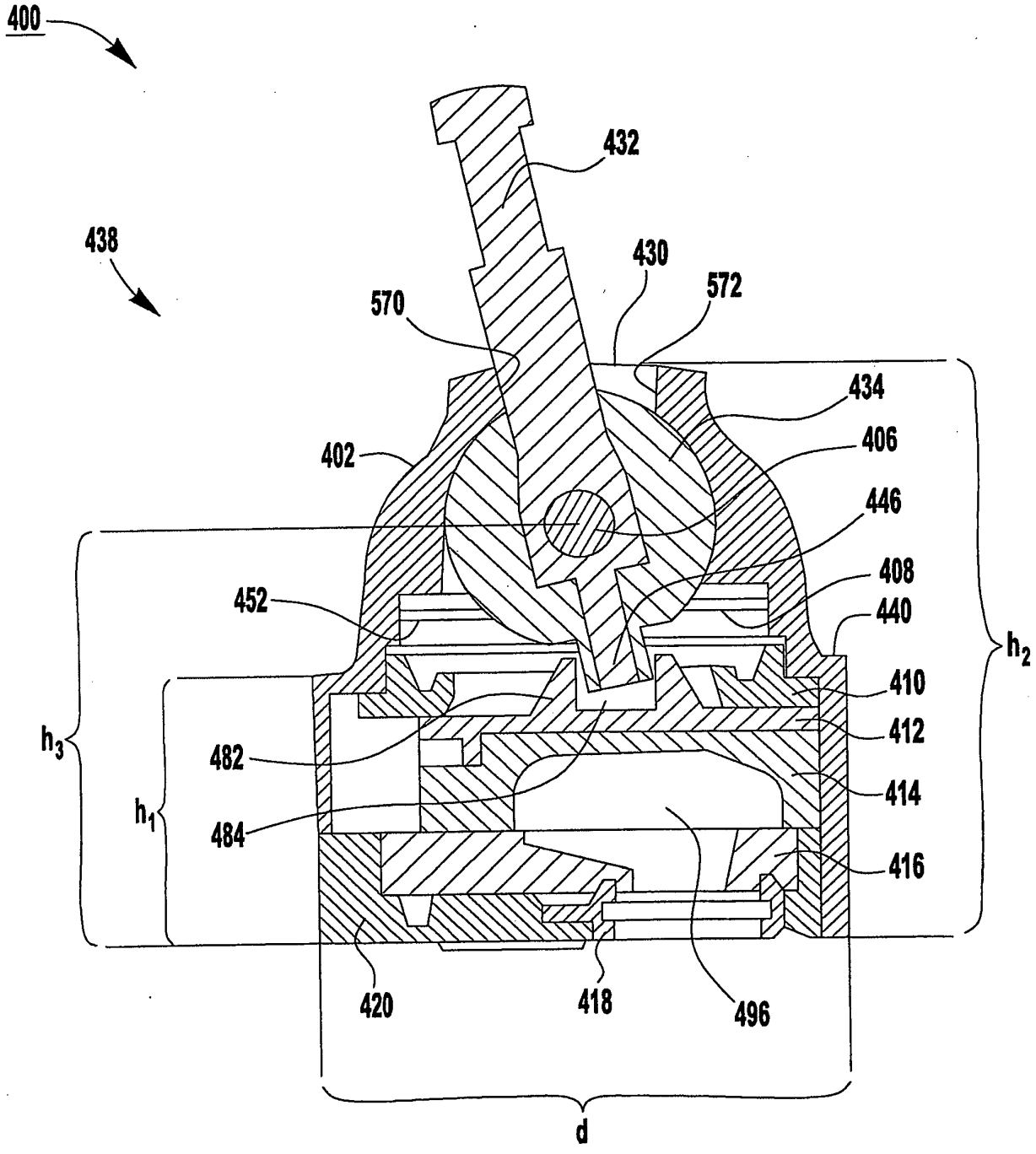


FIG. 22A



SECTION A-A

FIG. 22B



SECTION B-B

FIG. 22C

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2008/052670

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - F16K2 7/04 (2008.04)
USPC - 137/625.17
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - F16K2 7/04 (2008.04)
USPC - 137/625.17

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)
PatBase

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,209,581 B1 (GYÖZŐ) 03 April 2001 (03.04.2001) entire document	1-21

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

* 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
12 June 2008	25 JUN 2008
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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

[19] 中华人民共和国国家知识产权局

[51] Int. Cl.
F16K 27/04 (2006.01)

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[21] 申请号 200880003710.2
[30] 优先权
[32] 2007. 1.31 [33] US [31] 60/898,542
[86] 国际申请 PCT/US2008/052670 2008.1.31
[87] 国际公布 WO2008/095107 英 2008.8.7
[85] 进入国家阶段日期 2009.7.31
[71] 申请人 莫恩股份有限公司
地址 美国俄亥俄
[72] 发明人 M·S·凯西克 W·R·塔克
[74] 专利代理机构 中国国际贸易促进委员会专利商标事务所
代理人 张 涛

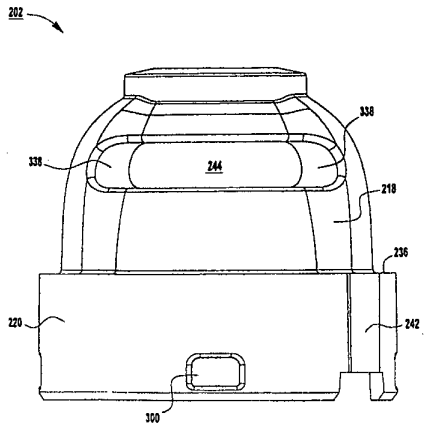
权利要求书 3 页 说明书 26 页 附图 59 页

[54] 发明名称

具有用于安装的低接触点的阀芯

[57] 摘要

一种单手柄阀芯，该阀芯具有用于在阀体中安装阀芯的低接触点。保持螺母压在该低接触点上，以将阀芯固定在阀体中。



1. 一种阀芯，其用于控制流体的流量，并通过保持构件可操作地固定在阀体中，所述阀芯包括：

外壳；

致动机构；以及

流体控制构件，

其中所述流体控制构件布置在所述外壳中，

其中所述致动机构的一部分延伸通过所述外壳中的上开口，

其中所述致动机构的运动使所述流体控制构件运动，以改变所述流体的所述流量，

其中所述外壳上用于接触所述保持构件的最高点形成安装凸耳，以及

其中所述安装凸耳基本位于所述外壳中的所述上开口的下方。

2. 根据权利要求 1 所述的阀芯，其中所述外壳上的所述安装凸耳的高度与所述外壳的最大外径的比值小于或等于 0.50。

3. 根据权利要求 2 所述的阀芯，其中所述安装凸耳的所述高度在 0.486 与 0.494 英寸之间。

4. 根据权利要求 1 所述的阀芯，其中所述外壳上的所述安装凸耳的高度与所述外壳的高度的比值小于或等于 0.39。

5. 根据权利要求 4 所述的阀芯，其中所述安装凸耳的所述高度在 0.486 与 0.494 英寸之间。

6. 根据权利要求 1 所述的阀芯，其中销将所述致动机构固定在所述外壳中，以便使所述致动机构可操作地绕所述销枢转，以及

其中所述外壳上的所述安装凸耳的高度与所述销的中心的高度的比值小于或等于 0.55。

7. 根据权利要求 8 所述的阀芯，其中所述安装凸耳的所述高度在 0.486 与 0.494 英寸之间。

8. 根据权利要求 1 所述的阀芯，其中所述外壳上的所述安装凸耳

的高度与所述外壳的最大外径的比值小于或等于 0.53。

9. 根据权利要求 8 所述的阀芯，其中所述安装凸耳的所述高度在 0.641 与 0.651 英寸之间。

10. 根据权利要求 1 所述的阀芯，其中所述外壳上的所述安装凸耳的高度与所述外壳的高度的比值小于或等于 0.49。

11. 根据权利要求 10 所述的阀芯，其中所述安装凸耳的所述高度在 0.641 与 0.651 英寸之间。

12. 根据权利要求 1 所述的阀芯，其中销将所述致动机构固定在所述外壳中，以便使所述致动机构可操作地绕所述销枢转，以及

其中所述外壳上的所述安装凸耳的高度与所述销的中心的高度的比值小于或等于 0.67。

13. 根据权利要求 12 所述的阀芯，其中所述安装凸耳的所述高度在 0.641 与 0.651 英寸之间。

14. 根据权利要求 1 所述的阀芯，其中所述安装凸耳位于所述致动机构的下方。

15. 根据权利要求 14 所述的阀芯，其中所述安装凸耳位于所述流体控制构件的上方。

16. 根据权利要求 1 所述的阀芯，其中所述安装凸耳绕所述外壳的外圆周延伸。

17. 一种阀芯，其用于控制冷水和热水的流量和混合比，并通过保持构件可操作地固定在阀体中，所述阀芯包括：

外壳；

致动机构；

可运动控制构件；以及

固定控制构件，

其中所述可运动控制构件和所述固定控制构件都布置在所述外壳中，

其中所述致动机构的一部分延伸通过所述外壳中的上开口，

其中所述致动机构绕第一轴线的运动可操作地使所述可运动控制

构件相对于所述固定控制构件运动，以改变所述冷水和所述热水中的至少一个的所述流量，

其中所述致动机构绕第二轴线的运动可操作地使所述可运动控制构件相对于所述固定控制构件运动，以改变所述冷水和所述热水的所述混合比，

其中所述外壳上用于接触所述保持构件的最高点形成安装凸耳，以及

其中所述安装凸耳基本位于所述外壳中的所述上开口的下方。

18. 根据权利要求 17 所述的阀芯，其中所述安装凸耳位于所述致动机构的下方。

19. 根据权利要求 18 所述的阀芯，其中所述安装凸耳位于所述固定控制构件的上方。

20. 根据权利要求 18 所述的阀芯，还包括在所述外壳内的混合室，用于混合冷水和热水，以及

其中所述安装凸耳位于所述混合室的上方。

21. 根据权利要求 17 所述的阀芯，其中所述安装凸耳绕所述外壳的外圆周延伸。

具有用于安装的低接触点的阀芯

相关申请

[0001]本申请作为非临时专利申请提交，其根据 35 U.S.C. § 119（e）要求享有 2007 年 1 月 31 日提交的美国临时专利申请 No.60/898,542 的优先权及任何其它权益，其整个内容通过参考包含于此。

技术领域

[0002]本发明总体上涉及阀芯，并且更具体地，本发明涉及具有用于在阀体中安装阀芯的低接触点的阀芯。

背景技术

[0003]典型地，对于卫生器具（例如，水龙头、浴盆喷口、淋浴头），阀体将从主水源流出的水运送到期望的目的地（例如，水槽、浴盆、脸盆）。阀体通常具有两个进水通路，来自主水源的冷水和热水可以分别流过所述两个进水通路。阀体也具有出水通路，冷水、热水或者冷水和热水的混合水可以通过所述出水通路排出到卫生器具的出口部分（例如，喷口）。在阀体的单手柄方案中，阀体具有用于接收阀芯的空腔，所述阀芯允许用户使用单个阀致动机构来控制通过进水通路流到出水通路的水的流量和温度。

[0004]一种类型的（传统的）阀芯是包括外壳的结构组件，在所述外壳中布置有两个或更多个盘、板等。盘通常由硬质材料（例如，陶瓷或金属）制成。这些盘中的至少一个盘（即，固定盘）相对于外壳固定。这些盘中的另一个盘（即，可运动盘）布置在固定盘的上方，并且相对于固定盘可以运动。阀芯包括致动机构，所述致动机构在一端处直接或间接地连接到可运动盘。致动机构的另一端延伸通过外壳

中的开口，以供用户操纵。致动机构延伸通过外壳中的开口的端部可以连接到手柄、旋钮等，以辅助用户操作阀芯。

[0005]在这种类型的阀芯的单手柄方案中，该阀芯用在单手柄方案的阀体中，固定盘包括两个进水口（即，冷水进水口和热水进水口），当阀芯安装在阀体中后，所述两个进水口基本与阀体的进水通路对准。此外，固定盘包括出水口，当阀芯安装在阀体中后，所述出水口基本与阀体的出水通路对准。致动机构经由联接器连接至可运动盘。可以枢转致动机构，以致使可运动盘平移运动。可以旋转致动机构，以致使可运动盘角运动。

[0006]这样，可运动盘可以相对于固定盘采取不同的位置。具体地，致动机构的枢转将水的流量从零改变到最大流量，而致动机构的旋转改变水的温度。因此，单手柄的致动机构既可以控制流过阀芯的水的流量又可以控制其温度。

[0007]阀芯还包括一个或多个密封件，用于防止水从阀芯中泄漏。密封件例如可以位于阀芯中的这些盘的下方、之间和/或上方。当阀芯安装在阀体中后，保持螺母用于将阀芯固定在阀体中。保持螺母接合阀芯的外壳的安装凸耳，以便使阀芯中的密封件被压缩，并因而向阀芯中的部件（包括盘）施加加载力。因此，固定盘和可运动盘在阀芯安装在阀体中之后保持水密接触。

[0008]通常，传统的阀芯具有安装凸耳，所述安装凸耳形成在阀芯的外壳上的较高的位置处，例如，靠近阀芯的上开口。当阀芯安装在阀体中后，较高的安装凸耳在保持螺母与阀芯之间形成接触点。

[0009]作为一个示例，传统阀芯 100 在图 1A 至 1C 中示出且也在美国专利 No.7,063,106 中说明。如图 1A 至 1B 中所示，传统阀芯 100 具有若干分离的部件，其包括外壳 102、下密封件 104、底部构件 106、上密封件 108、固定板 110、可移动板 112、承载件 114、可旋转支撑构件 116、操作杆 118 以及盖 120。外壳 102 具有管状形状，用于接收阀芯 100 的其余部件。

[0010]操作杆 118 是阀芯 100 的致动机构的一部分。操作杆 118

经由销 122 连接至可旋转支撑构件 116。可旋转支撑构件 116 的下表面搁置在承载件 114 的上表面上。可旋转支撑构件 116 可以相对于外壳 102 旋转。操作杆 118 的一部分在可旋转支撑构件 116 的下方延伸到外壳 102 中，这有助于将操作杆 118 连接到可移动板 112，这将在以下进行说明。操作杆 118 的一部分在可旋转支撑构件 116 的上方延伸出外壳 102，这有助于将操作杆 118 连接到诸如手柄、旋钮等的操作构件（未示出）。

[0011]外壳 102 具有内肩部 124，其形成在外壳 102 的下开口附近，其中内肩部 124 的形状设计成接收底部构件 106 的相对应形状的部分。盖 120 具有齿 126，所述齿 126 咬合配合到形成在外壳 102 的上开口附近的开口 128 中。因此，外壳 102 的下开口由底部构件 106 关闭，并且外壳 102 的上开口由盖 120 关闭，由此将这些部件固定在阀芯 200 中。

[0012]固定板 110 具有出水通路 132 和一对进水通路 130。固定板 110 布置在底部构件 106 的上方。可移动板 112 支撑在固定板 110 的顶部上，并且可以在固定板 110 的顶部上滑动。可移动板 112 包括混合室 134，所述混合室 134 用于混合通过固定板 110 中的相应的进水通路 130 流入阀芯 100 的冷水和热水。然后，混合的水通过固定板 110 中的出水通路 132 流出阀芯 100。

[0013]承载件 114 和可旋转支撑构件 116 的功能为将操作杆 118 的运动转化为可移动板 112 的运动。承载件 114 的下部分接合可移动板 112 的上部分。承载件 114 的上部分具有凹部 136，用于接收操作杆 118 的下端 138，由此将操作杆 118（所述操作杆 118 经由销 122 连接至可旋转支撑构件 116）连接到承载件 114 和可移动板 112。

[0014]下密封件 104 配合在底部构件 106 的下表面上的凹部中，并且上密封件 108 配合在底部构件 106 的上表面上的凹部中。下密封件 104 在其中安装有阀芯 100 的阀体 140 与底部构件 106 之间形成水密密封件（参见图 1C）。上密封件 108 在底部构件 106 与固定板 110 之间形成水密密封件（参见图 1B）。下密封件 104 和上密封件 108 防

止水从阀芯 100 泄漏。

[0015]如图 1C 中所示，当阀芯 100 安装在卫生器具 142（例如，水龙头）的阀体 140 中时，保持螺母 144 用于将阀芯 100 固定在阀体 140 中。保持螺母 144 接合形成在阀芯 100 的外壳 102 的盖 120 上的安装凸耳 146，以便使阀芯 100 中的密封件 104 和 108 被压缩，并继而向阀芯 100 中的部件（包括固定板 110 和可移动板 112）施加加载力。因此，固定板 110 和可移动板 112 在阀芯 100 安装在阀体 140 中之后保持水密接触。

[0016]可移动板 112 相对于固定板 110 的位置和方向通过从外壳 202 突出的操作杆 118 控制。具体地，操作杆 118 可以在可旋转支撑构件 116 内部绕销 122 枢转，并且可以通过操作杆 118 的旋转致使可旋转支撑构件 116 旋转。操作构件（未示出）可以连接到操作杆 118，以帮助用户操纵操作杆 118。因此，在阀芯 100 安装在阀体 140 中之后，用户可以操纵操作构件，操作构件移动操作杆 118，以改变可移动板 112 相对于固定板 110 的位置和/或方向，由此控制通过阀芯 100 流出卫生器具 142 的水的流量和/或温度，例如通过喷口 148 流出卫生器具（参见图 1C）。

[0017]安装凸耳 146 形成在盖 120 上，从而布置在阀芯 100 上的较高的位置处。如上所述，保持螺母 144 接合安装凸耳 146，以在阀体 140 中固定阀芯 100。这样，密封件 104 和 108 被压缩，并且由于密封件 104 和 108 的压缩所产生的加载力向上传送到阀芯 100 中的部件。

[0018]然而，较高的安装凸耳 146 具有若干缺点。例如，较高的安装凸耳 146 导致在用于接收阀芯 200 的卫生器具的设计方面有较少的自由。另外，较高的安装凸耳 146 会导致增加的成本，这是因为阀体 140 的侧壁 150 的高度通常至少和安装凸耳 140 的高度一样高。

[0019]因此，本技术领域中需要一种阀芯，该阀芯具有用于在阀体中安装阀芯的低接触点。

发明内容

[0020]鉴于上述内容，本发明的一个典型方面是提供一种阀芯，其具有外壳，所述外壳具有形成在该外壳上的、用于在阀体中安装阀芯的低接触点。

[0021]本发明的另一个典型方面是提供一种阀芯，其具有外壳，在外壳上形成有至少一个安装凸耳，其中外壳的最高安装凸耳的高度与外壳的最大外径的比值小于或等于 0.53。

[0022]本发明的又一个典型方面是提供一种阀芯，其具有外壳，在外壳上形成有至少一个安装凸耳，其中外壳的最高安装凸耳的高度与外壳的最大外径的比值小于或等于 0.50。

[0023]本发明的再一个典型方面是提供一种阀芯，其具有外壳，在外壳上形成有至少一个安装凸耳，其中外壳的最高安装凸耳的高度与外壳的最大外径的比值小于或等于 0.41。

[0024]本发明的另一个典型方面是提供一种阀芯，其具有外壳，在外壳上形成有至少一个安装凸耳，其中外壳的最高安装凸耳的高度与外壳的高度的比值小于或等于 0.49。

[0025]本发明的又一个典型方面是提供一种阀芯，其具有外壳，在外壳上形成有至少一个安装凸耳，其中外壳的最高安装凸耳的高度与外壳的高度的比值小于或等于 0.39。

[0026]本发明的再一个典型方面是提供一种阀芯，其具有外壳，在外壳上形成有至少一个安装凸耳，其中外壳的最高安装凸耳的高度与阀芯的销的高度的比值小于或等于 0.67。

[0027]本发明的另一个典型方面是提供一种阀芯，其具有外壳，在外壳上形成有至少一个安装凸耳，其中外壳的最高安装凸耳的高度与阀芯的销的高度的比值小于或等于 0.55。

[0028]本发明的又一个典型方面是提供一种阀芯，其具有外壳，在外壳上形成有至少一个安装凸耳，其中外壳的最高安装凸耳位于阀芯的致动机构的下方。

[0029]本发明的再一个典型方面是提供一种阀芯，其具有外壳，

在外壳上形成有至少一个安装凸耳，其中外壳的最高安装凸耳位于阀芯的致动机构的下方且位于阀芯的混合室的上方。

[0030]本发明的又一个典型方面是提供一种阀芯，其具有外壳，在外壳上形成有至少一个安装凸耳，其中外壳的最高安装凸耳位于阀芯的致动机构的下方且位于阀芯的固定盘的上方。外壳的最高安装凸耳可以延伸超出固定盘的一部分。

[0031]本发明的又一个典型方面是提供一种阀芯，其具有外壳，在外壳上形成有至少一个安装凸耳，其中外壳的最高安装凸耳的高度是在 0.641 与 0.651 英寸之间。

[0032]本发明的再一个典型方面是提供一种阀芯，其具有外壳，在外壳上形成有至少一个安装凸耳，其中外壳的最高安装凸耳的高度是在 0.486 与 0.494 英寸之间。

附图说明

[0033]上述方面和另外的方面、特征以及优点将通过参照附图详细地说明本发明的示例性实施例而变得容易清楚，其中相同的附图标记表示相同的元件，其中：

[0034]图 1A 至 1C 示出了传统阀芯，其中在阀芯与保持螺母之间的接触点较高，所述保持螺母用于在阀体中固定阀芯，图 1A 示出了未组装形式的阀芯的剖视图，图 1B 示出了组装形式的图 1A 的阀芯的剖视图，图 1C 示出了图 1B 的阀芯安装在卫生器具中之后的剖视图；

[0035]图 2 是根据示例性实施例的阀芯的分解透视图；

[0036]图 3A 至 3E 示出了用在图 2 的示例性阀芯中的示例性外壳，图 3A 是外壳的透视图，图 3B 是外壳的侧视图，图 3C 是沿着图 10A 中的线 A-A 得到的外壳的剖视图，图 3D 是沿着图 10A 中的线 B-B 得到的外壳的剖视图，图 3E 是沿着图 3C 中的线 C-C 得到的外壳的剖视图。

[0037]图 4 是图 2 的示例性阀芯的示例性球茎的透视图；

[0038]图 5A 至 5C 示出了用在图 2 的示例性阀芯中的示例性弹簧，

图 5A 是弹簧的透视图，图 5B 是弹簧的平面图，图 5C 是弹簧的侧视图；

[0039]图 6A 至 6D 示出了用在图 2 的示例性阀芯中的示例性衬套，图 6A 是衬套的透视图，图 6B 是衬套的侧视图，图 6C 是衬套的仰视图，图 6D 是沿着图 6C 的线 A-A 得到的衬套的剖视图；

[0040]图 7A 至 7D 示出了用在图 2 的示例性阀芯中的示例性流板，图 7A 是流板的透视图，图 7B 是流板的平面图，图 7C 是沿着图 7B 的线 A-A 得到的流板的剖视图，图 7D 是沿着图 7B 的线 B-B 得到的流板的剖视图；

[0041]图 8 是图 2 的示例性阀芯的示例性歧管的透视图；

[0042]图 9A 至 9B 示出了用在图 2 的示例性阀芯中的示例性基部密封件，图 9A 是基部密封件的顶部透视图，图 9B 是基部密封件的底部透视图；

[0043]图 10A 至 10C 示出了组装形式的图 2 的示例性阀芯，图 10A 是组装形式的阀芯的平面图，图 10B 是沿着图 10A 的线 A-A 得到的阀芯的剖视图，图 10C 是沿着图 10A 的线 B-B 得到的阀芯的剖视图；

[0044]图 11 是安装在卫生器具中之后的图 2 的示例性阀芯（沿着图 10A 的线 B-B 得到的）剖视图的镜像；

[0045]图 12 是根据另一个示例性实施例的阀芯的分解透视图；

[0046]图 13A 至 13C 示出了用在图 12 的示例性阀芯中的示例性上外壳，图 13A 是上外壳的透视图，图 13B 是上外壳的侧视图，图 13C 是沿着图 13B 的线 A-A 得到的上外壳的剖视图；

[0047]图 14 示出了图 12 的示例性阀芯的示例性球茎的透视图；

[0048]图 15A 至 15C 示出了用在图 12 的示例性阀芯中的示例性弹簧，图 15A 是弹簧的透视图，图 15B 是弹簧的平面图，图 15C 是沿着图 15B 的线 A-A 得到的弹簧的剖视图；

[0049]图 16A 至 16C 示出了用在图 12 的示例性阀芯中的示例性衬套，图 16A 是衬套的侧视图，图 16B 是沿着图 16A 的线 A-A 得到的衬套的剖视图，图 16C 是衬套的平面图；

[0050]图 17A 至 17D 示出了用在图 12 的示例性阀芯中的示例性承载件，图 17A 是承载件的透视图，图 17B 是承载件的平面图，图 17C 是承载件的仰视图，图 17D 是承载件的侧视图；

[0051]图 18A 至 18C 示出了用在图 12 的示例性阀芯中的示例性可运动盘，图 18A 是可运动盘的平面图，图 18B 是沿着图 18A 的线 A-A 得到的可运动盘的剖视图，图 18C 是可运动盘的仰视图；

[0052]图 19A 至 19D 示出了用在图 12 的示例性阀芯中的示例性固定盘，图 19A 是固定盘的顶部透视图，图 19B 是固定盘的底部透视图，图 19C 是固定盘的平面图，图 19D 是固定盘的仰视图；

[0053]图 20A 至 20B 示出了用在图 12 的示例性阀芯中的示例性基部密封件，图 20A 是基部密封件的顶部透视图，图 20B 是基部密封件的平面图；

[0054]图 21A 至 21D 示出了用在图 12 的示例性阀芯中的示例性下外壳，图 21A 是下外壳的顶部透视图，图 21B 是下外壳的底部透视图，图 21C 是下外壳的平面图，图 21D 是下外壳的仰视图；

[0055]图 22A 至 22C 示出了组装形式的图 12 的示例性阀芯，图 22A 是组装形式的阀芯的平面图，图 22B 是沿着图 22A 的线 A-A 得到的阀芯的剖视图，图 22C 是沿着图 22A 的线 B-B 得到的阀芯的剖视图。

具体实施方式

[0056]虽然本发明的一般概念容许多种不同形式的实施例，但是在附图中示出并将在此详细说明其特定实施例，应当理解，本公开将被认为是本发明的一般概念的原理的举例说明。因此，本发明的一般概念不受在此说明的特定实施例限制。

[0057]根据示例性实施例的单手柄阀芯 200 具有用于在阀体 240 中固定阀芯 200 的低接触点。因此，阀芯 200 可以克服具有高接触点的传统阀盒的缺点。

[0058]如图 2 和 10A 至 10C 中所示，示例性阀芯 200 具有若干分

离的部件，其包括外壳 202、球茎 204、销 206、弹簧 208、衬套 210、流板 212、歧管 214 以及基部密封件 216。流板 212 和/或歧管 214 可以由硬质材料制成。例如，流板 212 和/或歧管 214 可以由不锈钢制成。外壳 202 例如可以由塑料或金属制成。

[0059]如图 3A 至 3E 中所示，外壳 202 具有穹顶部分 218 和圆柱部分 220。在外壳 202 中形成有空腔 222，用于接收阀芯 200 的其余部件。空腔 222 在外壳 202 的穹顶部分 218 和圆柱部分 220 内部延伸。外壳 202 的圆柱部分 220 包括下开口 224，部件可以通过所述下开口 224 插入到外壳 202 中。外壳 202 的穹顶部分 218 包括上开口 226，球茎 204 的茎部分 228 延伸通过所述上开口 226。外壳 202 中的空腔 222 靠近下开口 224 的部分宽于靠近上开口 226 的部分。空腔 222 靠近外壳 202 的上开口 226 的部分接收球茎 204 的球部分 230。因此，空腔 222 靠近上开口 226 的该部分的第一内表面 232 的形状基本与球茎 204 的球部分 230 的形状一致（参见图 10B 至 10C 和 11）。

[0060]空腔 222 靠近外壳 202 的下开口 224 的部分接收衬套 210、流板 212、歧管 214 以及基部密封件 216。空腔 222 靠近下开口 224 的直径基本与基部密封件 216、歧管 214 和衬套 210 的平环形部分 234 的直径相同，以便当这些部件被接收在外壳 202 中时，在这些部件与外壳 202 之间仅存有较小的空隙。

[0061] 外壳 202 的穹顶部分 218 与圆柱部分 220 相接的部分在外壳 202 的外表面上形成安装凸耳 236。安装凸耳 236 基本在位于壳 202 的上开口 226 的下方。保持螺母 238 接合安装凸耳 236，以在阀体 240 中固定阀芯 200（参见图 11）。此外，外壳 202 具有一个或多个键 242，各键都与阀体 240 中的互补形状的凹部（未示出）接合，以防止在阀芯 200 安装之后外壳 202 相对于阀体 240 旋转。一个或多个键 242 可以具有小叶片的形状。外壳 202 还包括在外壳 202 的相对的侧面上形成的一对狭槽 244，所述一对狭槽 244 与销 206 的远端相接（interface），以起温度限制器的作用，这将在下面进行说明。

[0062]如图 4 中所示，球茎 204 是用于阀芯 200 的致动机构。球

茎 204 包括球部分 230 和茎部分 228。球部分 230 和茎部分 228 可以是分离的部件或者可以一体地形成。球部分 230 包括从球部分 230 的一侧延伸的突起 246，所述茎部分 228 从球部分 230 的相反的另一侧延伸。突起 246 用作联接装置，用于将球茎 204 连接到流板 212，这将在以下进行说明。球部分 230 和突起 246 可以是分离的部件或者可以一体地形成。

[0063]经过球茎 204 的球部分 230 的中心形成有孔 248。孔 248 与球茎 204 的茎部分 228 正交。在球茎 204 插入到外壳 202 的空腔 222 中之后，销 206 可以通过外壳 202 中的一个狭槽 244 插入到球茎 204 的孔 248 中。这样，销 206 保持球茎 204 处在外壳 202 中。

[0064]如图 5A 至 5C 中所示，弹簧 208 呈具有中央开口 250 的环形形状。弹簧 208 在外壳 202 中并布置在球茎 204 的球部分 230 的下方（参见图 10B 至 10C）。弹簧 208（例如，通过螺纹连接、摩擦配合、咬合配合、焊接）连接到外壳 202 的第二内表面 252，以便使弹簧 208 也保持球茎 204 处在外壳 202 中。弹簧 208 具有多个凹槽 254，所述多个凹槽 254 形成在弹簧 208 的外周边 256 上。这些凹槽 254 与形成在外壳 202 的第二内表面 252 上的相对应的突出部 258（参见图 3C）接合，由此在外壳 202 内将弹簧 208 固定在球茎 204 的下方。

[0065]球茎 204 的突起 246 延伸通过弹簧 208 中的中央开口 250。球茎 204 的球部分 230 中的某一部分还可以延伸通过弹簧 208 中的中央开口 250。弹簧包括围绕中央开口 250 的多个弹性凸缘 260。弹簧 208 的弹性凸缘 260 接触球茎 204 的球部分 230，并且推压球茎 204 的球部分 230 抵靠外壳 202 的互补形状的第一内表面 232。

[0066]如图 6A 至 6D 中所示，衬套 210 包括平环形部分 234 和凸环形部分 262。平环形部分 234 的直径大于凸环形部分 262 的直径。衬套 210 布置在外壳 202 的空腔 222 中的弹簧 208 的下方并与其间隔开（参见图 10B 至 10C）。衬套 210 的平环形部分 234 的上表面 264 接触外壳 202 的第三内表面 266，所述第三内表面 266 位于安装凸耳 236 的下方（参见图 3C 至 3D 和 10B 至 10C）。衬套 210 的平环形部

分234的下表面268搁置在流板212的平坦部分272的上表面270上。另外，衬套210的凸环形部分262延伸到外壳202的空腔222直接在安装凸耳236的上方的部分中。衬套210的凸环形部分262尺寸设计成紧密地配合在外壳202的空腔222接收衬套210的凸环形部分262的部分中。因此，衬套210在外壳202与流板212之间提供支撑表面。

[0067]衬套210具有开口274，所述开口274延伸通过衬套210的平环形部分234和凸环形部分262。流板212的凸部分276延伸到衬套210的开口274中。流板212的凸部分276形成混合室278。衬套210的开口274的一部分的内表面的形状与流板212的凸部分276的形状一致（参见图6C至6D）。另外，在流板212的凸部分276上形成有联接凹部280（参见图7A至7D）。在流板212安装在阀芯200中之后，联接凹部280定位在衬套210的开口274内并且被衬套210的凸环形部分262围绕（参见图10B至10C）。

[0068]流板212的联接凹部280接收球茎204的突起246，由此连接致动机构（即，球茎204）和流板212。球茎204的突起246可以具有四个侧面，该四个侧面分别与联接凹部280的相对应的侧面接触。球茎204的突起246并没有接触联接凹部280的底表面。应当理解，尽管在此说明了示例性实施例，但是球茎204可以通过允许球茎204使流板212平移运动和角运动的任何适当的方式连接到流板212。

[0069]如图7A至7D中所示，流板212是能够相对于外壳202运动的形成为板、盘等的阀构件。流板212包括平坦部分272和凸部分276。流板212的平坦部分272形成密封表面，所述密封表面可以覆盖和打开歧管214中的进水孔口282和284，以便允许仅冷水、仅热水、或者冷水和热水两种水流过歧管214。通过进水孔口282和284流入到歧管214中的水进入混合室278（即，形成在流板212的凸部分276的下方的空腔），在所述混合室278处，冷水和热水在通过歧管214中的出水孔口286排放之前进行混合。此外，如上所述，流板212也包括联接凹部280，所述联接凹部280形成在流板212的凸部分276上。

[0070]如图 8 中所示，歧管 214 是相对于外壳 202 固定的形成为板、盘等的阀构件。歧管 214 包括一个或多个突起 288，所述一个或多个突起 288 形成在歧管 214 的周边 290 上，其中各突起 288 都配合在外壳 202 的多个键 242 中的一个的内部空腔 292 中（参见图 3A 和 3E）。突起 288 相对于外壳 202 固定歧管 214，从而防止歧管 214 在外壳 202 内旋转。

[0071]歧管 214 包括进水孔口 282 和 284，所述进水孔口 282 和 284 分别与冷水进水孔口和热水进水孔口相对应。歧管 214 还包括出水孔口 286，流过冷水进水孔口 282 的冷水、流过热水进水孔口 284 的热水、或者冷水和热水的混合水都可以通过所述出水孔口 286 流到阀体 240 的出水通路（未示出）。

[0072]如图 9A 至 9B 中所示，基部密封件 216 是由弹性材料（例如，橡胶）形成的密封构件。基部密封件 216 包括一个或多个突起 294，所述一个或多个突起 294 形成在基部密封件 216 的周边 296 上，其中各突起 294 都配合在外壳 202 的多个键 242 中的一个的内部空腔 292 中。突起 294 相对于外壳 202 固定基部密封件 216，从而防止基部密封件 216 在外壳 202 内旋转。基部密封件 216 还包括一个或多个突出部 298，所述一个或多个突出部 298 形成在基部密封件 216 的周边 296 上，其中一个或多个突出部 298 可变形地配合在相对应的一个或多个开口 300 中并延伸通过所述相对应的一个或多个开口 300，以便将基部密封件 216 固定在外壳 202 中，其中所述一个或多个开口 300 形成在外壳 202 中。一个或多个突出部 298 可以具有不同的尺寸。

[0073]如同歧管 214 一样，基部密封件 216 具有冷水进水孔口 302、热水进水孔口 304 和出水孔口 306。基部密封件 216 的冷水进水孔口 302 和热水进水孔口 304 各自都具有壁 308，所述壁 308 从基部密封件 216 的下表面 310 附近向基部密封件 216 的上表面 312 附近倾斜，以便提高通过基部密封件 216 并流入阀芯 200 中的水的流动。基部密封件 216 的出水孔口 306 具有壁 314，所述壁 314 从基部密封件 216 的上表面 312 附近向基部密封件 216 的下表面 310 附近倾斜，以便提高

通过基部密封件216并流出阀芯200的水的流动。重要的是，当阀芯200组装后，歧管214中的孔口282、284和286与基部密封件216中的孔口302、304和306对准。因此，歧管214上的突起288和基部密封件216上的突起294确保歧管214和基部密封件216仅沿一个方向配合到外壳202中，其中歧管214中的孔口282、284和286与基部密封件216中的孔口302、304和306沿该方向对准。

[0074]在基部密封件216的上表面312上围绕基部密封件216中的孔口302、304和306的是脊部316（参见图9A）。类似地，在基部密封件216的下表面310上围绕基部密封件216中的孔口302、304和306的是脊部318（参见图9B）。当阀芯200安装在阀体240中后，基部密封件216的脊部316和318被压缩（参见图10B至10C和11，这些附图为了例示的目的示出了与压缩结构交搭的脊部316和318）。具体地，当保持螺母238被向下拧紧在外壳202的安装凸耳236上时，脊部316在阀芯200的歧管214与基部密封件216之间被压缩，而脊部318在基部密封件216与阀体240的落座表面320之间压缩（参见图11）。应当注意到，虽然歧管214的突起288防止歧管214在外壳202内旋转，但是突起288允许歧管214在外壳202内轴向地运动。这样，基部密封件216的脊部316和318的压缩在流板212和歧管214上施加加载力。因此，在阀芯200安装之后，流板212和歧管214保持相互水密接合。

[0075]保持螺母238是空心螺母，其接合阀体240的侧壁322以将阀芯200固定在阀体240中（参见图11）。例如，保持螺母238可以具有外螺纹，用于接合侧壁322上的互补螺纹。保持螺母238的内表面的形状设计成基本与外壳202的穹顶部分218的形状一致。然而，安装凸耳236是在阀体240中安装阀芯200期间外壳202与保持螺母238接触的唯一部分。

[0076]另外，保持螺母238和/或阀体240可以具有防止过量的转矩传递到阀芯200的结构特征。例如，保持螺母238包括环形凸缘326，所述环形凸缘326在阀体240的表面328上是降至最低点，以防止保

持螺母238过度拧紧（参见图11）。因此，环形凸缘326的功能为限制从保持螺母238传递到阀芯200的最大转矩量。

[0077]流板212相对于歧管214的位置和方向由球茎204的茎部分228控制，所述茎部分228通过上开口226从外壳202突出。例如，绕销206枢转球茎204的茎部分228可以改变流板212相对于歧管214的位置，这改变水的流量。旋转球茎204的茎部分228可以改变流板212相对于歧管214的方向，这改变水的温度。

[0078]诸如手柄、旋钮等的操作构件330（参见图11）可以连接到球茎204的茎部分228，以便帮助用户操纵茎部分228。因此，在阀芯200安装在阀体240中以后，用户可以操纵操作构件330，所述操作构件330致动球茎204的茎部分228，以改变流板212相对于歧管214的位置和/或方向，由此控制通过阀芯200并流出卫生器具332的水的流量和温度，例如通过卫生器具332的喷口（未示出）流出卫生器具332（参见图11）。

[0079]通过茎部分228接触外壳202的上开口226的相对的表面可以限制球茎204的茎部分228绕销206的枢转。因而，当阀芯200处在与零流量相对应的完全关闭位置时，球茎204的茎部分228接触外壳202的上开口226的第一表面334（参见图10C）。当阀芯200处在与最大流量相对应的完全打开位置时，球茎204的茎部分228接触外壳202的上开口226的第二表面336。

[0080]通过销206的远端接触狭槽244的端部分338可以限制球茎204的茎部分228的旋转（参见图2、3A至3B和10A）。因此，狭槽244的长度限定阀芯200可以传送的水的温度的范围，所述狭槽244用作温度限制器。

[0081]阀芯200具有低接触点（即，在外壳202上形成的安装凸耳236），保持螺母238压在所述低接触点上。安装凸耳236是绕外壳202延伸的圆形凸耳，在该圆形凸耳处，外壳202的穹顶部分218与外壳202的圆柱部分220相接。安装凸耳236是外壳202上的与保持螺母238接触的最高点。

[0082]在示例性阀芯 200 的示例性实施例中，一个或多个安装凸耳（例如，安装凸耳 236）形成在阀芯 200 的外壳 202 上。安装凸耳的最高处是在用于在阀体 240 中安装阀芯 200 的外壳 202 上的低接触点。

[0083]外壳 202 上的最高安装凸耳的高度 h_1 与外壳 202 的最大外径 d 的比值 R_1 小于或等于 0.50（参见图 10B），其可以表示为 $h_1/d \leqslant 0.50$。在示例性阀芯 200 的另一个示例性实施例中，高度 h_1 与最大外径 d 的比值 R_1 小于或等于 0.41（参见图 10B）。在示例性阀芯 200 的又一个示例性实施例中，高度 h_1 与最大外径 d 的比值 R_1 大约等于 0.40。

[0084]根据示例性阀芯 200 的又一个示例性实施例，高度 h_1 与外壳 202 的高度 h_2 的比值 R_2 小于或等于 0.39（参见图 10B），其可以表示为 $h_1/h_2 \leqslant 0.39$。在另一个示例性实施例中，高度 h_1 比高度 h_2 的比值 R_2 大约等于 0.38。在又一个示例性实施例中，高度 h_1 比高度 h_2 的比值 R_2 大约等于 0.36。

[0085]根据示例性阀芯 200 的再一个示例性实施例，高度 h_1 与销 206 的高度 h_3（例如，从外壳 202 的底部到销 206 的中心线）的比值 R_3 小于或等于 0.55（参见图 10B），其可以表示为 $h_1/h_3 \leqslant 0.55$。在另一个示例性实施例中，高度 h_1 比高度 h_3 的比值 R_3 大约等于 0.54。在又一个示例性实施例中，高度 h_1 比高度 h_3 的比值 R_3 大约等于 0.50。

[0086]根据示例性阀芯 200 的另一个示例性实施例，外壳 202 上的最高安装凸耳是在阀芯 200 的致动机构（例如，球茎 204）的下方（参见图 10B）。在示例性阀芯 200 的又一个示例性实施例中，外壳 202 上的最高安装凸耳是在阀芯 200 的致动机构的下方且在混合室（例如，混合室 278）的上方。在示例性阀芯 200 的再一个示例性实施例中，外壳 202 上的最高安装凸耳是在阀芯 200 的致动机构的下方且在固定盘（例如，歧管 214）的上方。

[0087]根据示例性阀芯 200 的示例性实施例，外壳 202 上的最高安装凸耳的高度 h_1 是在 0.486 与 0.494 英寸之间。在一个示例性实施例中，外壳 202 上的最高安装凸耳的高度 h_1 大约等于 0.490 英寸。

[0088]根据示例性阀芯 200 的另一个示例性实施例，外壳 202 的高度 h_2 是在 1.377 和 1.385 英寸之间。在另一个示例性实施例，外壳 202 的高度 h_2 是在 1.277 和 1.285 英寸之间。在另一个示例性实施例中，外壳 202 的高度 h_2 大约等于 1.381 英寸。在另一个示例性实施例中，外壳 202 的高度 h_2 大约等于 1.281 英寸。

[0089]根据示例性阀芯 200 的又一个示例性实施例，销 206 的高度 h_3 是在 0.977 和 0.994 英寸之间。在另一个示例性实施例，销 206 的高度 h_3 是在 0.902 和 0.919 英寸之间。在一个示例性实施例中，销 206 的高度 h_3 大约等于 0.986 英寸。在另一个示例性实施例中，销 206 的高度 h_3 大约等于 0.911 英寸。

[0090]根据示例性阀芯 200 的又一个示例性实施例，外壳 202 的外径 d 是在 1.216 和 1.224 英寸之间。在一个示例性实施例中，外壳 202 的外径 d 大约等于 1.220 英寸。

[0091]如通过在此所述的示例性实施例的说明，安装凸耳 236（作为外壳 202 上的最高安装凸耳）是外壳 202 上的低接触点，在阀体 240 中安装阀芯 200 期间，保持螺母 238 可以压在该低接触点上。因此，阀芯 200 具有紧凑结构，该紧凑结构为容纳阀芯 200 的卫生器具（例如图 11 中所示的卫生器具 332）的设计提供增加的灵活性。此外，由于阀体 240 的侧壁 322 可以制造成更短（参见图 11），所以下安装凸耳 236 允许使用较少的材料来形成阀体 240。结果，下安装凸耳 236 可以节约成本。

[0092]根据另一个示例性实施例的单手柄阀芯 400 具有用于在阀体（例如，图 11 中所示的示例性阀体 240）中固定阀芯 400 的低接触点。因此，阀芯 400 可以克服具有高接触点的传统阀芯的缺点。

[0093]如图 12 和 22B 至 22C 中所示，示例性阀芯 400 具有若干分离的部件，其包括上外壳 402、球茎 404、销 406、弹簧 408、衬套 410、承载件 412、可运动盘 414、固定盘 416、基部密封件 418 以及下外壳 420。可运动盘 414 和/或固定盘 416 可以由硬质材料制成。例如，可运动盘 414 和/或固定盘 416 可以由陶瓷制成。上外壳 402 例如可以由

塑料或金属制成。

[0094]如图 13A 至 13C 中所示，上外壳 402 具有穹顶部分 422 和圆柱部分 424。在上外壳 402 中形成有空腔 426，用于接收阀芯 400 的其余部件。空腔 426 在上外壳 402 的穹顶部分 422 和圆柱部分 424 内部延伸。上外壳 402 的圆柱部分 424 包括下开口 428，部件通过所述下开口 428 可以插入到上外壳 402 中。上外壳 402 的穹顶部分 422 包括上开口 430，球茎 404 的茎部分 432 延伸通过所述上开口 430。上外壳 402 中的空腔 426 靠近下开口 428 的部分宽于靠近上开口 430 的部分。空腔 426 靠近上外壳 402 的上开口 430 的部分接收球茎 404 的球部分 434。因此，空腔 426 靠近上开口 430 的部分的第一内表面 436 的形状基本与球茎 404 的球部分 434 的形状一致(参见图 13C 和 22B)。

[0095]空腔 426 靠近上外壳 402 的下开口 428 的部分接收衬套 410、承载件 412、可运动盘 414、固定盘 416 以及基部密封件 418（参见图 22B 至 22C）。此外，如将在以下进行说明的那样，下外壳 420 与上外壳 402 相连以形成外壳组件 438，所述外壳组件 438 将这些部件保持在上外壳 402 的空腔 426 中（参见图 22B 至 22C）。

[0096] 上外壳 402 的穹顶部分 422 与圆柱部分 424 相接的部分在上外壳 402 的外表面上形成安装凸耳 440(参见图 13A 至 13C 以及 22A 至 22C）。安装凸耳 440 基本在上外壳 402 的上开口 430 的下方。在一个示例性实施例中，保持螺母（例如，图 11 中所示的保持螺母 234）接合安装凸耳 440，以在阀体（例如，图 11 中所示的阀体 240）中固定阀芯 400。此外，上外壳 402 具有一个或多个键 442，各键都与阀体中的互补形状的凹部接合，以防止在阀芯 400 安装之后上外壳 402 相对于阀体旋转。一个或多个键 442 可以具有小叶片的形状。上外壳 402 还包括在上外壳 402 的相对的侧面上形成的一对狭槽 444，所述一对狭槽 444 与销 406 的远端相连，以起温度限制器的作用，这将在以下进行说明。

[0097]如图 14 中所示，球茎 404 是用于阀芯 400 的致动机构。球茎 404 包括球部分 434 和茎部分 432。球部分 434 和茎部分 432 可以

是分离的部件或者可以一体地形成。球部分 434 包括从球部分 434 的一侧延伸的突起 446，所述茎部分 432 从球部分 434 的相反的另一侧延伸。突起 446 用作联接装置，用于将球茎 404 连接到承载件 412，这将在以下进行说明。球部分 434 和突起 446 可以是分离的部件或者可以一体地形成。

[0098]经过球茎 404 的球部分 434 的中心形成有孔 448。孔 448 与球茎 404 的茎部分 432 正交。在球茎 404 插入到上外壳 402 的空腔 426 中之后，销 406 可以通过上外壳 402 中的狭槽 444 中的一个插入到球茎 404 的孔 448 中。这样，销 406 保持球茎 404 处在上外壳 402 中。

[0099]如图 15A 至 15C 中所示，弹簧 408 呈具有中央开口 450 的环形形状。弹簧 408 在上外壳 402 中布置在球茎 404 的球部分 434 的下方（参见图 22B 至 22C）。弹簧 408（例如，通过螺纹连接、摩擦配合、咬合配合、焊接）连接到上外壳 402 的第二内表面 452，以便使弹簧 408 也保持球茎 404 处在上外壳 402 中（参见图 13C 和 22C）。在一个示例性实施例中，弹簧 408 的外周边 454 的至少一部分焊接到上外壳 402 的第二内表面 452 上。

[00100]球茎 404 的突起 446 延伸通过弹簧 408 中的中央开口 450。球茎 404 的球部分 434 中的某一部分还可以延伸通过弹簧 408 中的中央开口 450。弹簧 408 包括围绕中央开口 450 的多个弹性凸缘 456。弹性凸缘 456 相互间隔开，以便在弹性凸缘 456 之间产生空隙 458。弹簧 408 的弹性凸缘 456 接触球茎 404 的球部分 434，并且推压球茎 404 的球部分 434 抵靠上外壳 402 的互补形状的第一内表面 436。空隙 458 例如功能为减少由接合球茎 404 而施加在弹簧 408 上的应力。

[00101]如图 16A 至 16C 中所示，衬套 410 包括平环形部分 460 和凸环形部分 462。平环形部分 460 的直径大于凸环形部分 462 的直径。衬套 410 布置在上外壳 402 的空腔 426 中的弹簧 408 的下方并与其间隔开（参见图 22B 至 22C）。衬套 410 的平环形部分 460 的上表面 464 接触上外壳 402 的第三内表面 466，所述第三内表面 466 位于安装凸耳 440 的下方（参见图 13C 和 22B）。衬套 410 的平环形部分

460 的下表面 468 搁置在承载件 412 的平坦部分 472 的上表面 470 上（参见图 17A 至 17B、17D 以及 22B 至 22C）。另外，衬套 410 的凸环形部分 462 延伸到上外壳 402 的空腔 426 直接在安装凸耳 440 的上方（并与安装凸耳 440 相邻）的部分中。衬套 410 的凸环形部分 462 尺寸设计成紧密地配合在上外壳 402 的空腔 426 的接收衬套 410 的凸环形部分 462 的部分中。因此，衬套 410 在上外壳 402 与承载件 412 之间提供支撑表面。

[00102]衬套 410 具有开口 474，所述开口 474 延伸通过衬套 410 的平环形部分 460 和凸环形部分 462。凸环形部分 462 可以包括第一凸环形部分 476 和第二凸环形部分 478，在第一凸环形部分 476 和第二凸环形部分 478 之间布置有肋部 480（参见图 16C）。承载件 412 的凸部分 482 延伸到衬套 410 的开口 474 中（参见图 17A 至 17B 和 17D）。另外，在承载件 412 的凸部分 482 中形成有联接凹部 484。在承载件 412 安装在阀芯 400 中之后，包括联接凹部 484 的凸部分 482 定位在衬套 410 的开口 474 内并且被衬套 410 围绕（参见图 22B 至 22C）。

[00103]承载件 412 的联接凹部 484 接收球茎 404 的突起 446，由此连接致动机构（即，球茎 404）和承载件 412（参见图 22B 至 22C）。球茎 404 的突起 446 可以具有四个侧面，所述四个侧面分别与联接凹部 484 的相对应的侧面接触。球茎 404 的突起 446 并没有接触联接凹部 484 的底表面。将应当理解，尽管在此说明了示例性实施例，但是球茎 404 可以通过允许球茎 404 使承载件 412 的平移运动和角运动的任何适当的方式连接到承载件 412。

[00104]如图 17A 至 17D 中所示，承载件 412 包括平坦部分 472 和凸部分 482。承载件 412 的平坦部分 472 的下表面 486 包括用于与可运动盘 414 的上表面 488 相连的结构，以便使承载件 412 和可运动盘 414 相互连结而不相互运动。在一个示例性实施例中，承载件 412 的下表面 486 包括三个 U 形突起 490，所述三个 U 形突起 490 摩擦配合到相对应的 U 形凹部 492 中，所述 U 形凹部 492 形成在可运动盘

414 的上表面 488 中。可以改变相邻的 U 形突起 490 之间的间距（并因而也可以改变在相对应的 U 形凹部 492 之间的间距），以便使承载件 412 将仅沿一个方向与可运动盘 414 相连。此外，如上所述，承载件 412 还包括联接凹部 484，所述联接凹部 484 形成在承载件 412 的凸部分 482 中。这样，承载件 412 的功能为在阀芯 400 中将致动机构（例如，球茎 404）和动态密封元件（例如，可运动盘 414）相互连接。

[00105]如图 18A 至 18C 中所示，可运动盘 414 是相对于上外壳 402 可运动的形成为板、盘等的阀构件。如上所述，可运动盘 414 的上表面 488 包括 U 形凹部 492。上表面 488 基本是平坦的。可运动盘 414 的下表面 494 包括混合室 496(即，形成在可运动盘 414 中的空腔)。在可替代的示例性实施例中，混合室 496 延伸通过可运动盘 414（即，从下表面 494 至上表面 488）。下表面 494 基本是平坦的。可运动盘 414 的下表面 494 形成密封表面，所述密封表面可以覆盖和打开固定盘 416 中的进水孔口 498 和 500，以便允许仅冷水、仅热水、或者冷水和热水两种水流过固定盘 416。流过固定盘 416 中的进水孔口 498 和 500 的水进入混合室 496，在所述混合室 496 处冷水和热水在通过固定盘 416 中的出水孔口 502 排放之前进行混合。

[00106]如图 19A 至 19D 中所示，固定盘 416 是相对于上外壳 402 固定的形成为板、盘等的阀构件。固定盘 416 具有上表面 504 和下表面 506。固定盘 416 包括用于与下外壳 420 相连的结构，以便一旦阀芯 400 组装后，相对于外壳组件 438 固定固定盘 416（即，防止固定盘 416 相对于外壳组件 438 旋转）。例如，沿着固定盘 416 的周边 510 形成四个凹槽 508。一个或多个凹槽 508 接合形成在下外壳 420 上的相对应的突起 512，由此防止固定盘 416 相对于下外壳 420 旋转。在一个示例性实施例中，两个凹槽 508 接合相对应的突起 512。通过改变凹槽 508 的尺寸和/或凹槽 508 之间的间距（并因而改变相对应的突起 512 的尺寸和/或突起 512 之间的间距），能够确保固定盘 416 仅沿一个方向与下外壳 420 相连。从而，因为固定盘 416 被防止相对于下外壳 420 旋转并且下外壳 420 固定到上外壳 402，如在以下进行说明

的那样，所以固定盘 416 不会在外壳组件 438 内旋转。

[00107]固定盘 416 包括进水孔口 498 和 500，所述进水孔口 498 和 500 分别与冷水进水孔口和热水进水孔口相对应。固定盘 416 还包括出水孔口 502，流过冷水进水孔口 498 的冷水、流过热水进水孔口 500 的热水、或者冷水和热水的混合水都可以通过所述出水孔口 502 流到阀体的出水通路。固定盘 416 的冷水进水孔口 498 和热水进水孔口 500 各自都具有壁 514，所述壁 514 从固定盘 416 的下表面 506 附近向固定盘 416 的上表面 504 附近倾斜，以便提高通过固定盘 416 流入阀芯 400 中的水的流动。固定盘 416 的出水孔口 502 具有壁 516，所述壁 516 从固定盘 416 的上表面 504 附近向固定盘 416 的下表面 506 附近倾斜，以便提高通过固定盘 416 并流出阀芯 400 的水的流动。

[00108]如图 20A 至 20B 中所示，基部密封件 418 是由弹性材料（例如，橡胶）形成的密封构件。基部密封件 418 形成围绕固定盘 416 的冷水进水孔口 498、热水进水孔口 500 和出水孔口 502 的水密密封件。与固定盘 416 一样，基部密封件 418 具有冷水进水孔口 518、热水进水孔口 520 和出水孔口 522。在一个示例性实施例，基部密封件 418 的出水孔口 522 通过将其中具有出水孔口 522 的构件 524（例如，弹性插入件）插入到基部密封件 418 中的开口中而形成。在另一个示例性实施例中，基部密封件 418 与下外壳 420 一体地形成。

[00109]冷水进水孔口 518、热水进水孔口 520 以及出水孔口 522 全部通过靠近基部密封件 418 的中心的轮毂 526 连接。此外，冷水进水孔口 518 通过第一连接部 528 连接至出水孔口 522；热水进水孔口 520 通过第二连接部 530 连接至出水孔口 522；冷水进水孔口 518 通过第三连接部 532 连接至热水进水孔口 520。通过第一连接部 528 实现的冷水进水孔口 518 与出水孔口 522 之间的连结形成了第一空间 534；通过第二连接部 530 实现的热水进水孔口 520 与出水孔口 522 之间的连结形成了第二空间 536；并且，通过第三连接部 532 实现的冷水进水孔口 518 与热水进水孔口 520 之间的连结形成了第三空间 538。

[00110]重要的是，当阀芯 400 组装后，固定盘 416 中的孔口 498、

500 和 502 与基部密封件 418 中的孔口 518、520 和 522 对准。因此，如将在以下进行说明的那样，轮毂 526、第一连接部 528、第二连接部 530、第三连接部 532、第一空间 534、第二空间 536 以及第三空间 538 都用于对准下外壳 420 中的基部密封件 418，并因而与固定盘 416 对准。

[00111]如图 21A 至 21D 以及 22B 至 22C 中所示，下外壳 420 与上外壳 402 对接以形成外壳组件 438，用于在阀芯 400 组装之后，在所述外壳组件 438 中（例如，在上外壳 402 的空腔 426 中）保持部件（例如，衬套 410、承载件 412、可运动盘 414、固定盘 416 以及基部密封件 418）。下外壳 420 例如可以由塑料或金属制成。下外壳 420 可以由与上外壳 402 的材料相同的材料形成。

[00112]此外，下外壳 420 用作支撑构件，以在阀芯 400 组装之前定向和保持固定盘 416 和基部密封件 418。与固定盘 416 和基部密封件 418 类似，下外壳 420 包括冷水进水孔口 540、热水进水孔口 542 以及出水孔口 544（参见图 21A 至 21D）。如上所述，下外壳 420 也包括突起 512。一个或多个突起 512 延伸超过下外壳 420 的侧壁 546。在一个示例性实施例中，两个突起 512 延伸超过侧壁 546。一个或多个突起 512 的高度可以基本与侧壁 546 的高度相同。在一个示例性实施例中，两个突起 512 的高度基本与侧壁 546 的高度相同。

[00113]一个或多个突起 512 可以配合到相对应的开口 548 中，所述开口 548 在上外壳 402 中形成在键 442 的下方（参见图 13A 至 13C）。在一个示例性实施例中，三个突起 512 配合到三个开口 548 中。这些突起 512 的形状基本与键 442 的形状相同，例如，都是小叶片的形状。通过配合到键 442 的下方的开口 548 中，突起 512 也用作键 442 的部件，例如，通过接合阀体中的互补形状的凹部。

[00114] 可以改变突起 512 的尺寸和/或形状，以便使下外壳 420 将仅沿一个方向与固定盘 416 和上外壳 402 对接，由此确保当阀芯 400 组装后，固定盘 416 将相对于上外壳 402 和下外壳 420 被适当地定向。通过接合固定盘 416 中的凹槽 508，突起 512 也防止固定盘 416 相对

于下外壳420旋转(并因而也防止固定盘416相对于上外壳402旋转)。

[00115]下外壳420包括第一凹部550、第二凹部552、第三凹部554和第四凹部556。下外壳420还包括第一突起558、第二突起560、以及第三突起562。基部密封件418的轮毂526、第一连接部528、第二连接部530和第三连接部532分别配合到下外壳420的第一凹部550、第二凹部552、第三凹部554和第四凹部556中。此外，下外壳420的第一突起558、第二突起560、以及第三突起562分别配合到基部密封件418的第一空间534、第二空间536和第三空间538中。因此，下外壳420将基部密封件418定向、固定并保持在下外壳420中。

[00116]下外壳420还包括一对弹性凸缘564，各弹性凸缘564都具有倾斜的上部分566。固定盘416中的凹槽508允许弹性凸缘564被向内按压（即，朝阀芯400的中心竖直轴线），以便使倾斜的上部分566可以进入上外壳402中的空腔426中。当倾斜的上部分566与形成在上外壳402中的相对应的开口568（参见图13A至13C）对准时，弹性凸缘564向外按压，并且倾斜的上部分566被接收在开口568中。这样，下外壳420(包括与其对接的固定盘416和基部密封件418)可以固定到上外壳402（参见图22B至22C）。

[00117]应当注意到，虽然固定盘416的凹槽508与下外壳420的突起512对接以防止固定盘416在下外壳420内旋转（并因而防止固定盘416在上外壳402中旋转)，但是允许固定盘416在外壳组件438（即，上外壳402和下外壳420）中轴向地运动。这样，基部密封件418的压缩在可运动盘414和固定盘416上施加加载力。因此，可运动盘414和固定盘416在阀芯400组装之后保持相互水密接合。

[00118]可运动盘414相对于固定盘416的位置和方向由球茎404的通过上开口430从上外壳402突出的茎部分432控制。例如，球茎404的茎部分432绕枢轴（例如，销406）的枢转改变可运动盘414相对于固定盘416的位置，这改变水的流量。球茎404的茎部分432的旋转改变可运动盘414相对于固定盘416的方向，这改变水的温度。

[00119]诸如手柄、旋钮等的操作构件（例如，图11中所示的操

作构件 330）可以连接到球茎 404 的茎部分 432，以便帮助用户操纵茎部分 432。因此，在阀芯 400 安装在阀体中以后，用户可以操纵操作构件，所述操作构件移动球茎 404 的茎部分 432，以改变可运动盘 414 相对于固定盘 416 的位置和/或方向，由此控制通过阀芯 400 流出卫生器具（例如，图 11 中所示的卫生器具 332）的水的流量和温度。

[00120]通过茎部分 432 接触上外壳 402 的上开口 430 的相对的表面可以限制球茎 404 的茎部分 432 绕销 406 的枢转。因而，当阀芯 400 处在与零流量相对应的完全关闭位置时，球茎 404 的茎部分 432 接触上外壳 402 的上开口 430 的第一表面 570（参见图 22C）。当阀芯 400 处在与最大流量相对应的完全打开位置时，球茎 404 的茎部分 432 接触上外壳 402 的上开口 430 的第二表面 572。

[00121]通过销 406 的远端接触狭槽 444 的端部分 574 可以限制球茎 404 的茎部分 432 的旋转（参见图 22A）。因此，狭槽 444 的长度限定阀芯 400 可以传送的水的温度范围，所述狭槽 444 用作温度限制器。

[00122]阀芯 400 具有低接触点（即，在上外壳 402 上形成的安装凸耳 440），保持螺母压在所述低接触点上。安装凸耳 440 是绕上外壳 402 延伸的圆形凸耳，在该圆形凸耳处，上外壳 402 的穹顶部分 422 与上外壳 402 的圆柱部分 424 相接。安装凸耳 440 是外壳组件 438 上的与保持螺母接触的最高点。

[00123]在示例性阀芯 400 的示例性实施例中，一个或多个安装凸耳（例如，安装凸耳 440）形成在阀芯 400 的外壳组件 438 上。安装凸耳的最高处是在用于在阀体中安装阀芯 400 的外壳组件 438 上的低接触点。

[00124]外壳组件 438 上的最高安装凸耳的高度 h_1 与外壳组件 438 的最大外径 d 的比值 R_1 小于或等于 0.53（参见图 22C），其可以表示为 $h_1/d \leqslant 0.53$。在示例性阀芯 400 的另一个示例性实施例中，高度 h_1 与最大外径 d 的比值 R_1 小于或等于 0.52。在示例性阀芯 400 的又一个示例性实施例中，高度 h_1 与最大外径 d 的比值 R_1 大约等于 0.53。

[00125]根据示例性阀芯 400 的又一个示例性实施例，高度 h_1 与外壳组件 438 的高度 h_2 的比值 R_2 小于或等于 0.49（参见图 22C），其可以表示为 $h_1/h_2 \leqslant 0.49$。在另一个示例性实施例中，高度 h_1 与高度 h_2 的比值 R_2 小于或等于 0.47。在又一个示例性实施例中，高度 h_1 与高度 h_2 的比值 R_2 大约等于 0.48。

[00126]根据示例性阀芯 400 的再一个示例性实施例，高度 h_1 与销 406 的高度 h_3（从外壳组件 438 的底部到销 406 的中心线的高度）的比值 R_3 小于或等于 0.67（参见图 22C），其可以表示为 $h_1/h_3 \leqslant 0.67$。在另一个示例性实施例中，高度 h_1 与高度 h_3 的比值 R_3 小于或等于 0.65。在又一个实示例性施例中，高度 h_1 与高度 h_3 的比值 R_3 大约等于 0.66。

[00127]根据示例性阀芯400的另一个示例性实施例，外壳组件438上的最高安装凸耳位于阀芯 400 的致动机构（例如，球茎 404）的下方。在示例性阀芯 400 的又一个示例性实施例中，外壳组件 438 上的最高安装凸耳位于阀芯 400 的致动机构的下方且位于混合室（例如，混合室 496）的上方。在示例性阀芯 400 的再一个示例性实施例中，外壳组件 438 上的最高安装凸耳位于阀芯 400 的致动机构的下方且位于固定盘（例如，固定盘 416）的上方。

[00128]根据示例性阀芯 400 的示例性实施例，外壳组件 438 上的最高安装凸耳的高度 h_1 是在 0.641 与 0.651 英寸之间。在一个示例性实施例中，外壳组件 438 上的最高安装凸耳的高度 h_1 大约等于 0.646 英寸。

[00129]根据示例性阀芯400的另一个示例性实施例，外壳组件438的高度 h_2 是在 1.339 和 1.369 英寸之间。在一个示例性实施例中，外壳组件 438 的高度 h_2 大约等于 1.354 英寸。

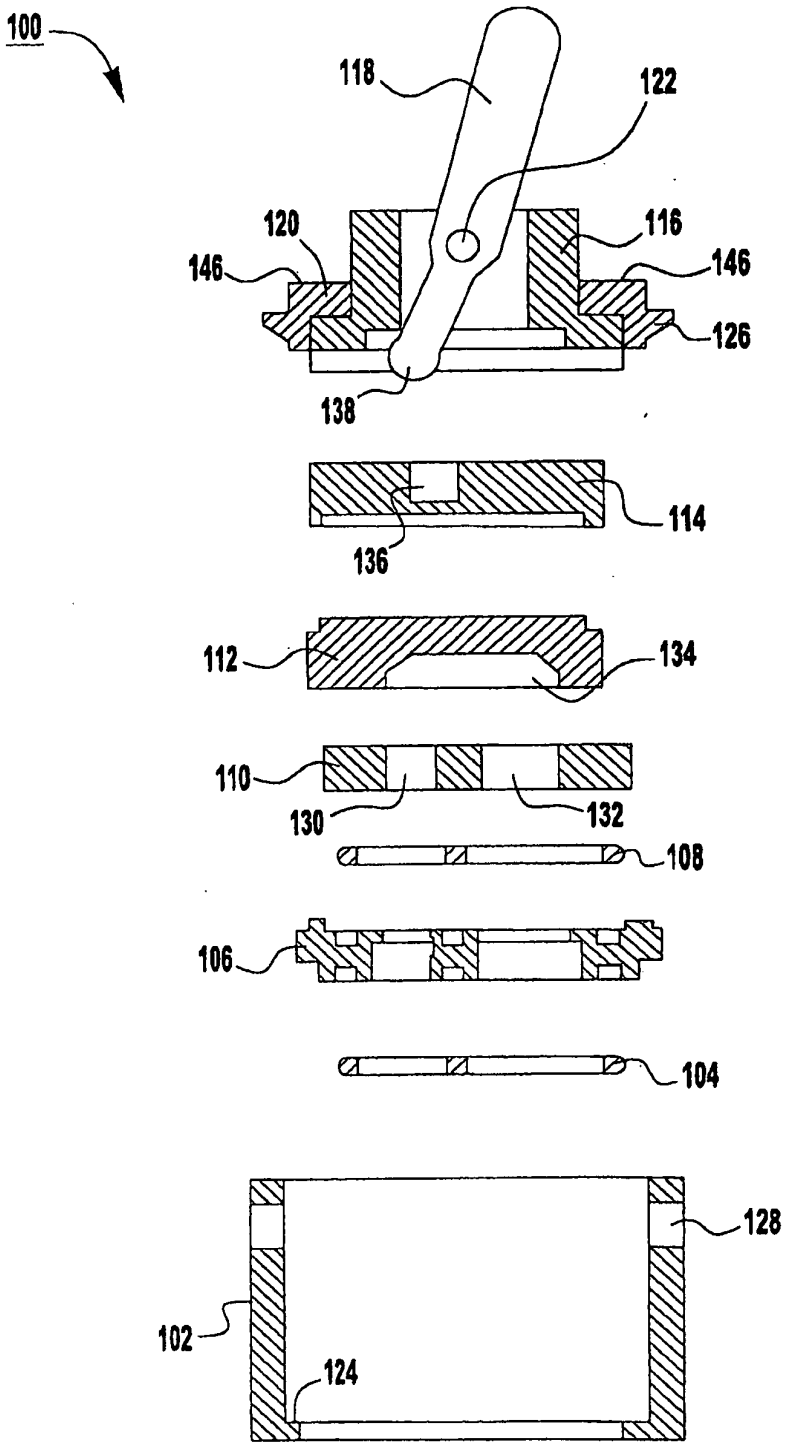
[00130]根据示例性阀芯 400 的又一个示例性实施例，销 406 的高度 h_3 是在 0.973 和 0.993 英寸之间。在一个示例性实施例中，销 406 的高度 h_3 大约等于 0.983 英寸。

[00131]根据示例性阀芯400的再一个示例性实施例，外壳组件438

的外径 *d* 是在 1.220 和 1.228 英寸之间。在一个示例性实施例中，外壳组件 438 的外径 *d* 大约等于 1.224 英寸。

[00132]如通过在此所述的示例性实施例所说明的那样，安装凸耳 440（作为外壳组件 438 上的最高安装凸耳）是外壳组件 438 上的低接触点，在将阀芯 400 安装在阀体中期间，保持螺母可以压在该低接触点上。因此，阀芯 400 具有紧凑结构，该紧凑结构为容纳阀芯 400 的卫生器具（例如图 11 中所示的卫生器具 332）的设计提供了增加的灵活性。此外，由于阀体的侧壁可以制造成更短（参见图 11），所以下安装凸耳 440 允许使用较少的材料来形成阀体。结果，下安装凸耳 440 可以节约成本。

[00133] 以上通过示例的形式对特定实施例进行了说明。本领域的技术人员从所给出的描述将不仅理解本发明的一般概念和所伴随的优点，而且也会发现所公开的结构和方法的明显的多种变化和修改。因此，所附权利要求意在于覆盖落入在此限定的本发明的一般概念的精神和范围内的所有这种变化和修改以及等同结构。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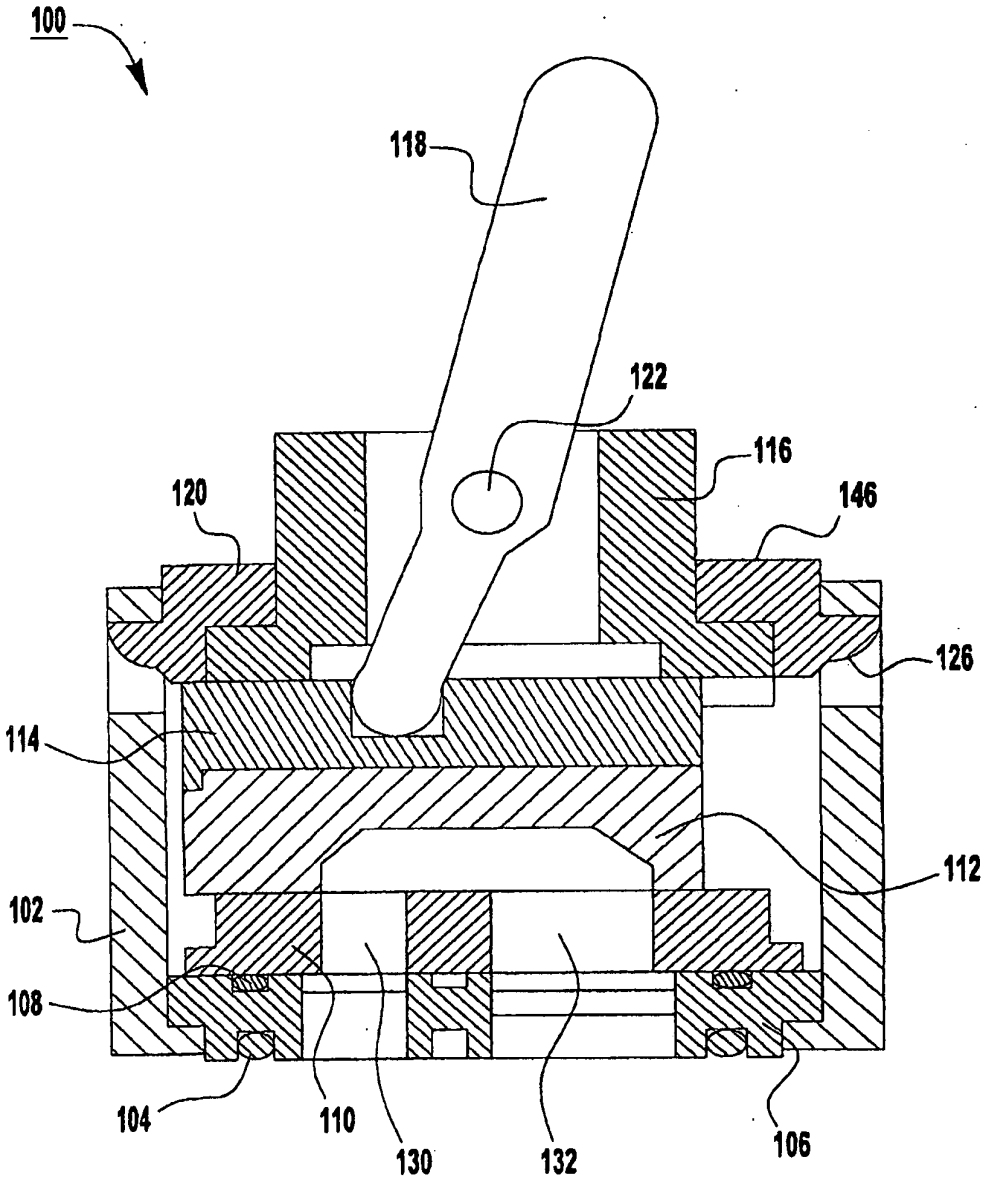
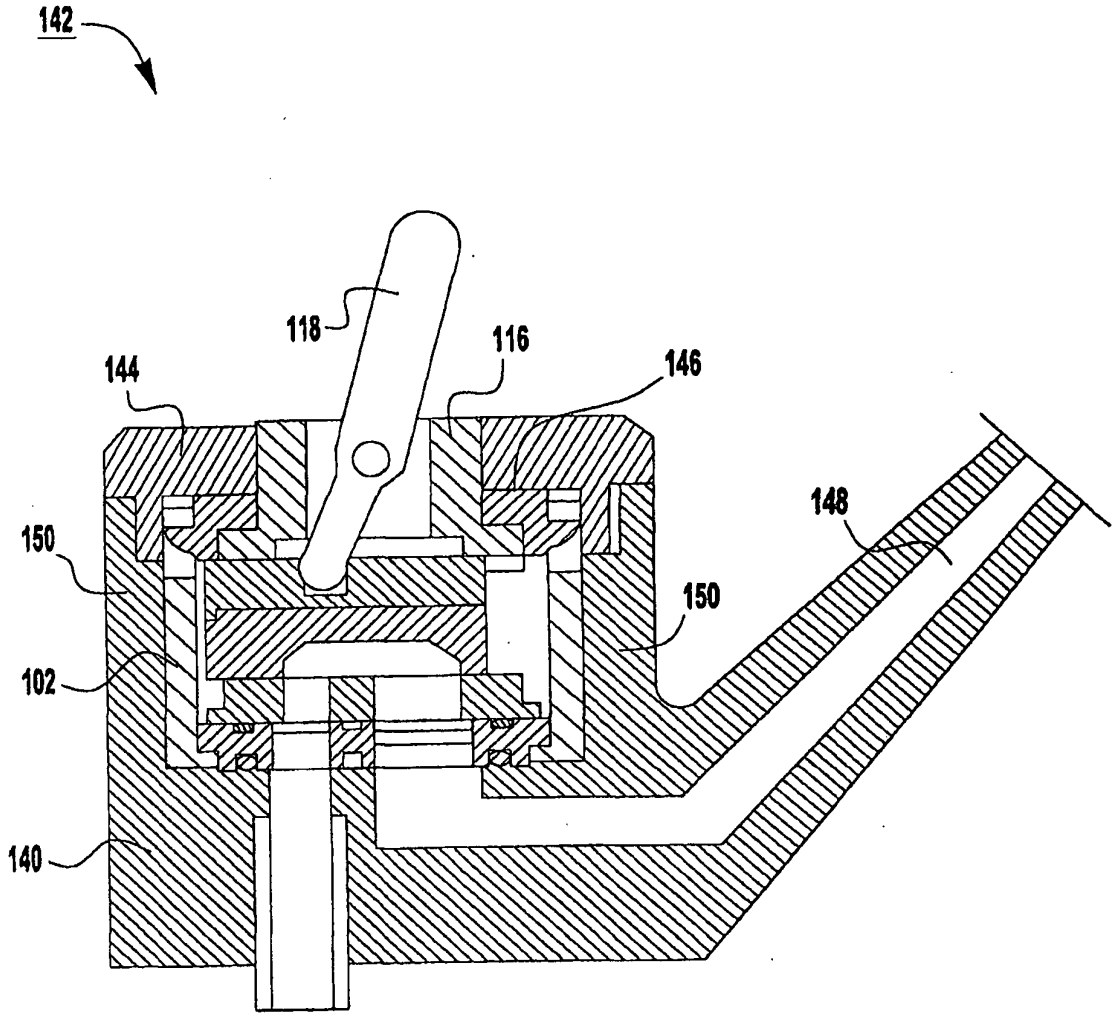
现有技术

图 1A



现有技术

图 1B



现有技术

图 1C

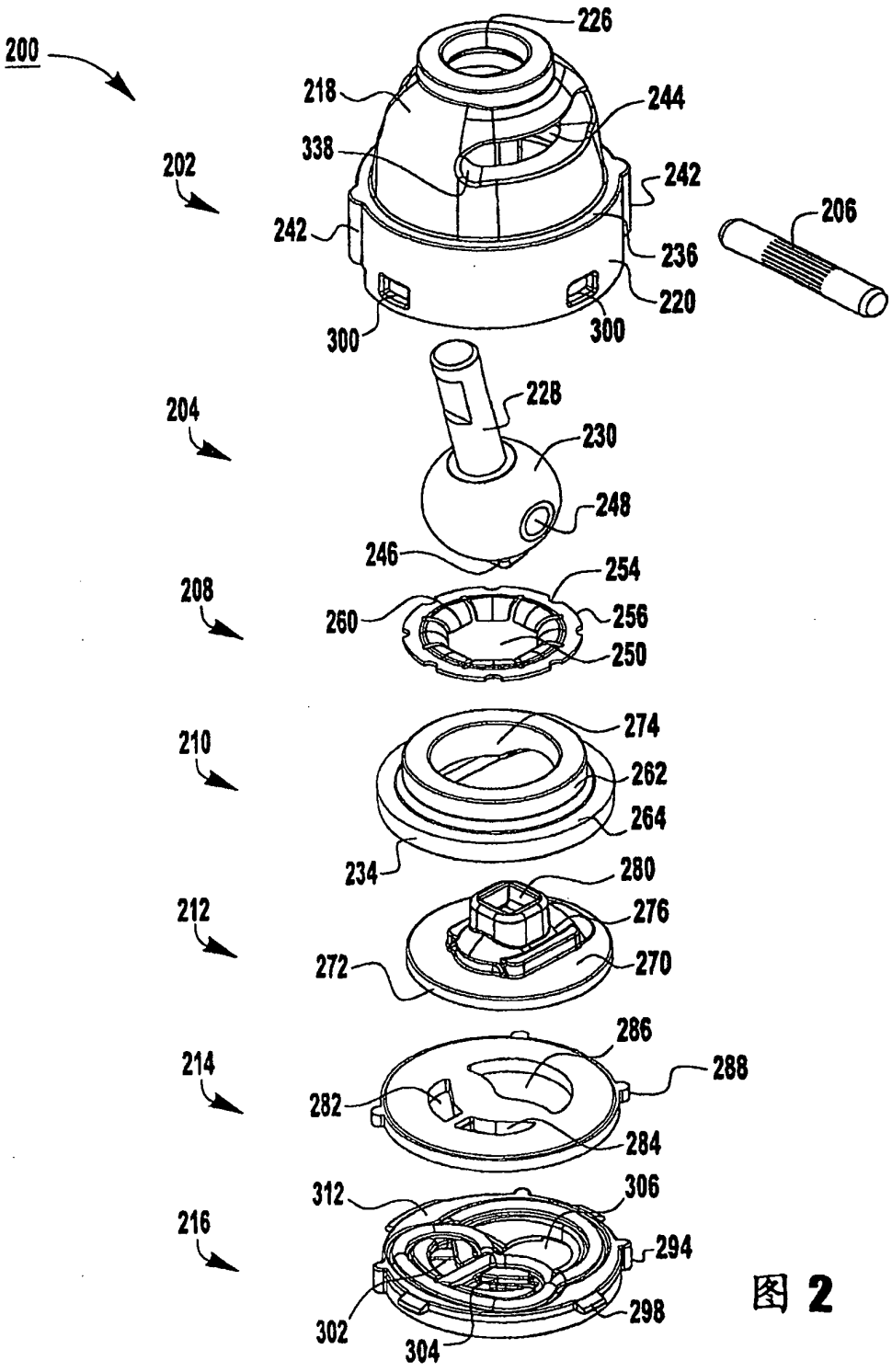

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图 2

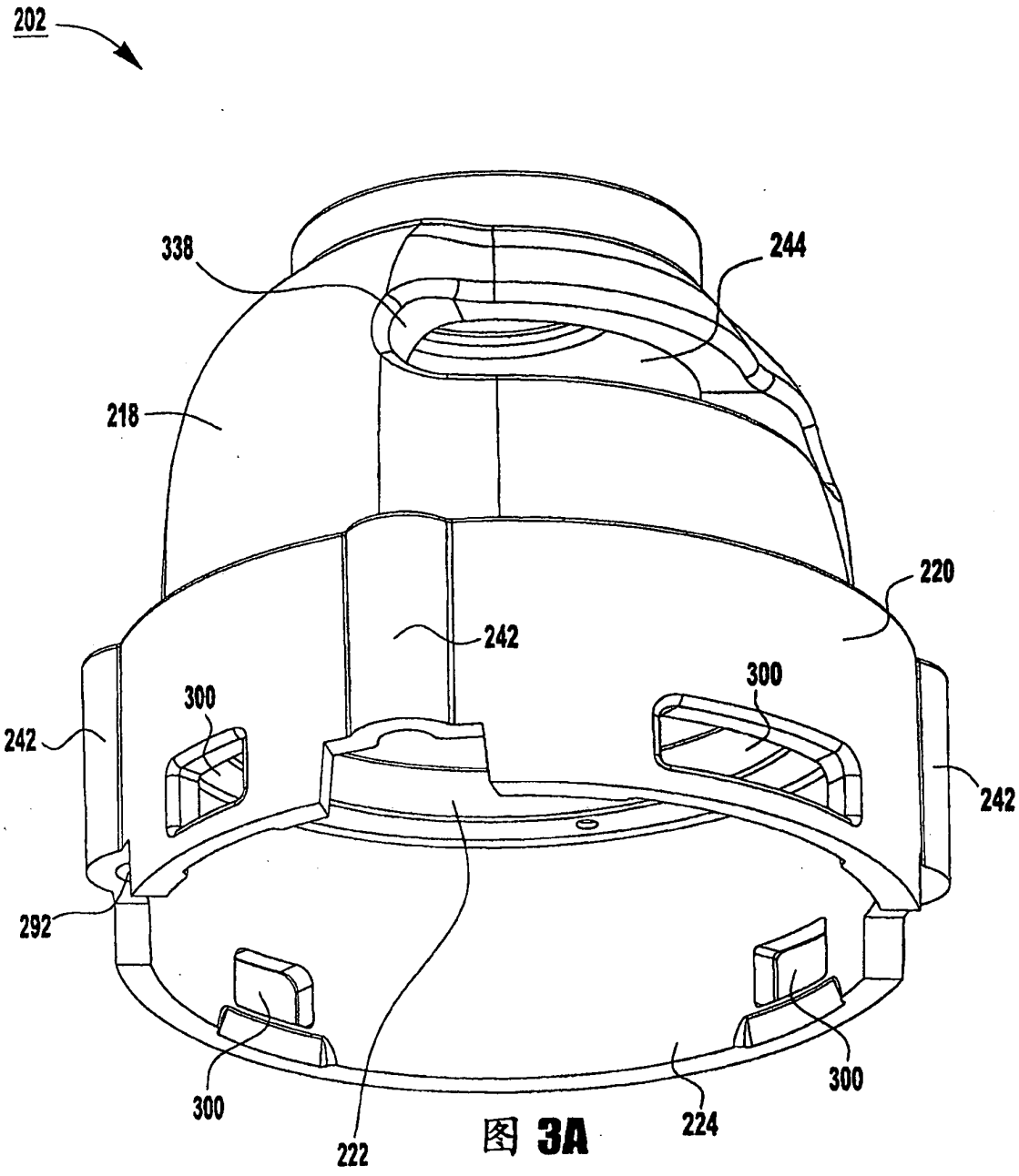


图 3A

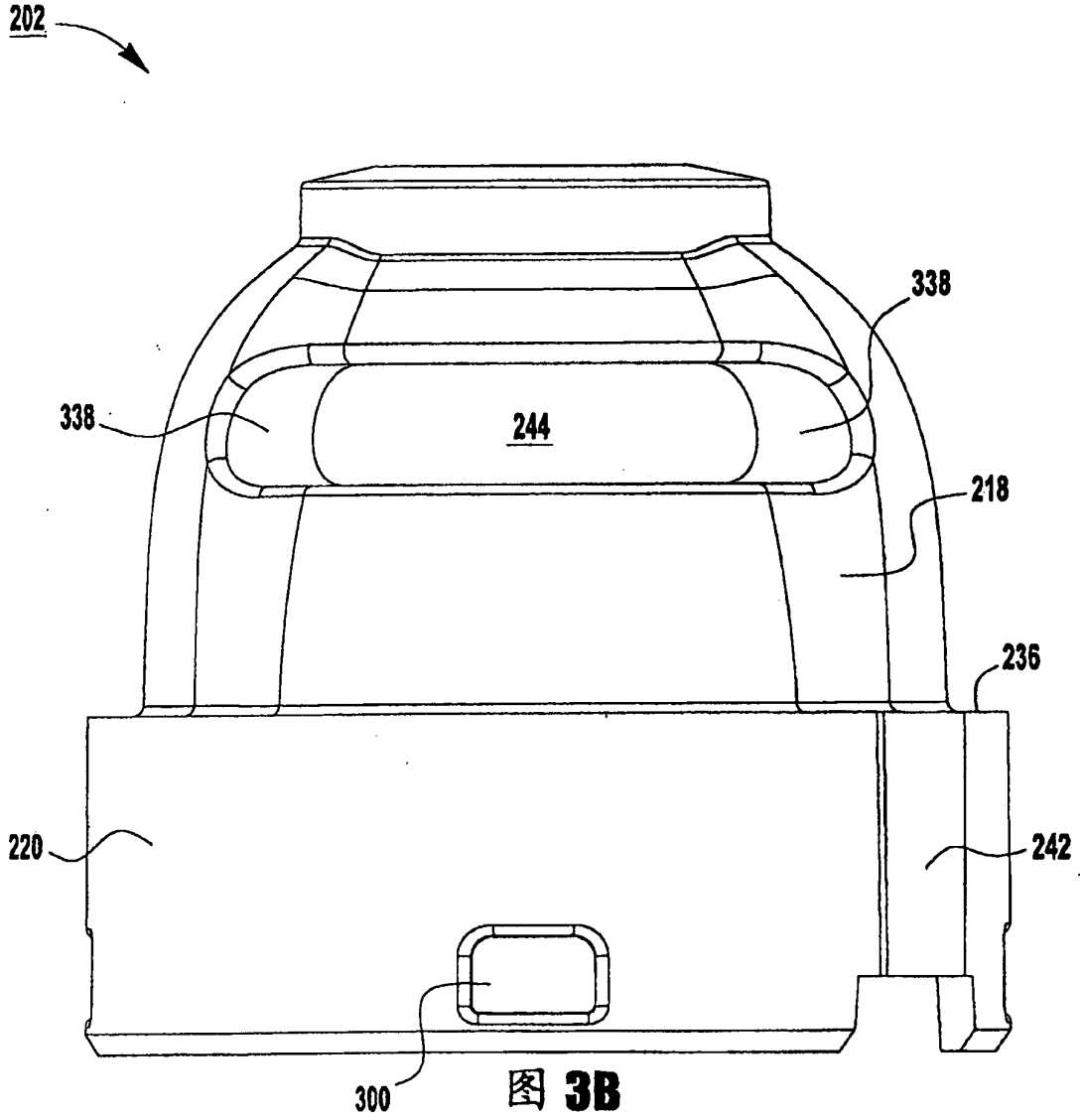
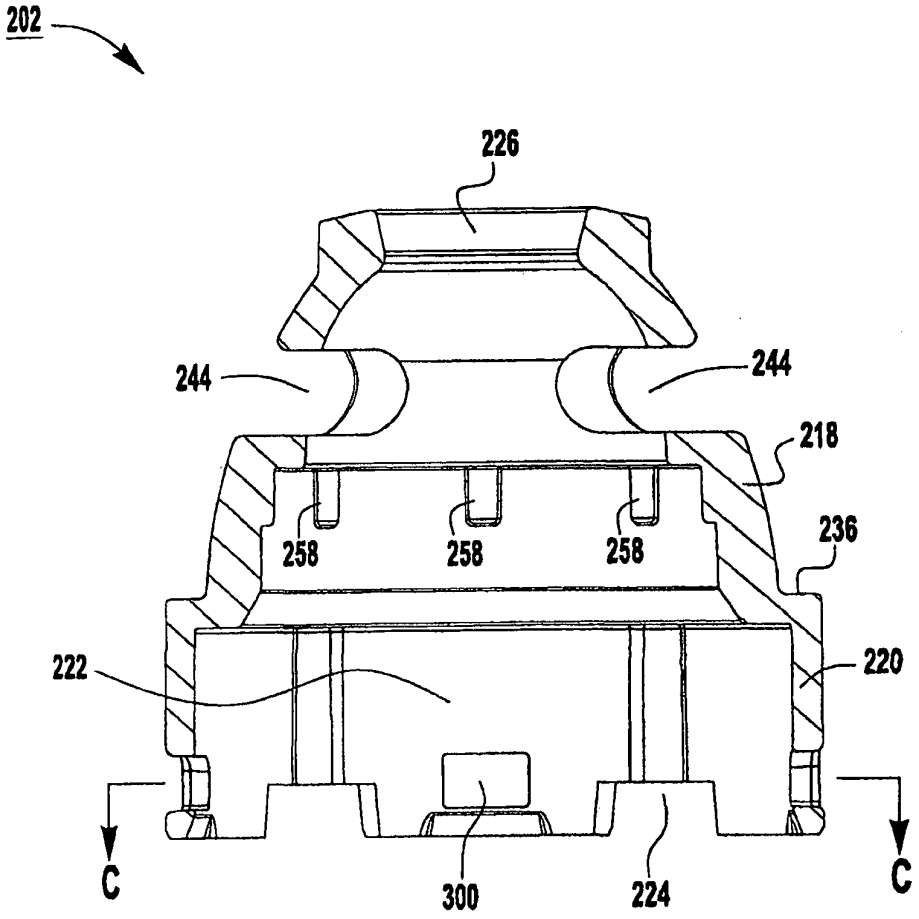
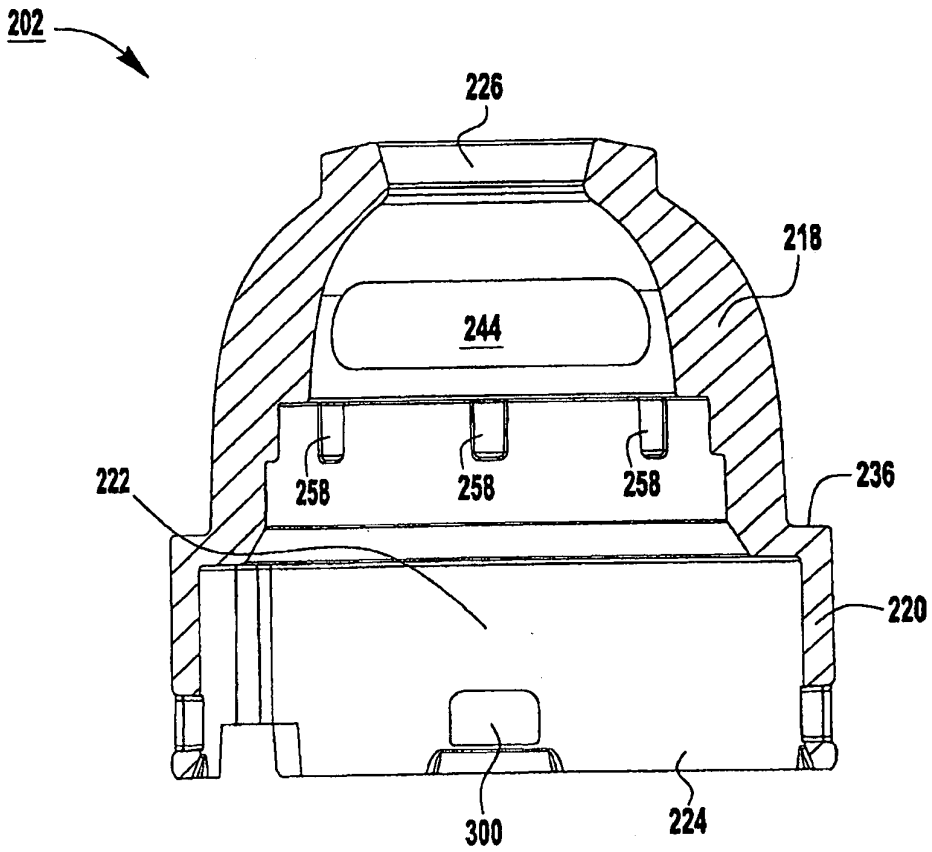


图 3B



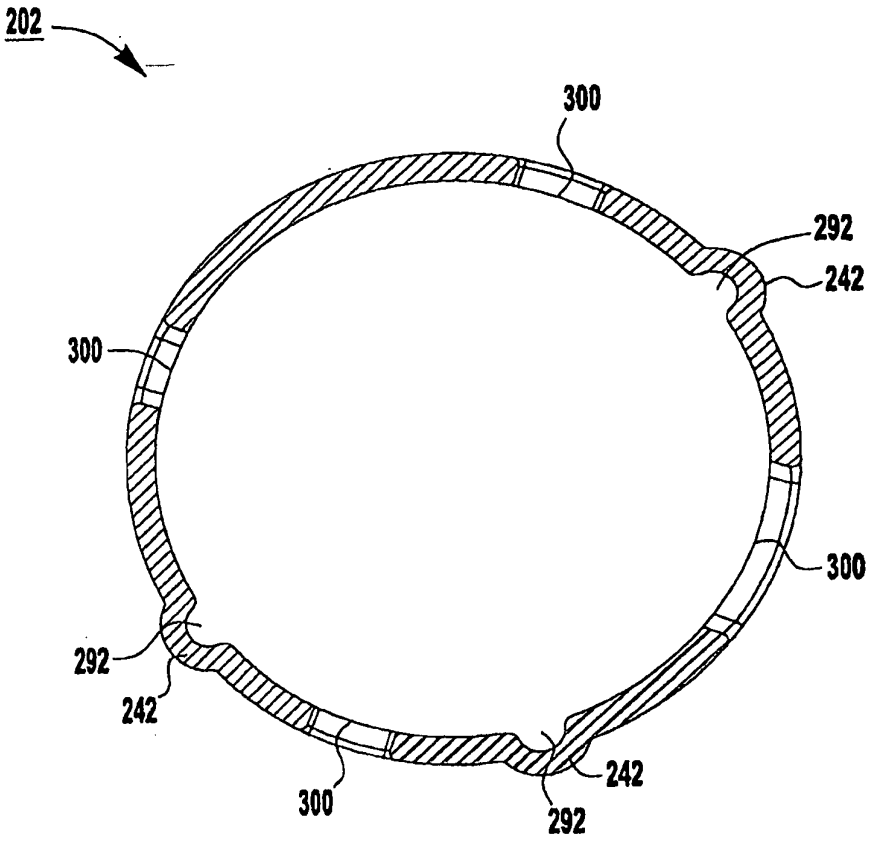
剖面 A-A

图 3C



剖面 B-B

图 3D



剖面 C-C

图 3E

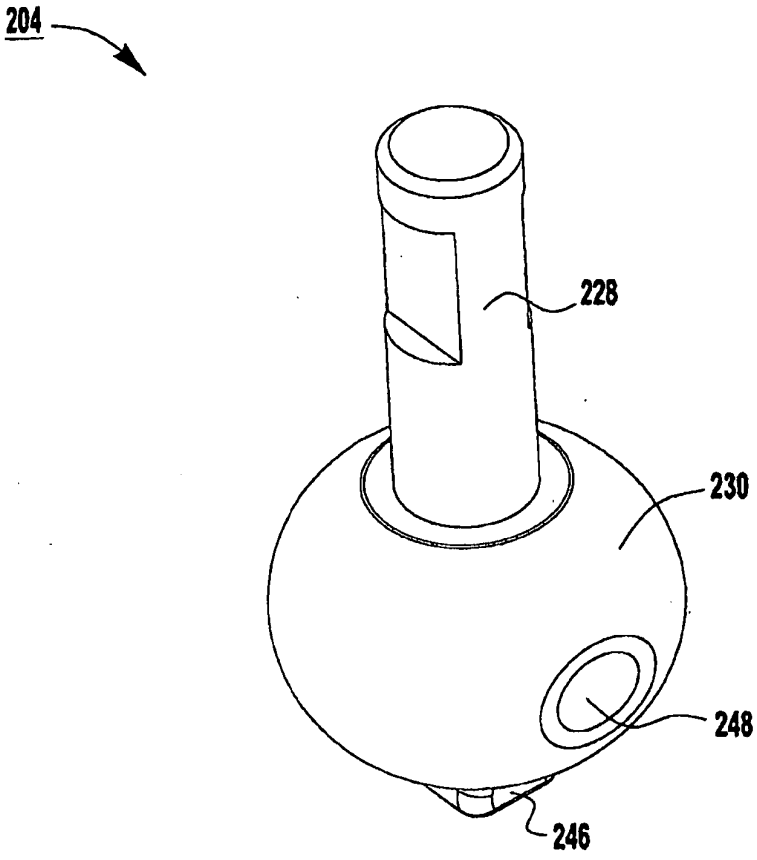


图 4

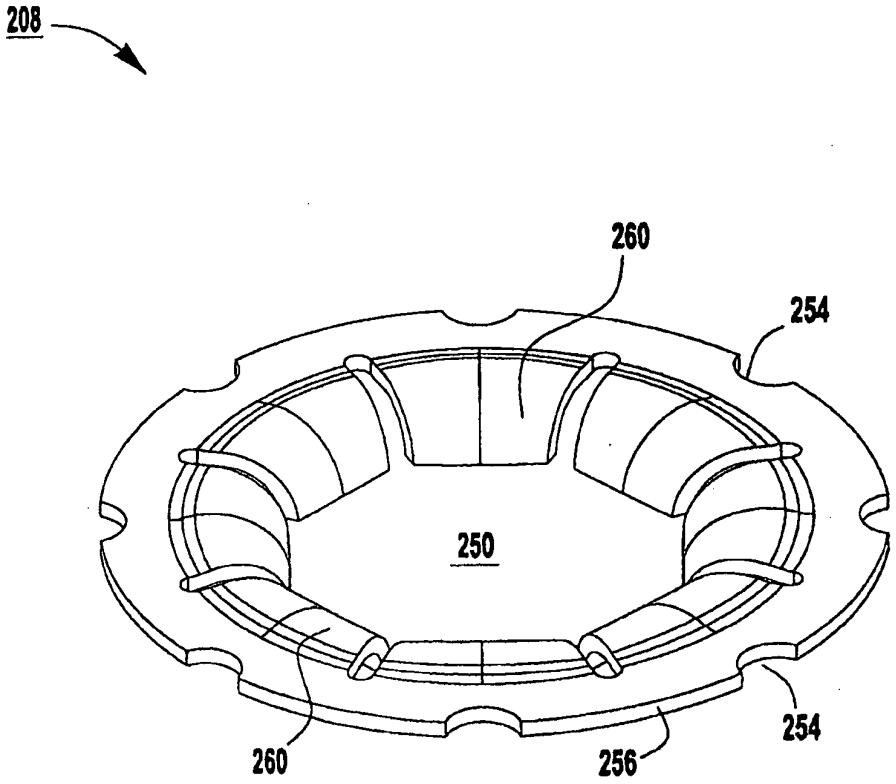


图 5A

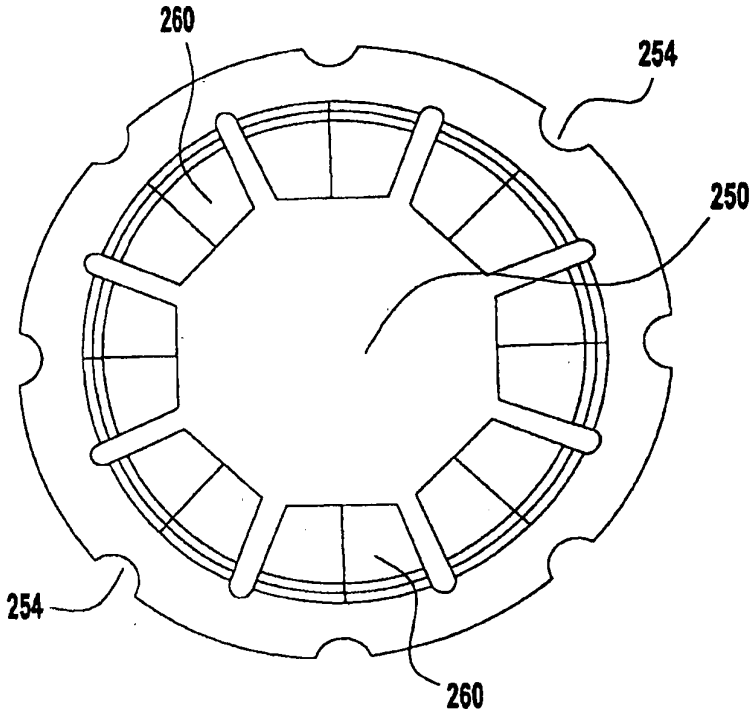


图 5B

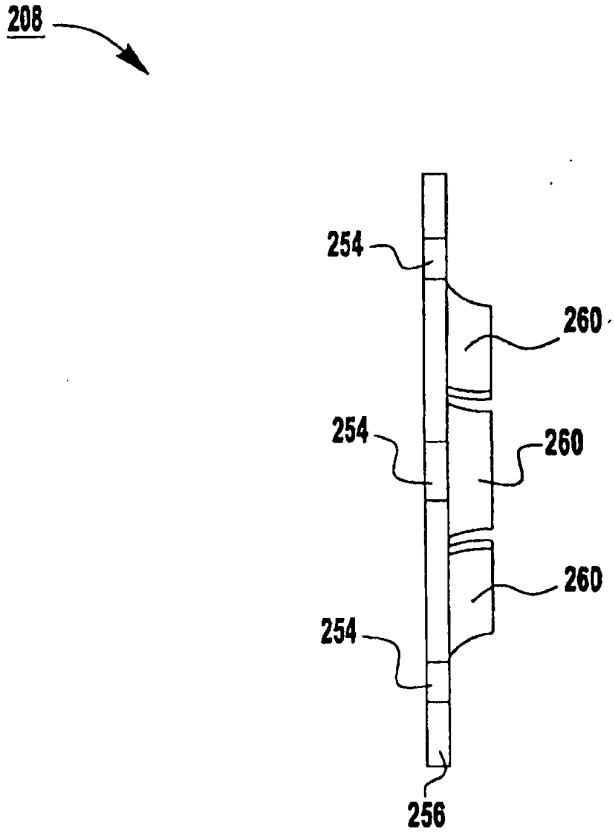


图 5C

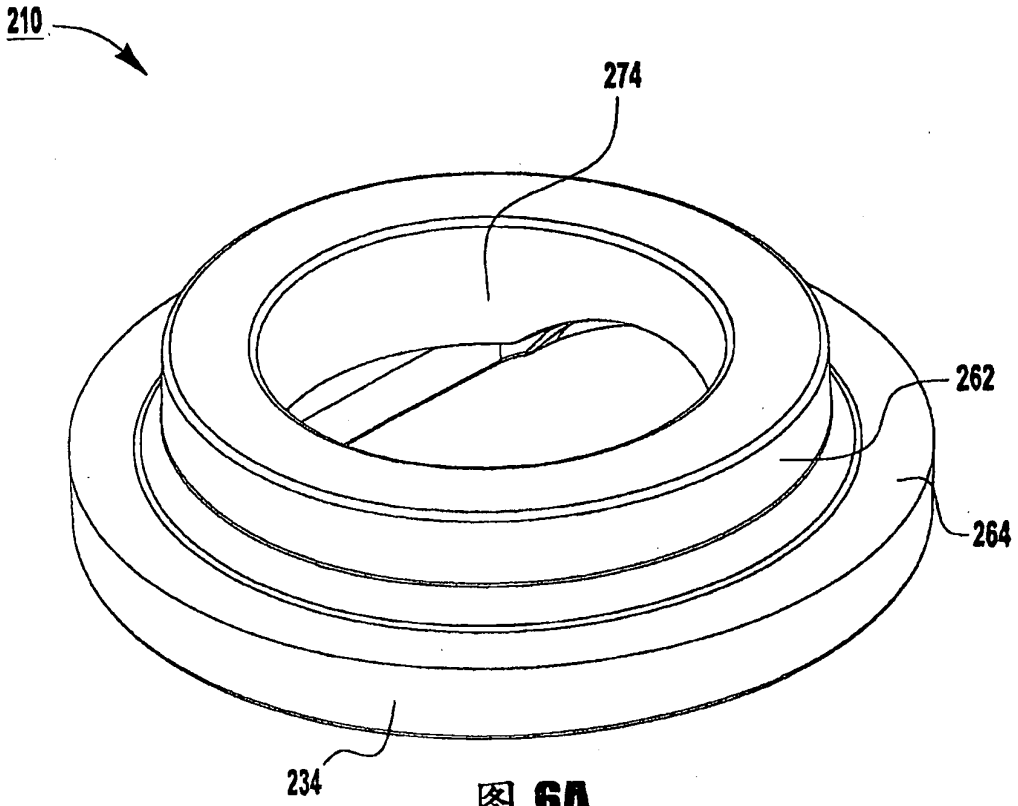


图 6A

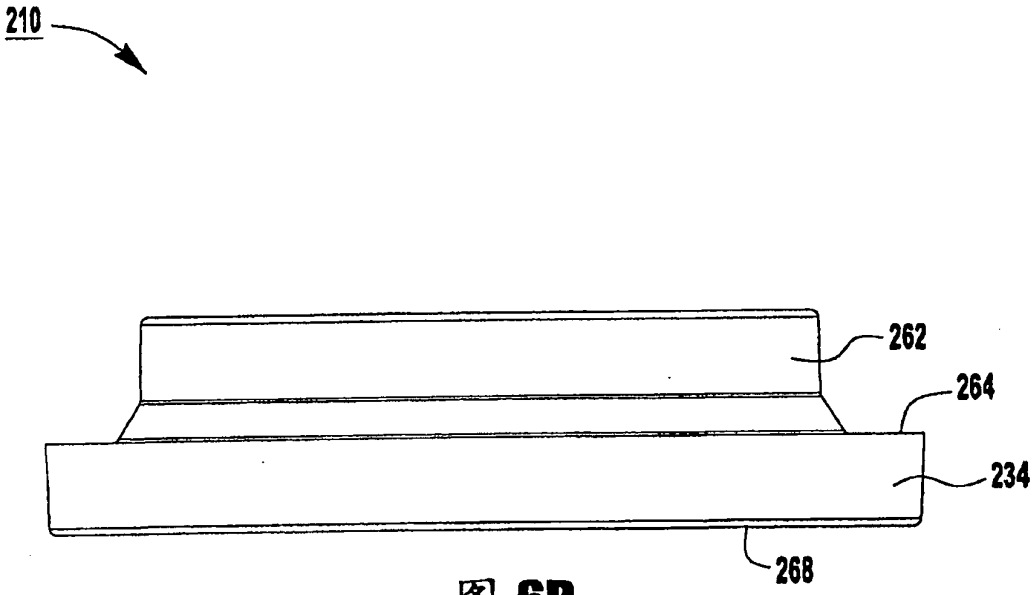


图 6B

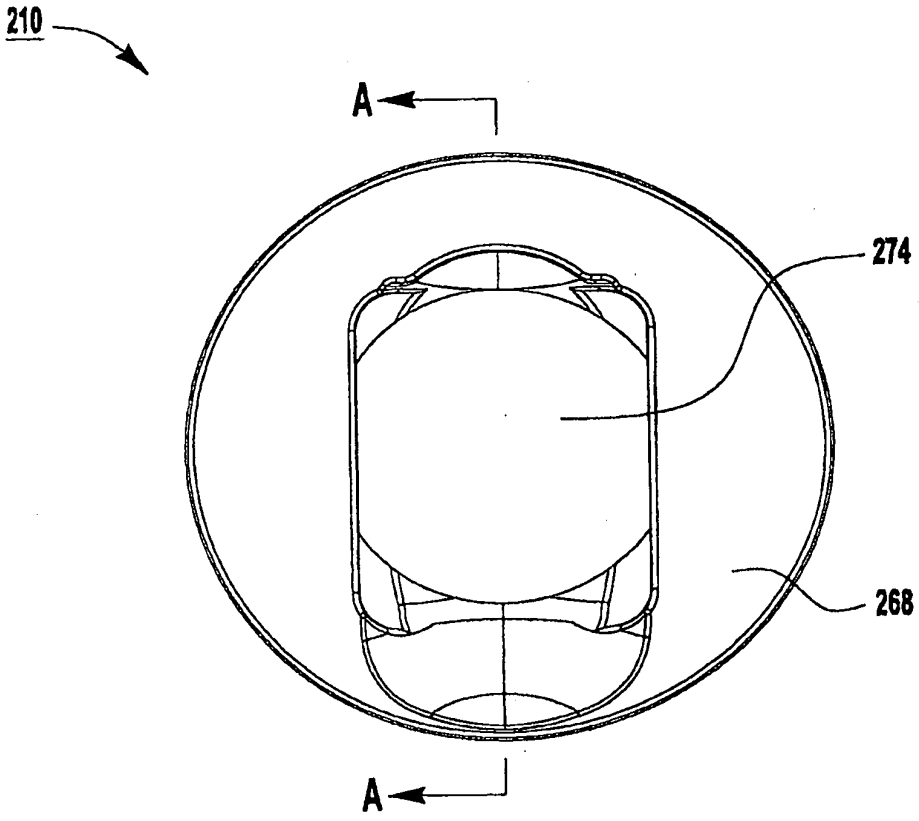
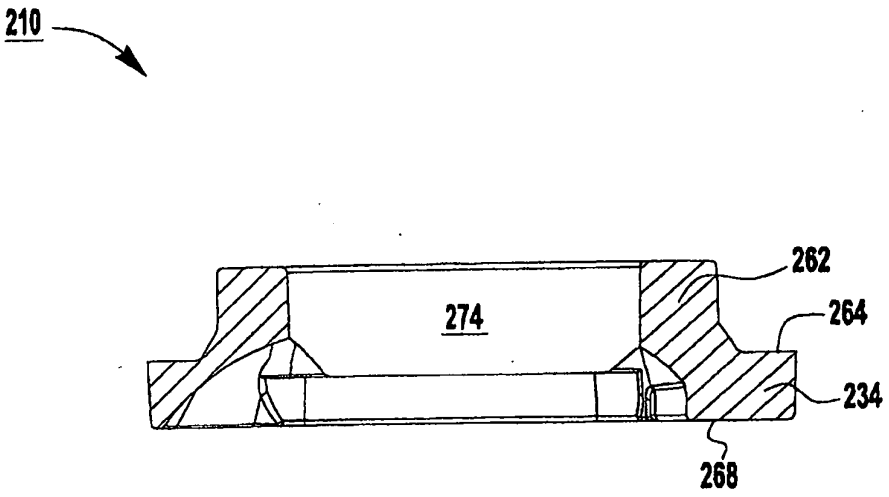


图 6C



剖面 A-A

图 6D

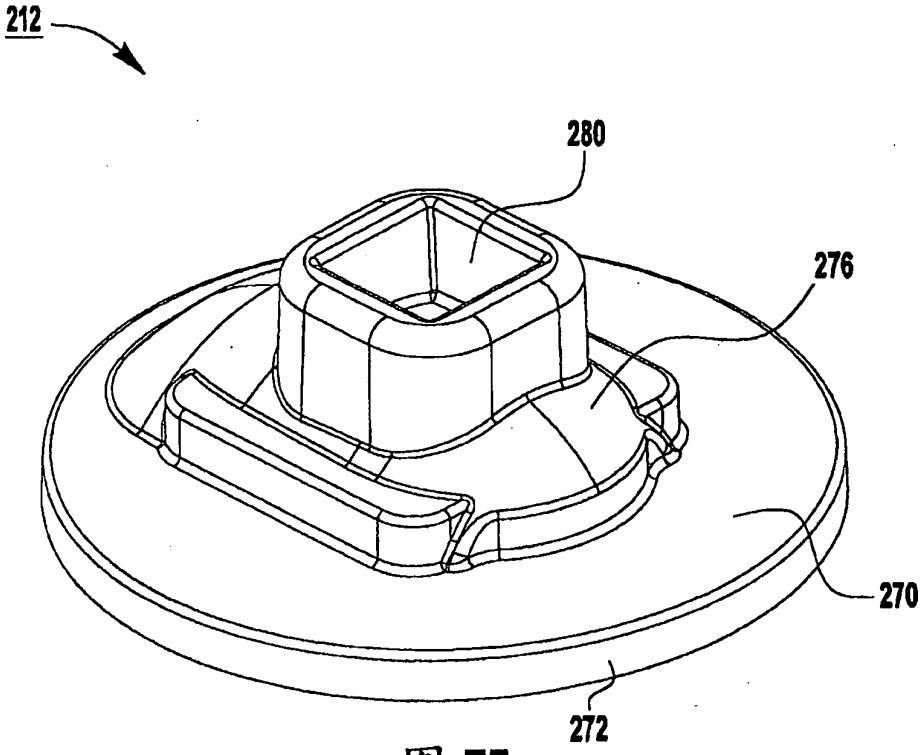


图 7A

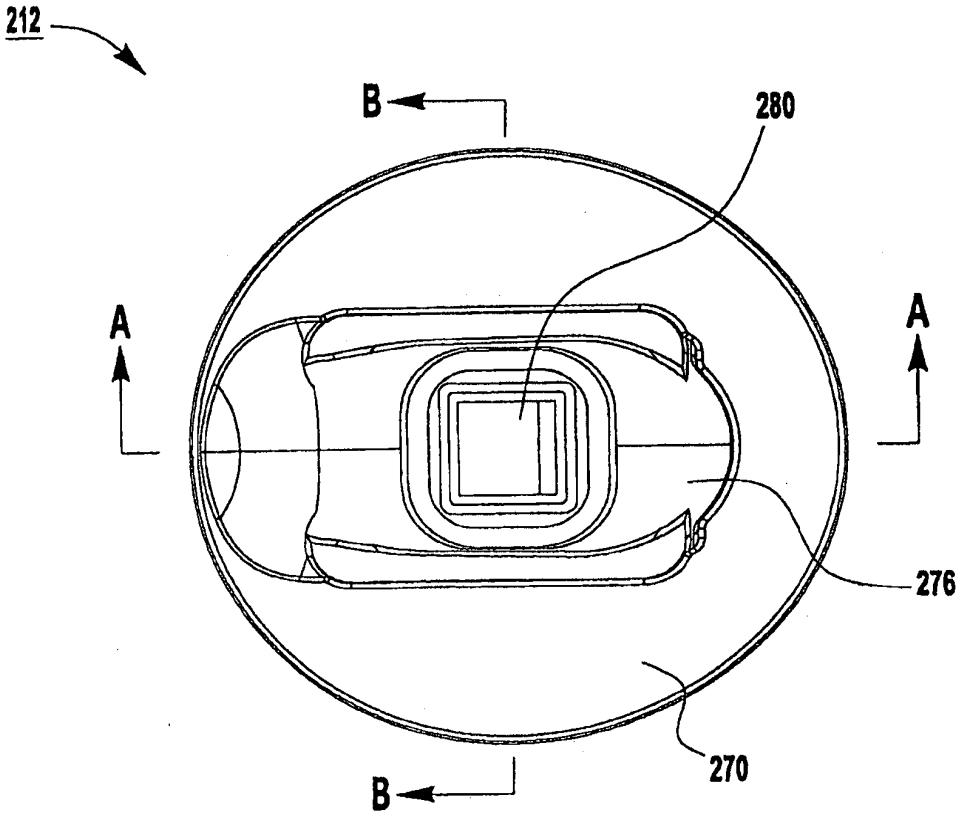
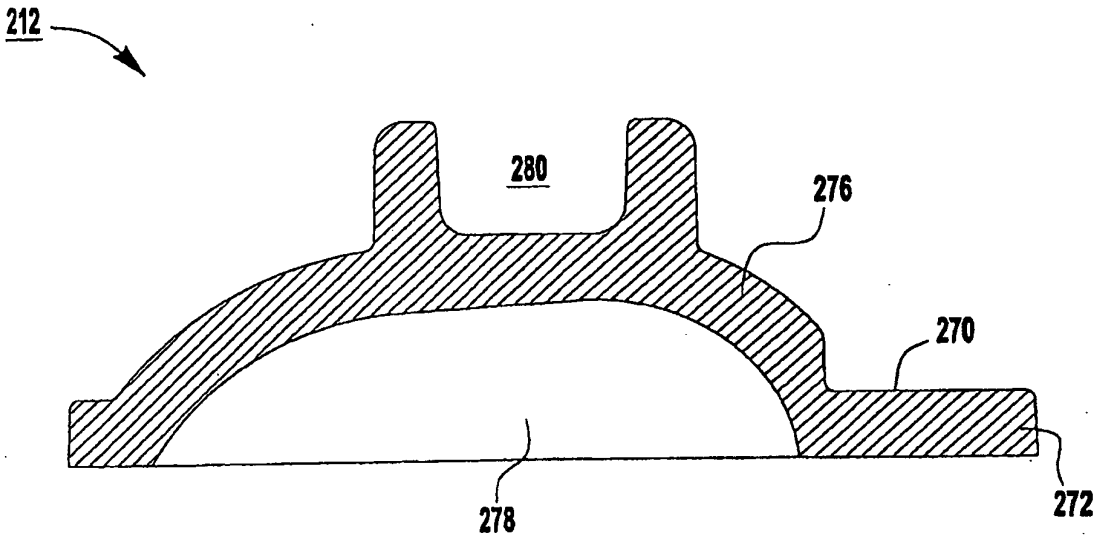
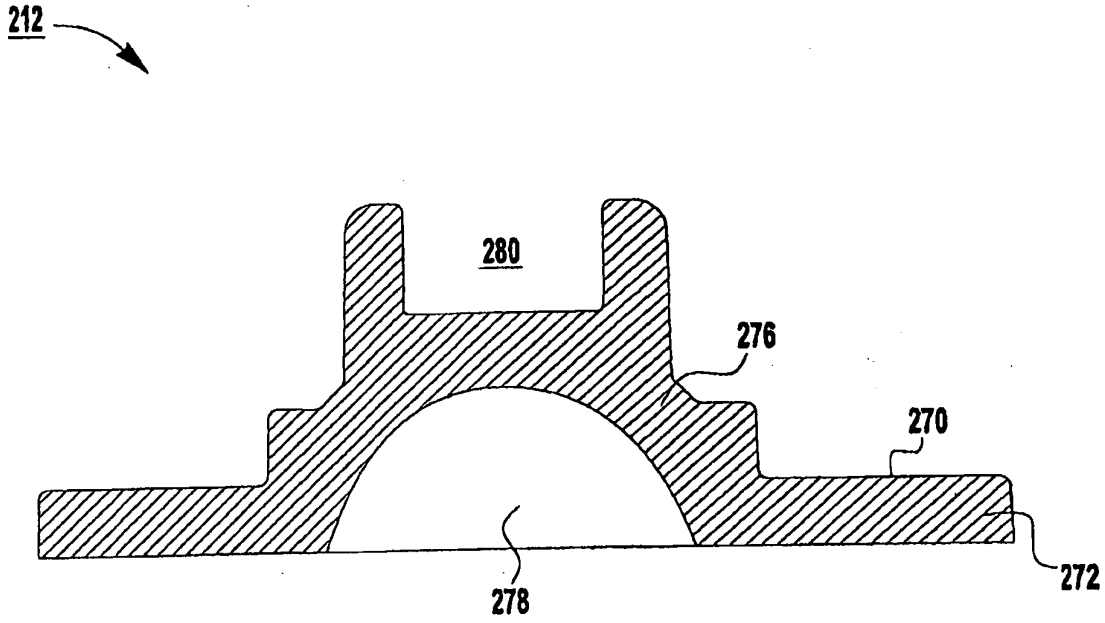


图 7B



剖面 A-A

图 7C



剖面 B-B

图 7D

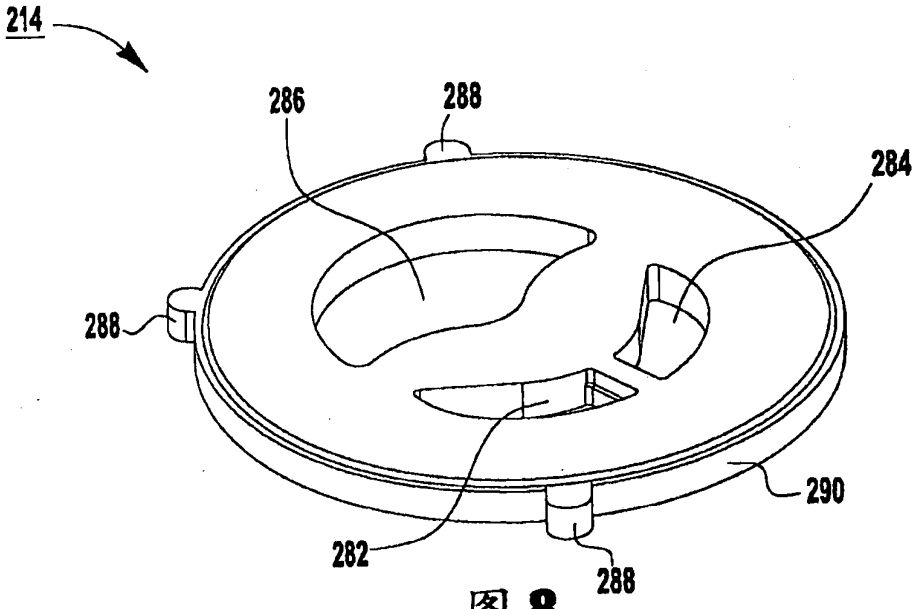


图 8

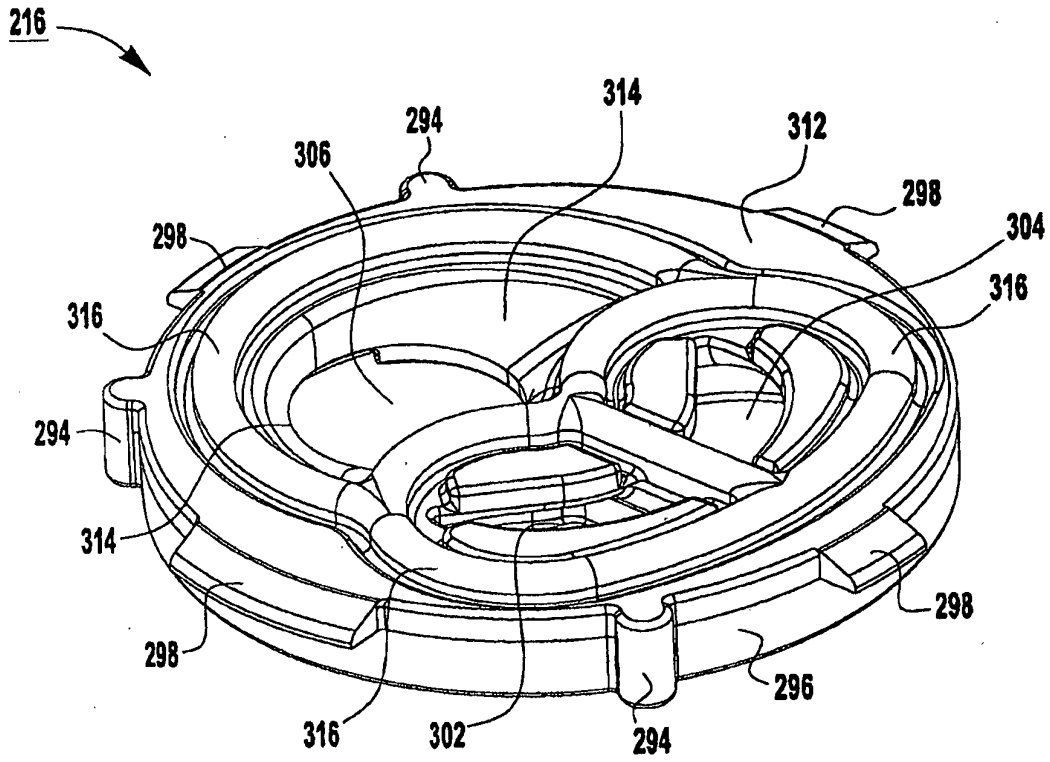

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图 9A

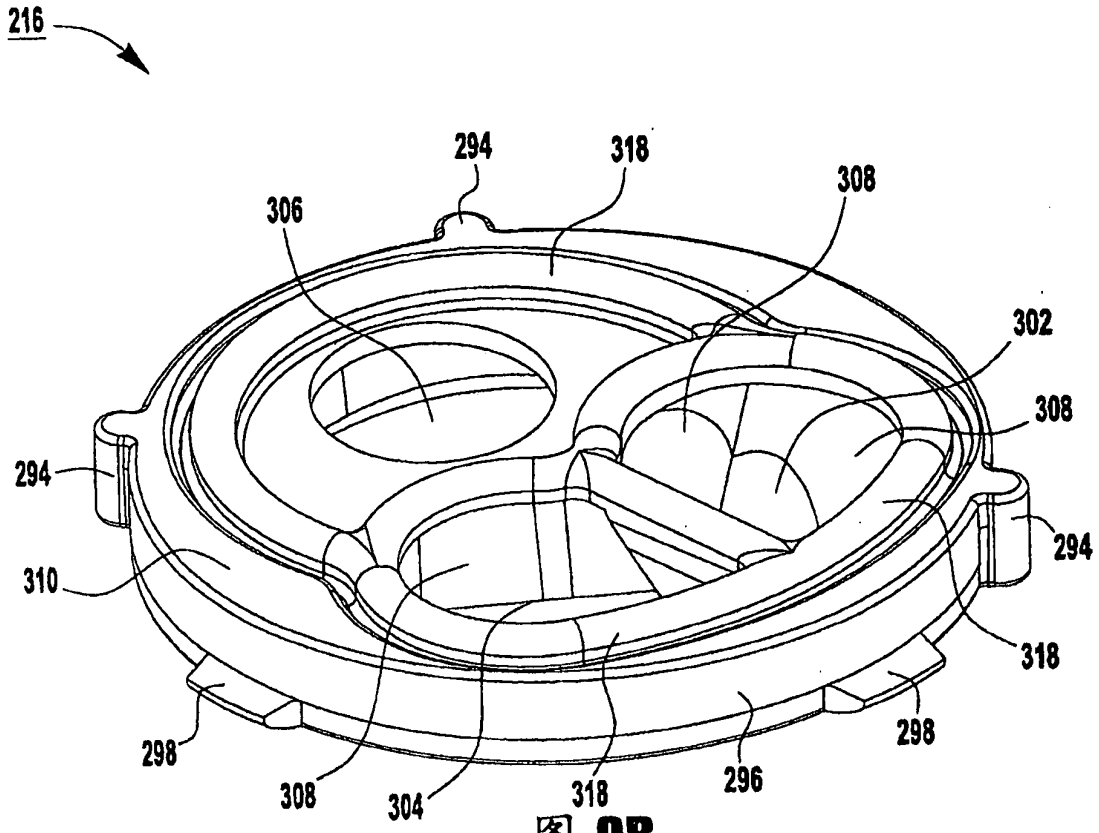
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图 9B

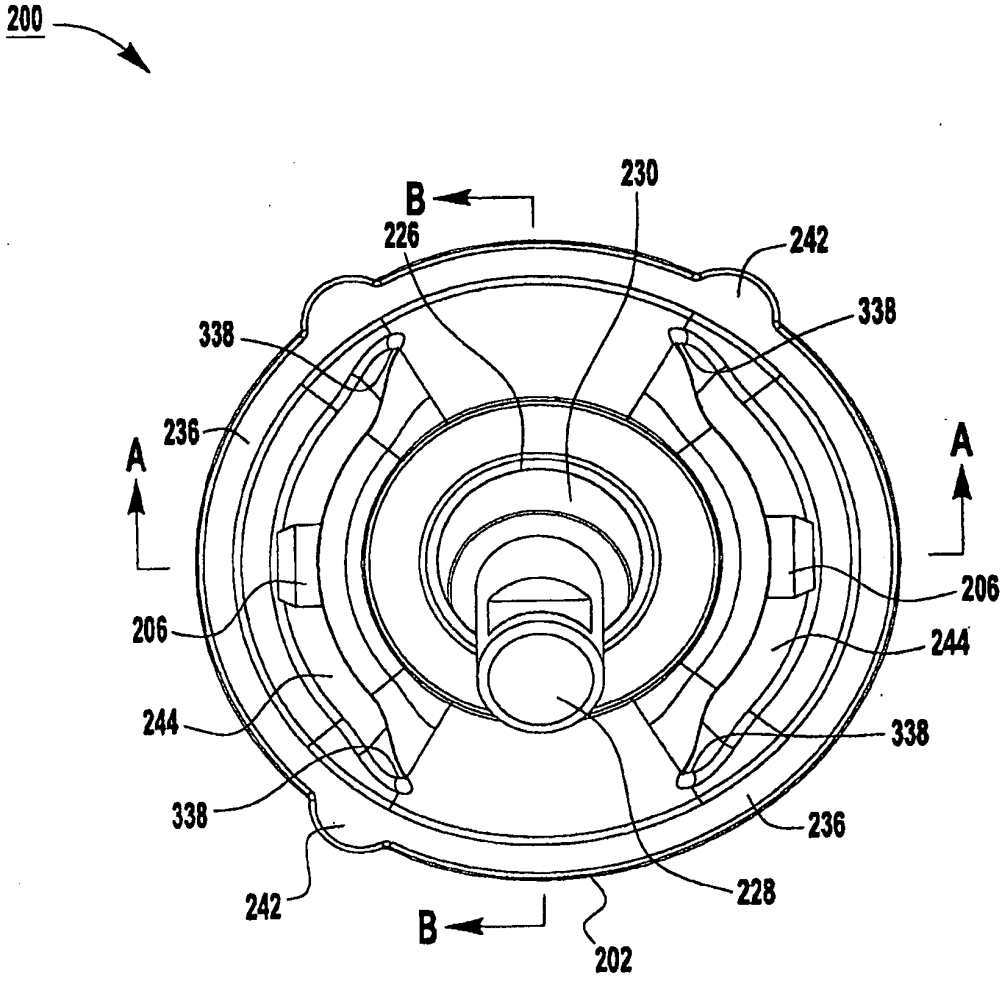
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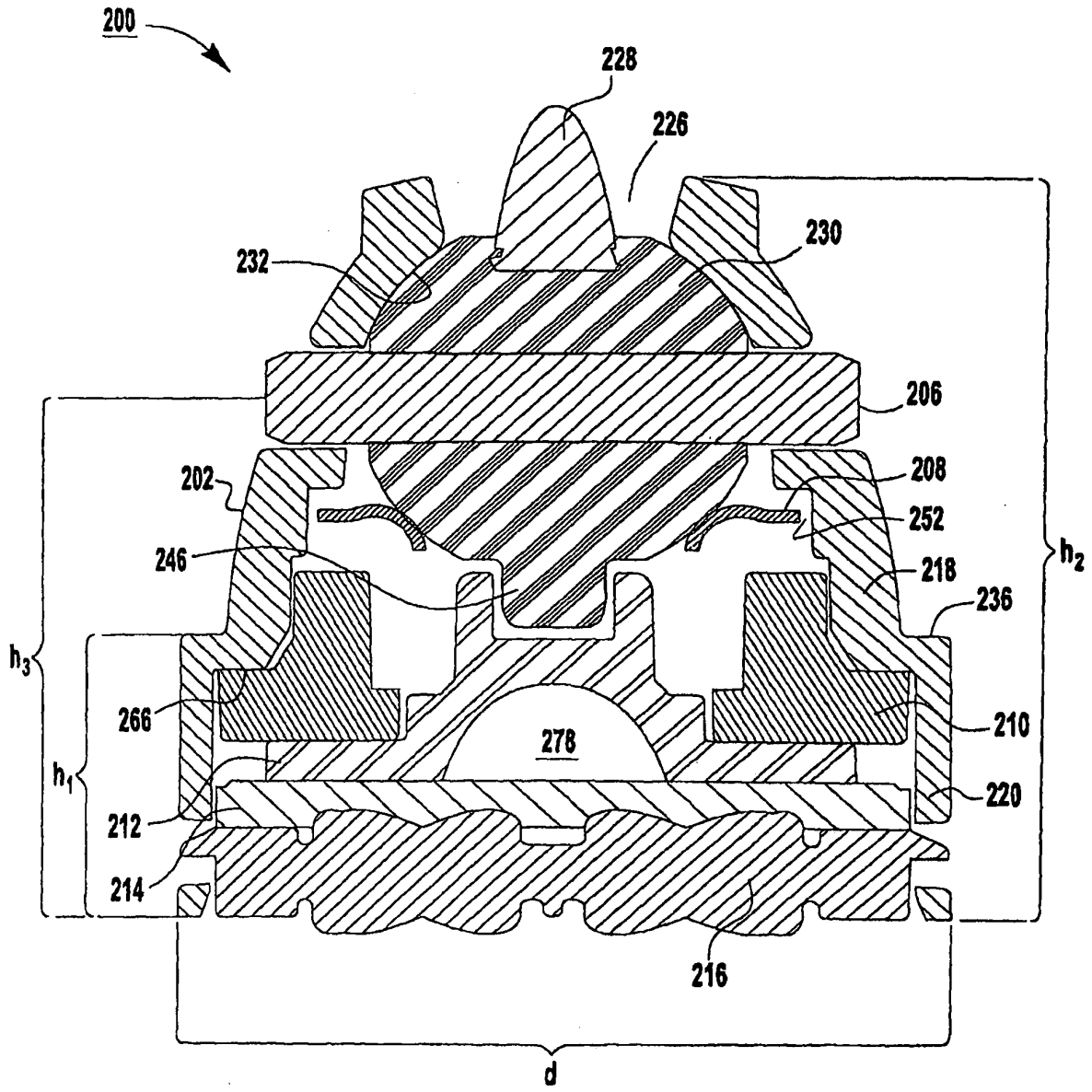
图 10A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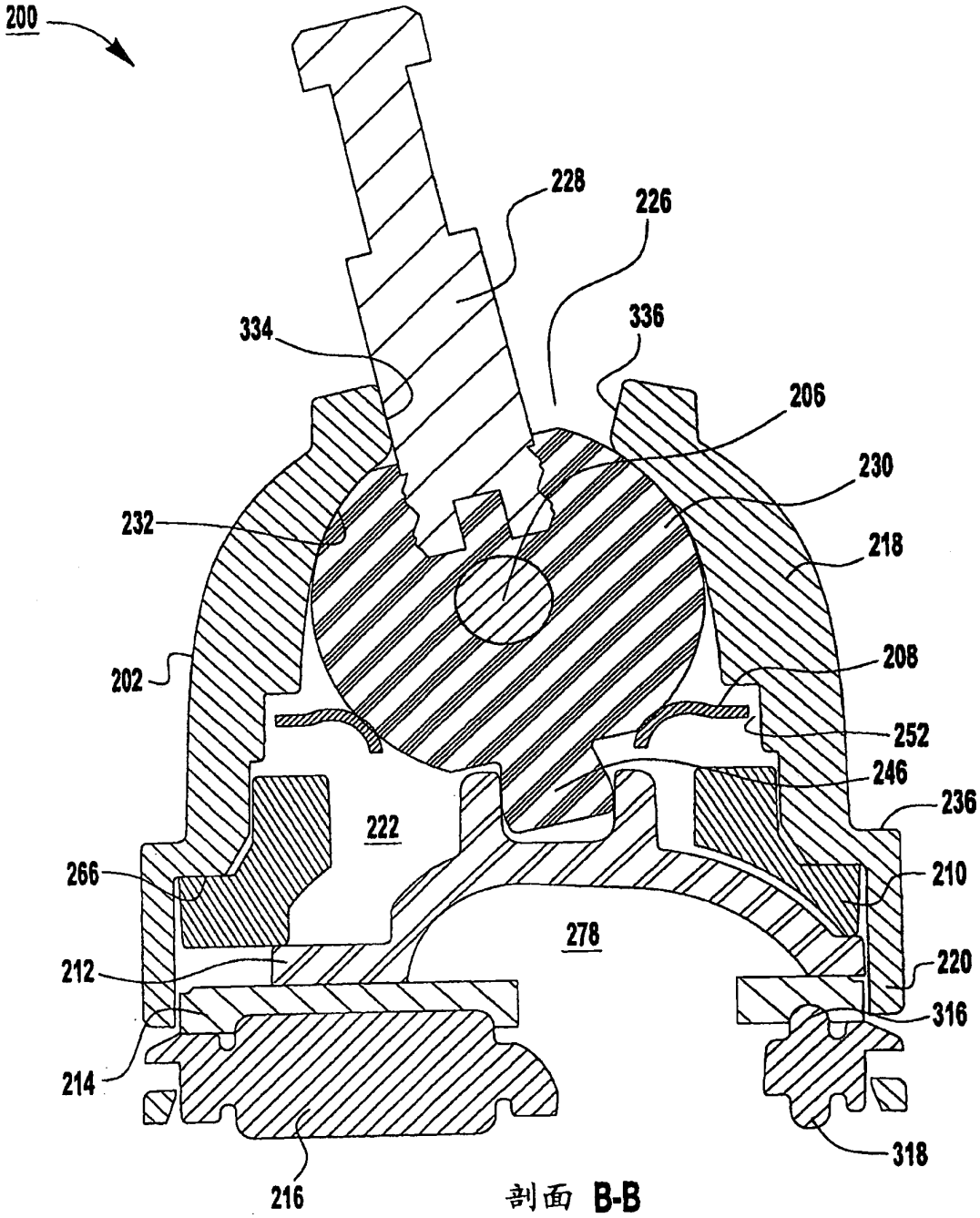
剖面 A-A

图 10B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剖面 B-B

图 10C

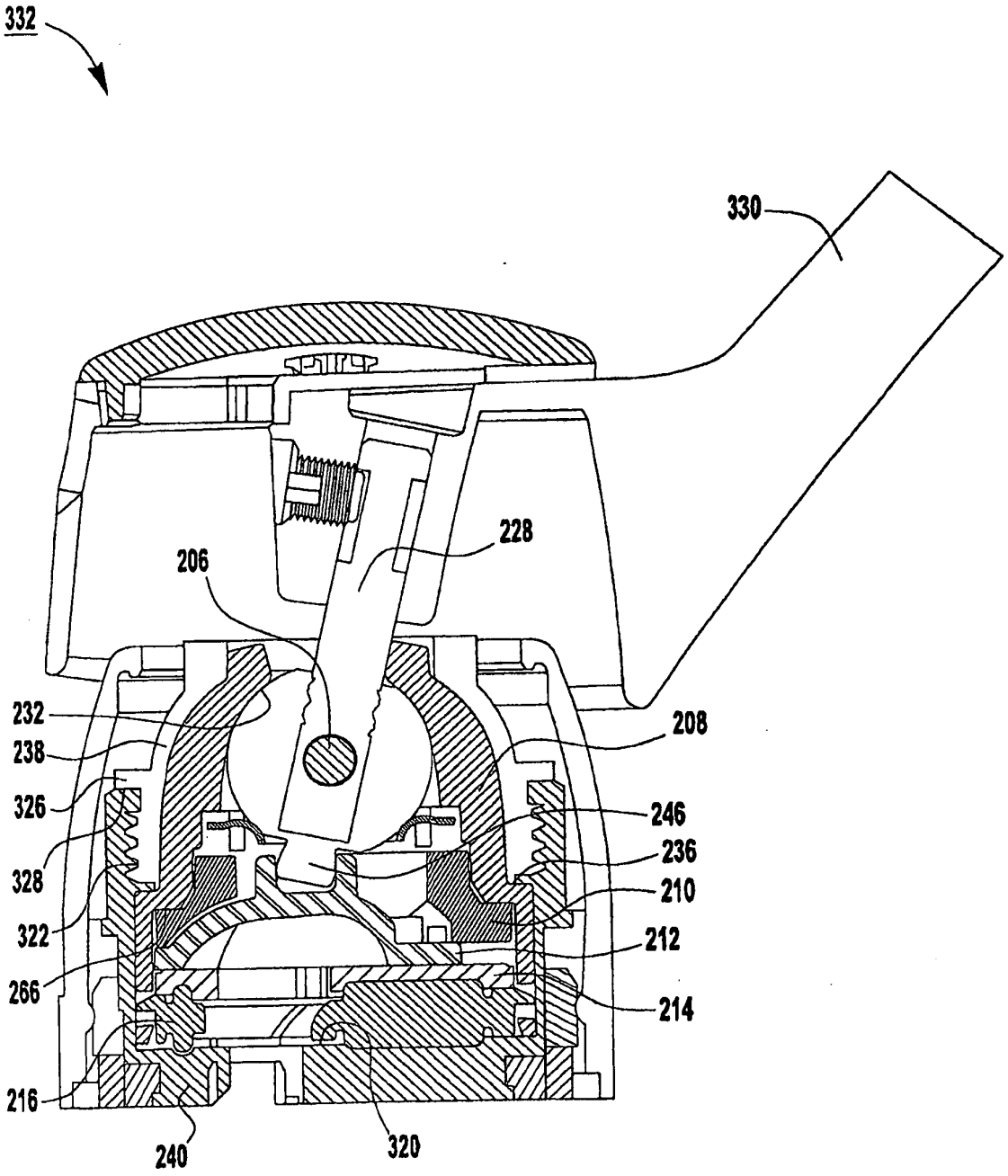
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图 11

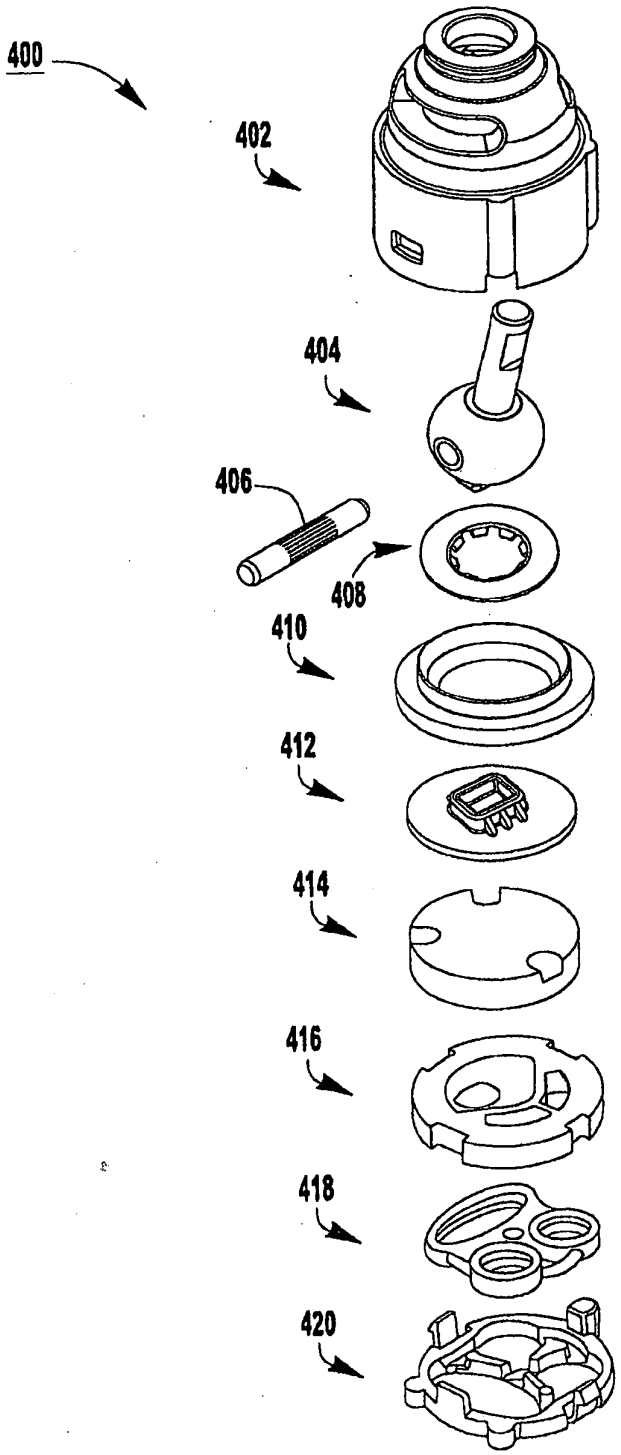


图 12

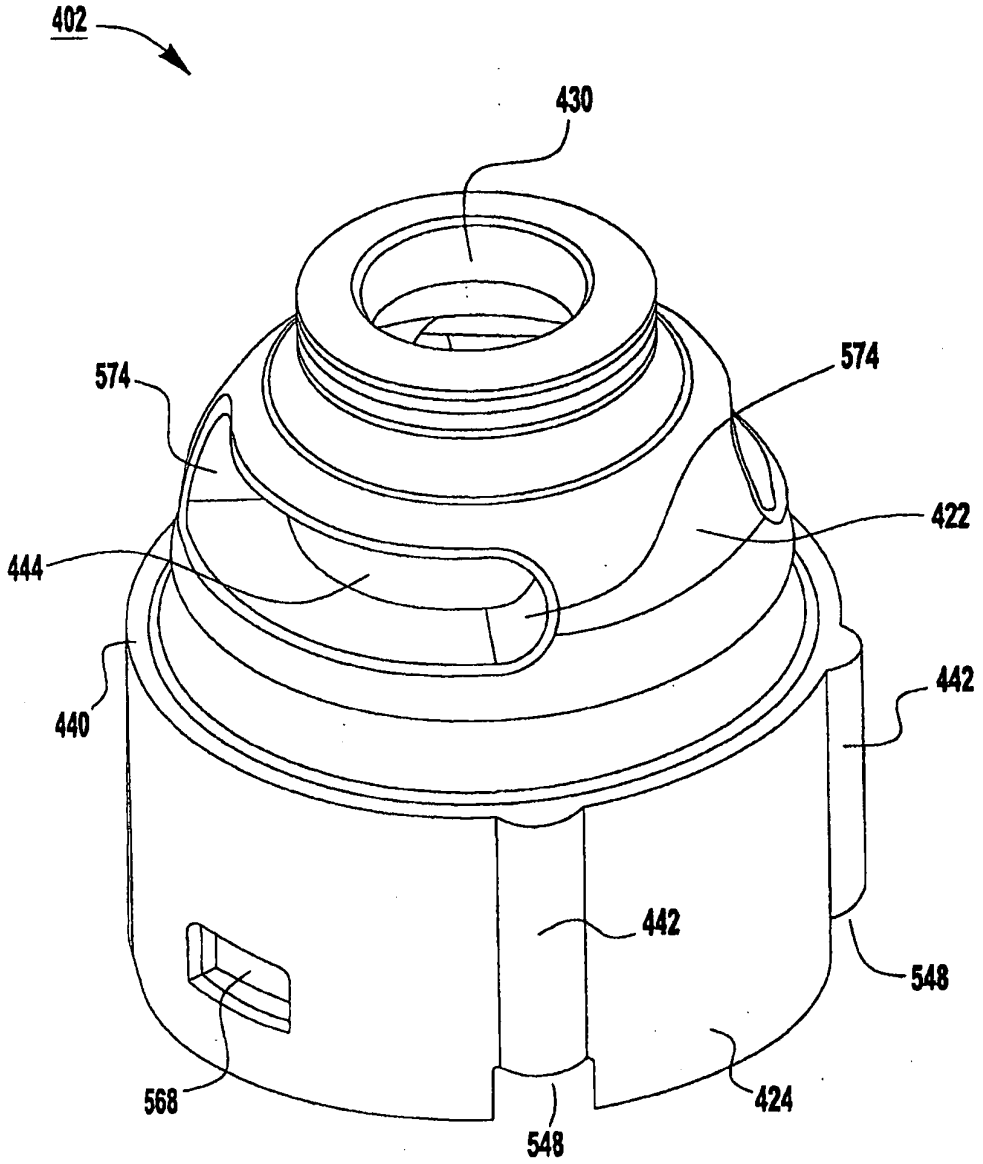


图 13A

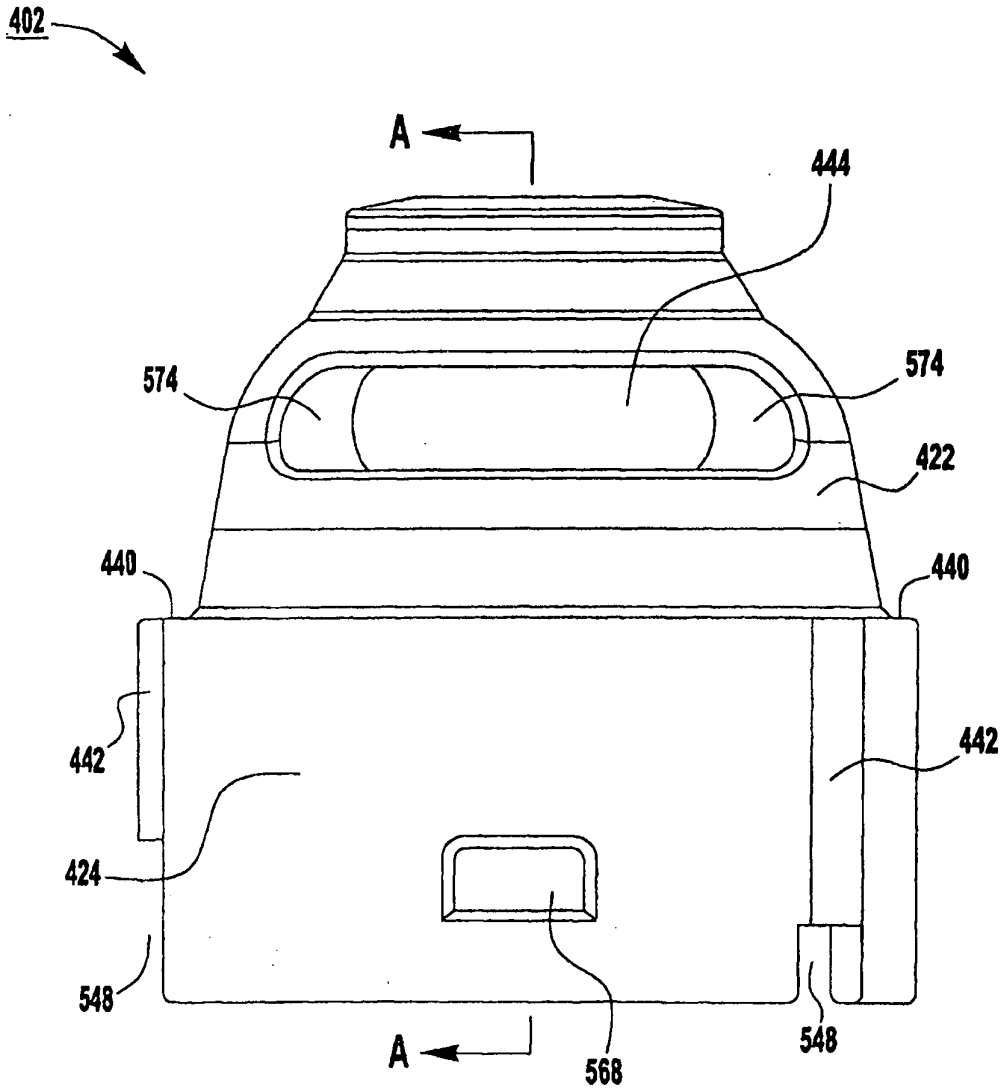
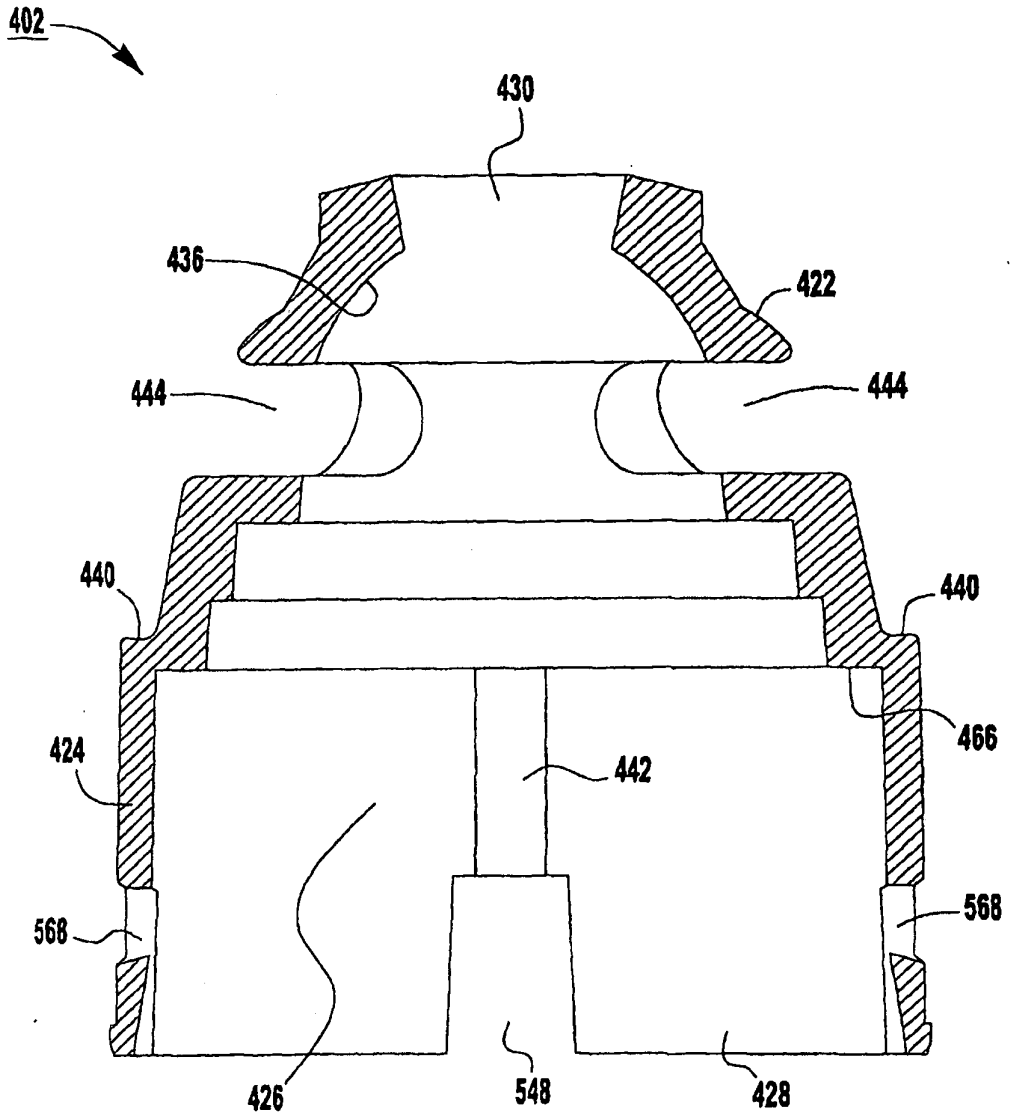


图 13B



剖面 A-A

图 13C

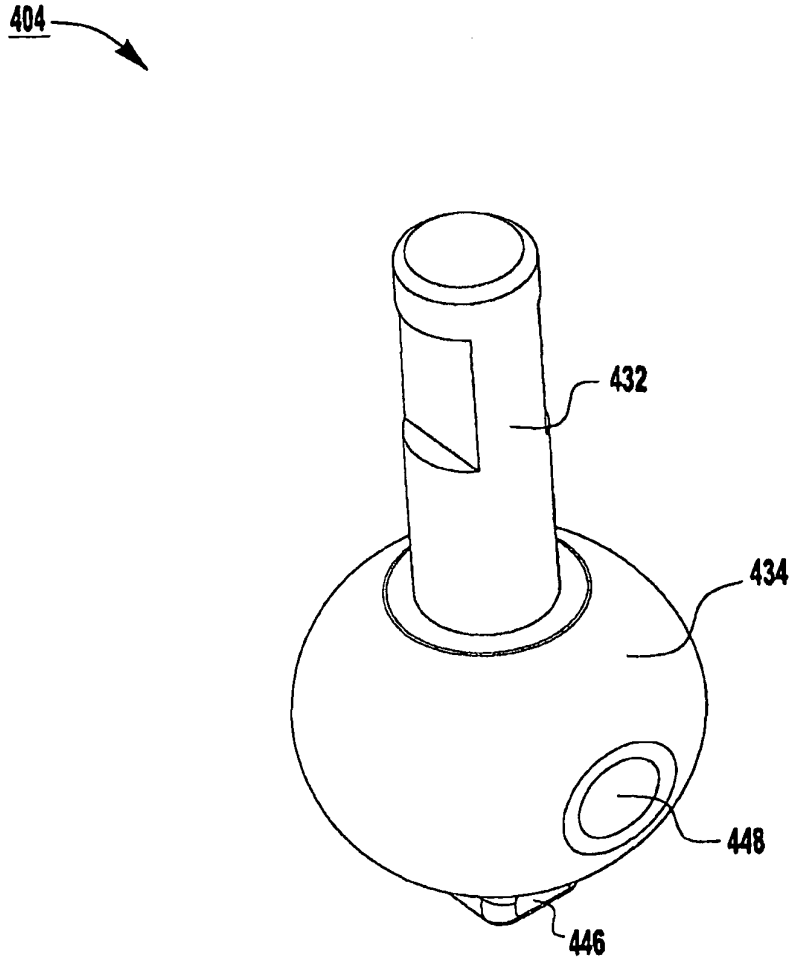


图 14

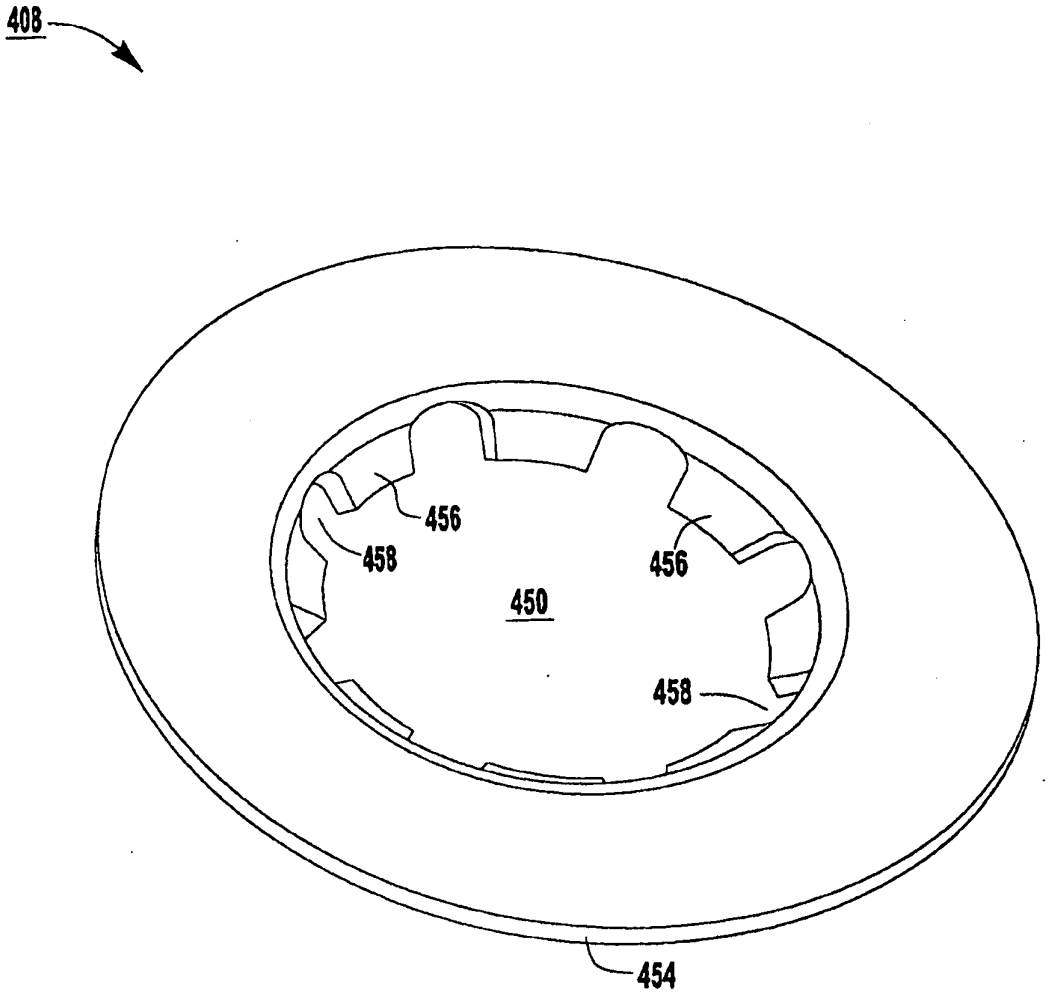


图 15A

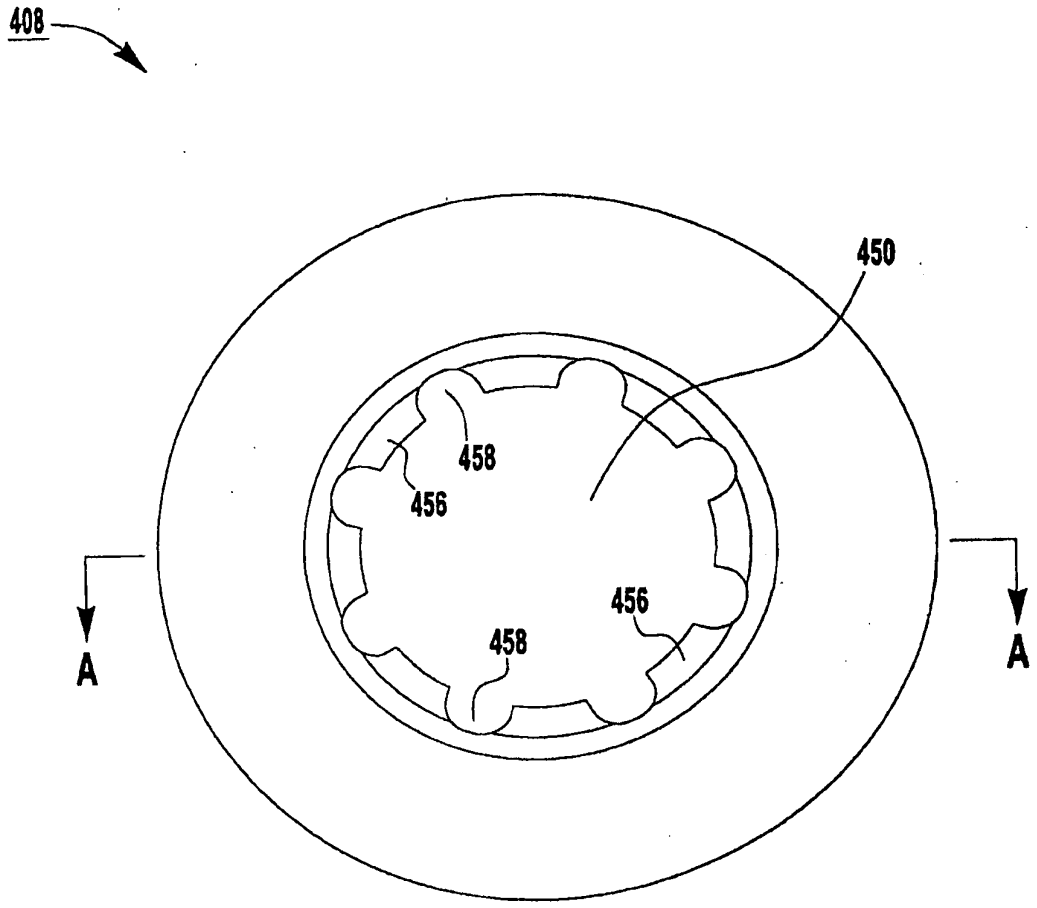
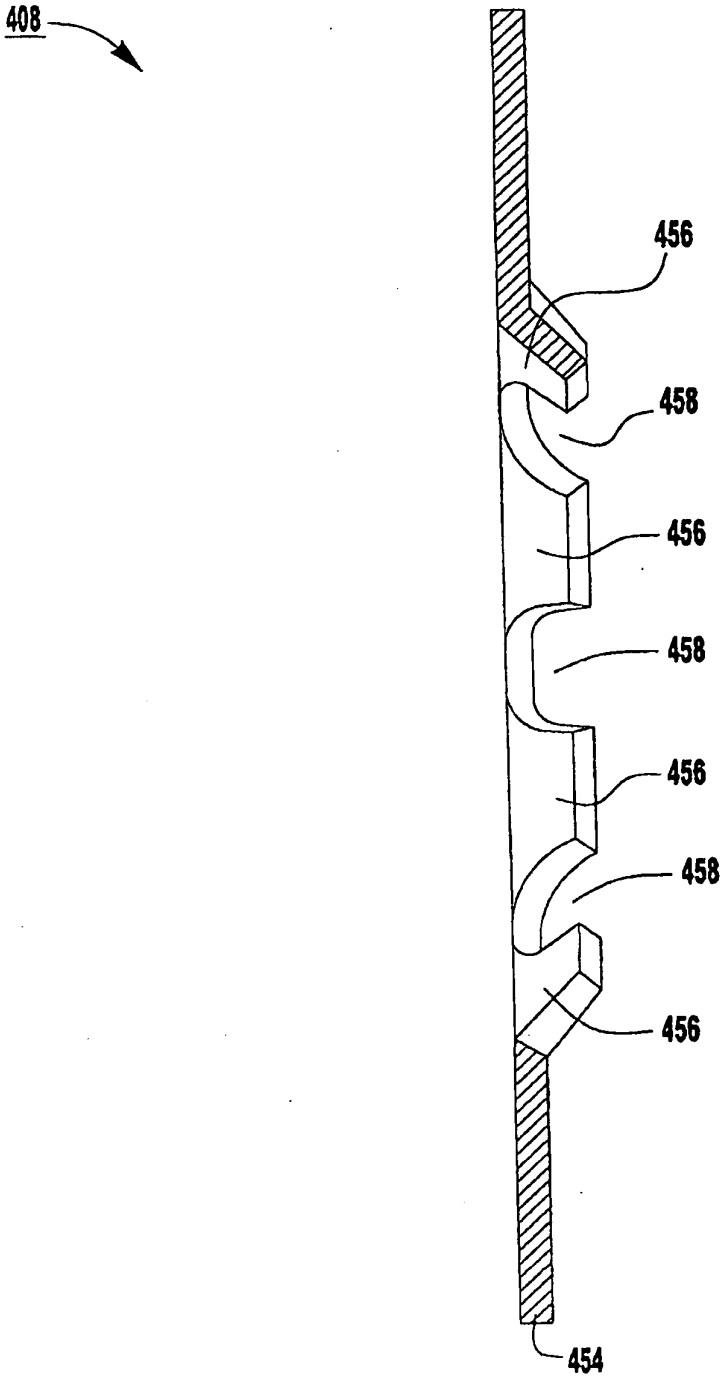


图 15B



剖面 A-A

图 15C

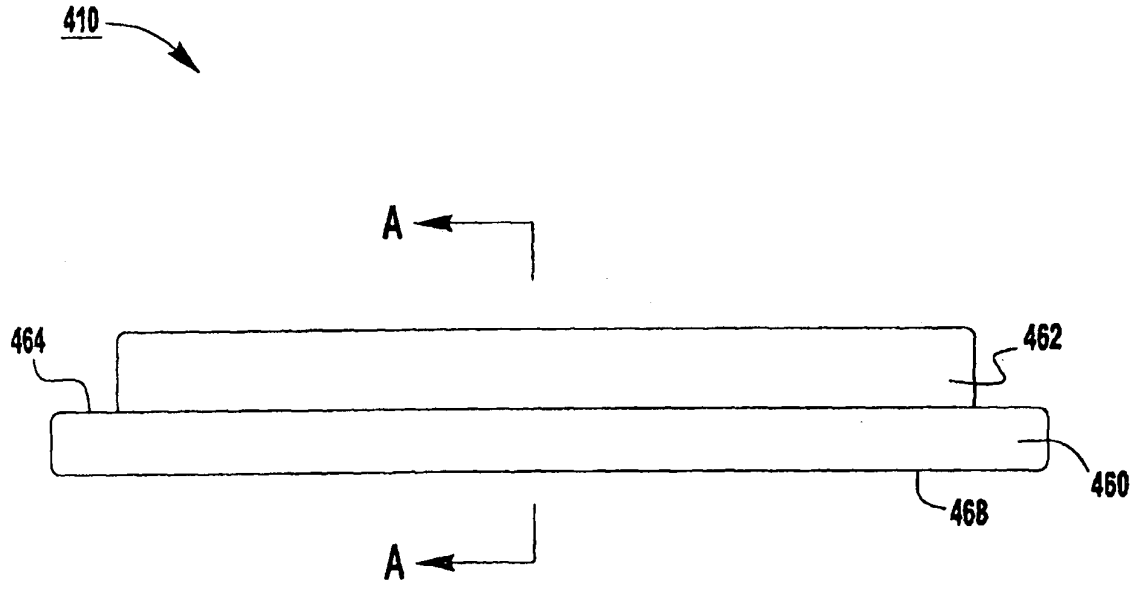
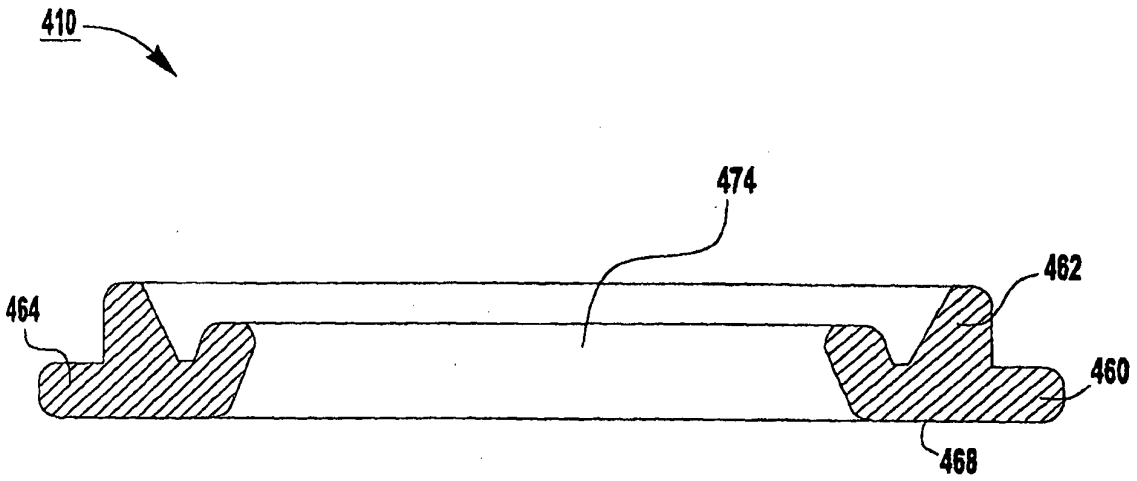


图 16A



剖面 A-A

图 16B

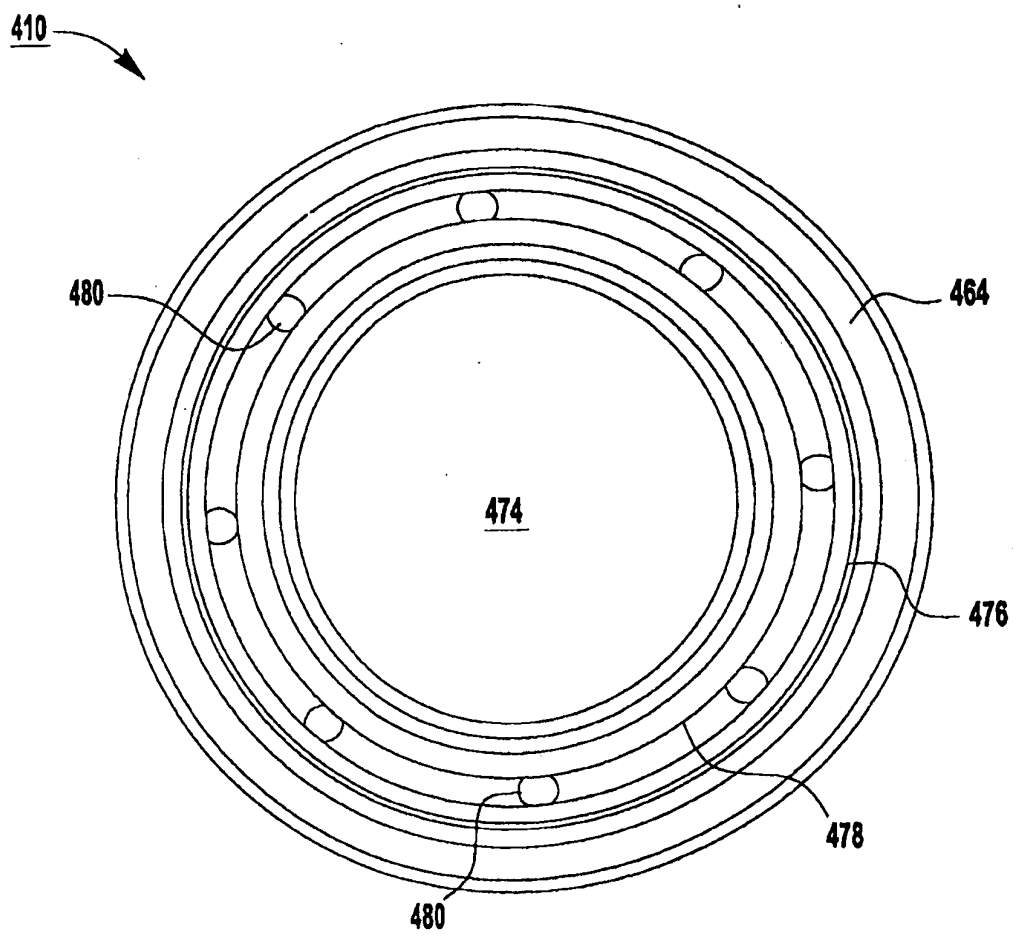


图 16C

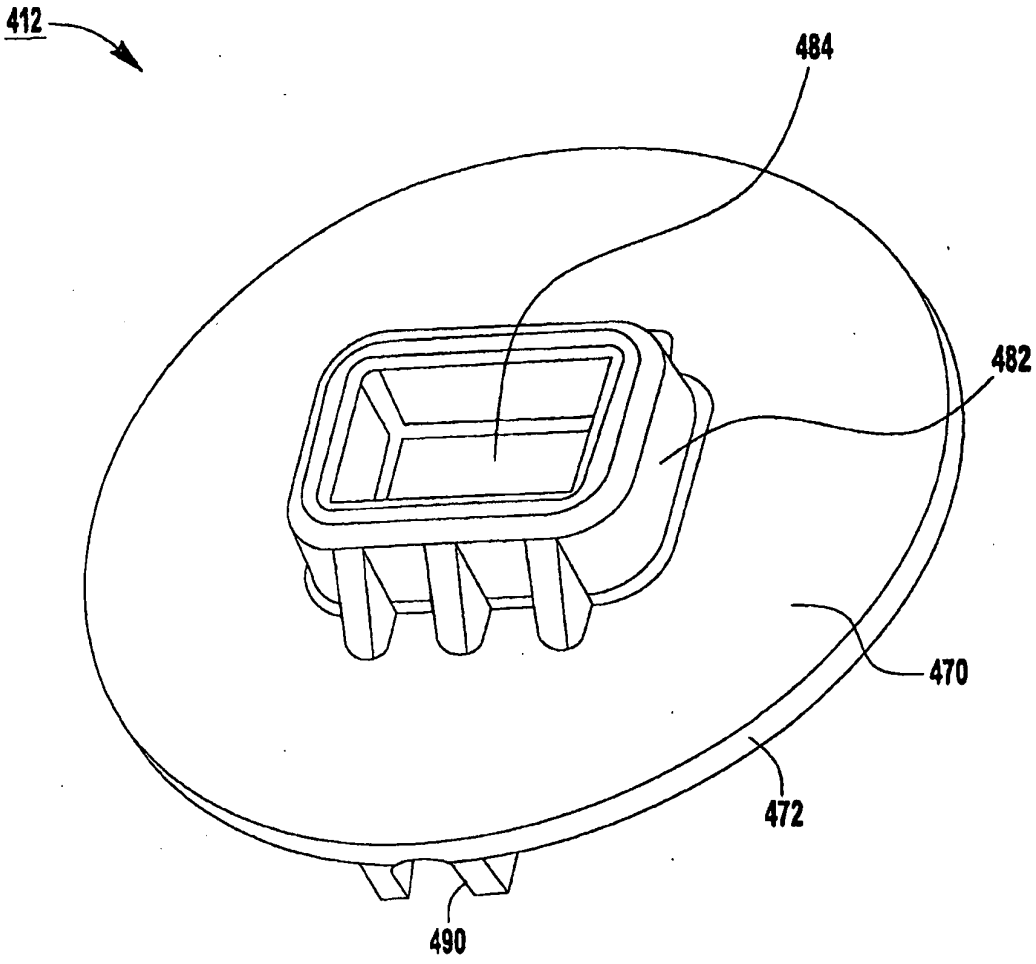


图 17A

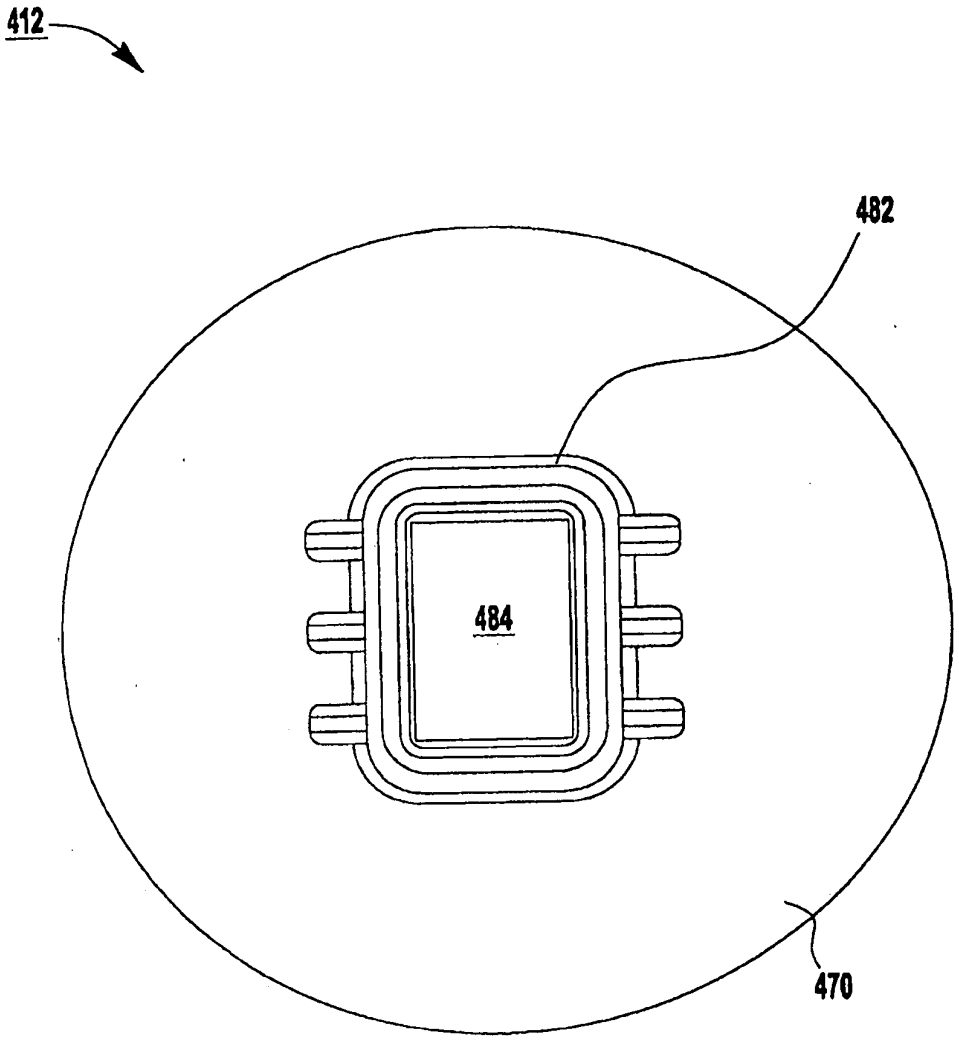


图 17B

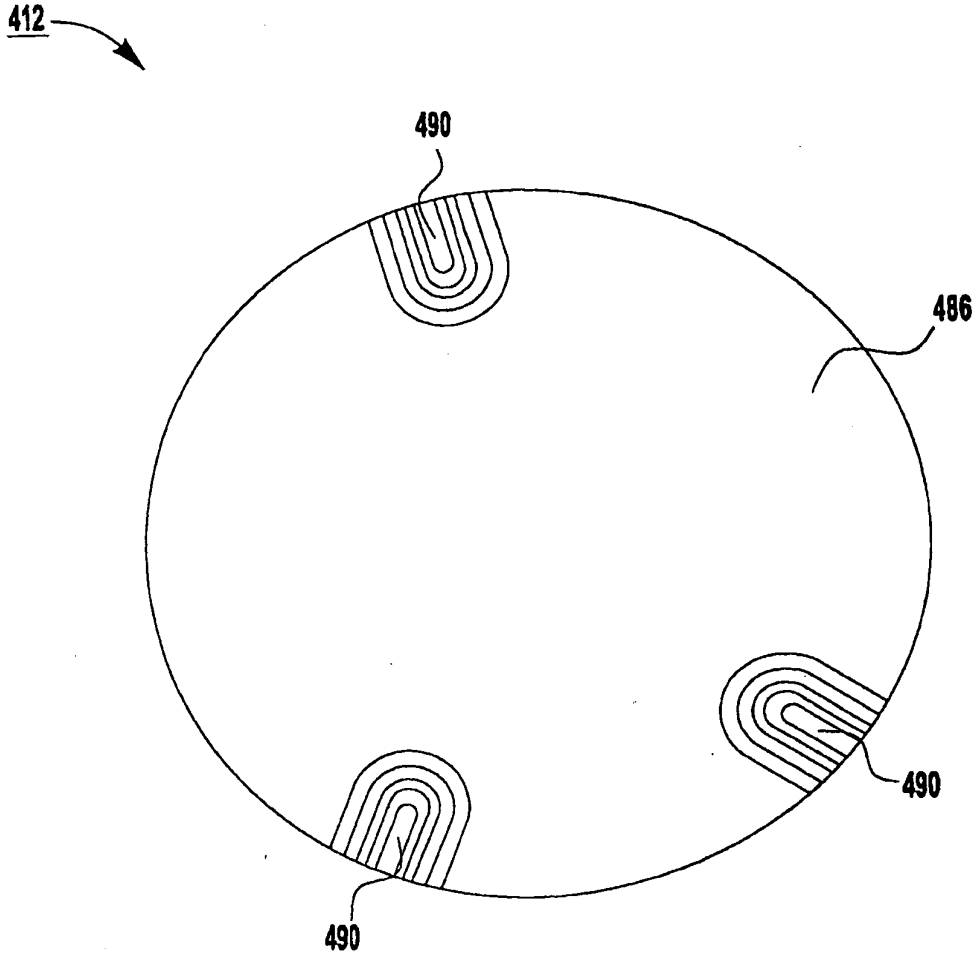


图 17C

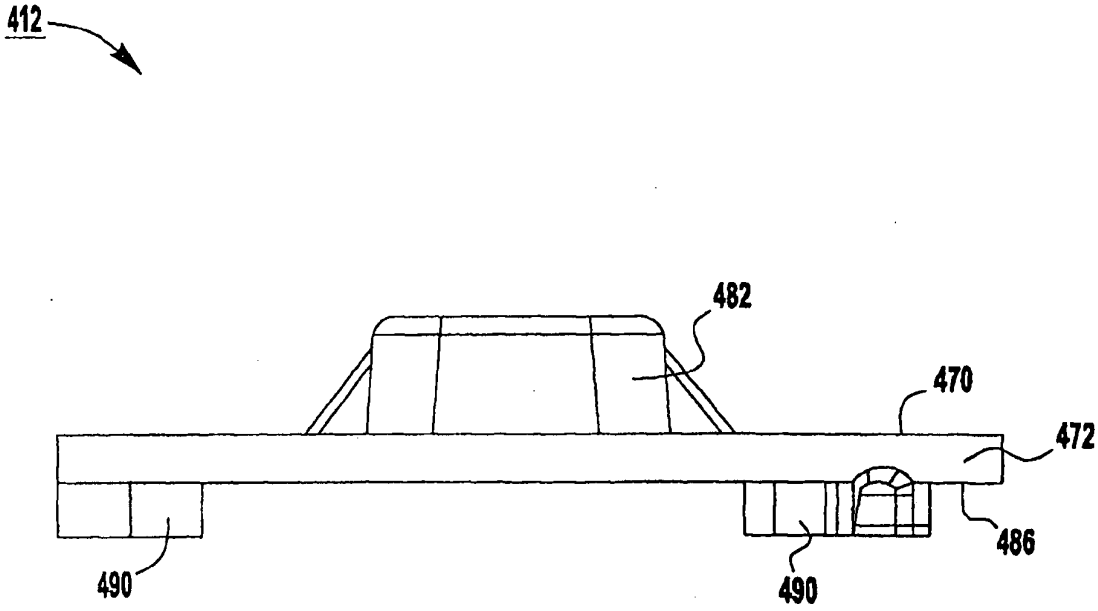


图 17D

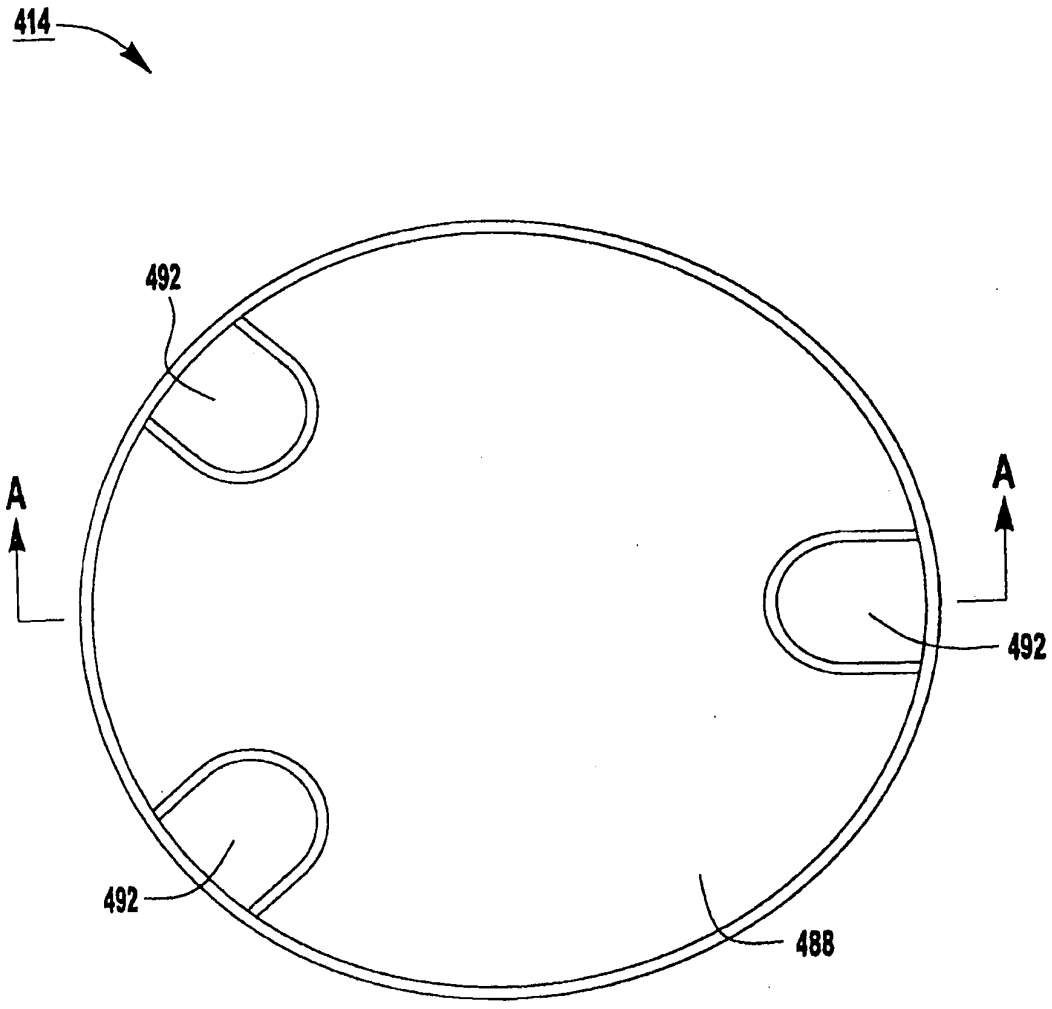
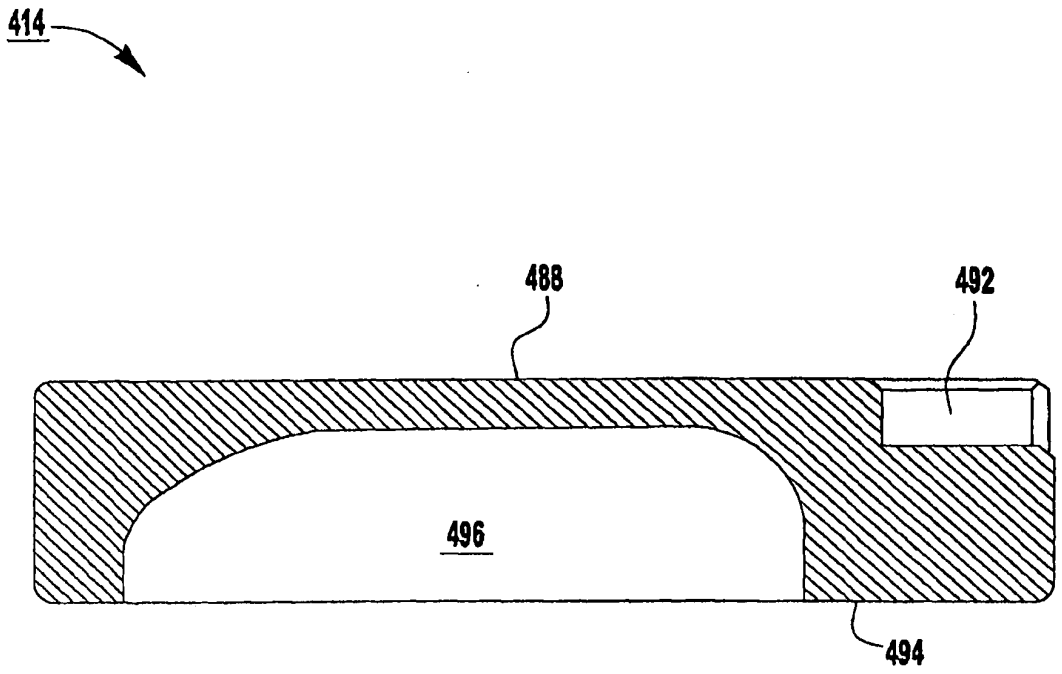


图 18A



剖面 A-A

图 18B

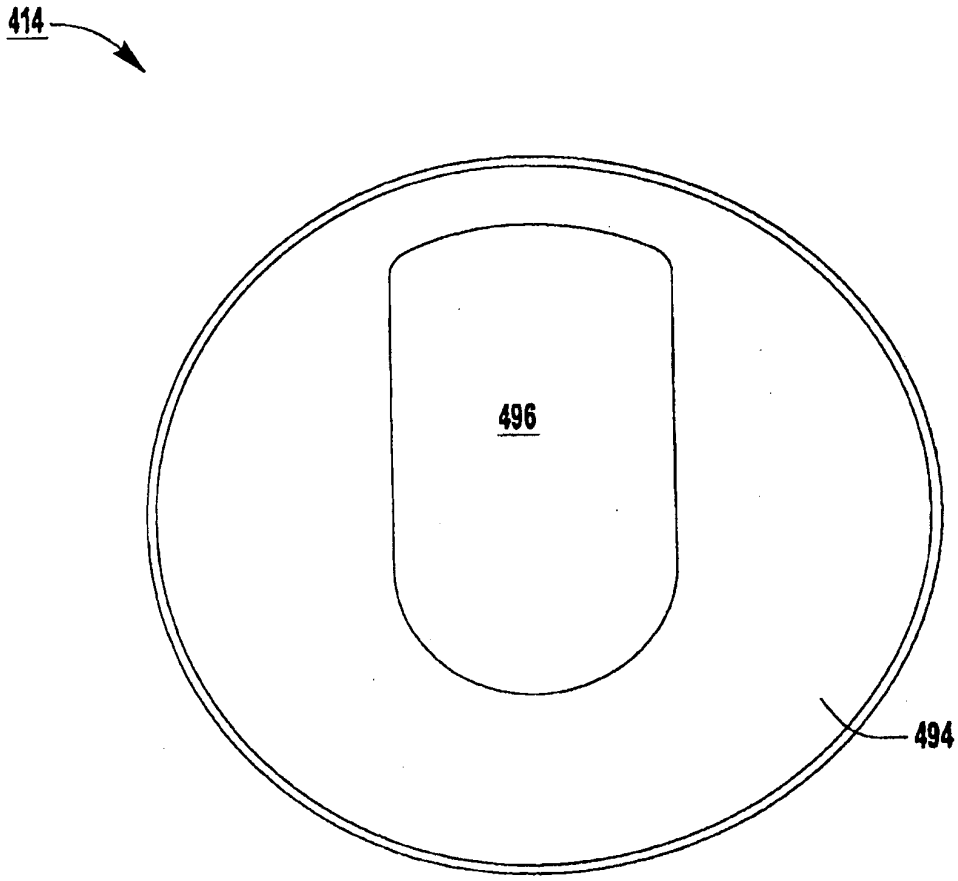


图 18C

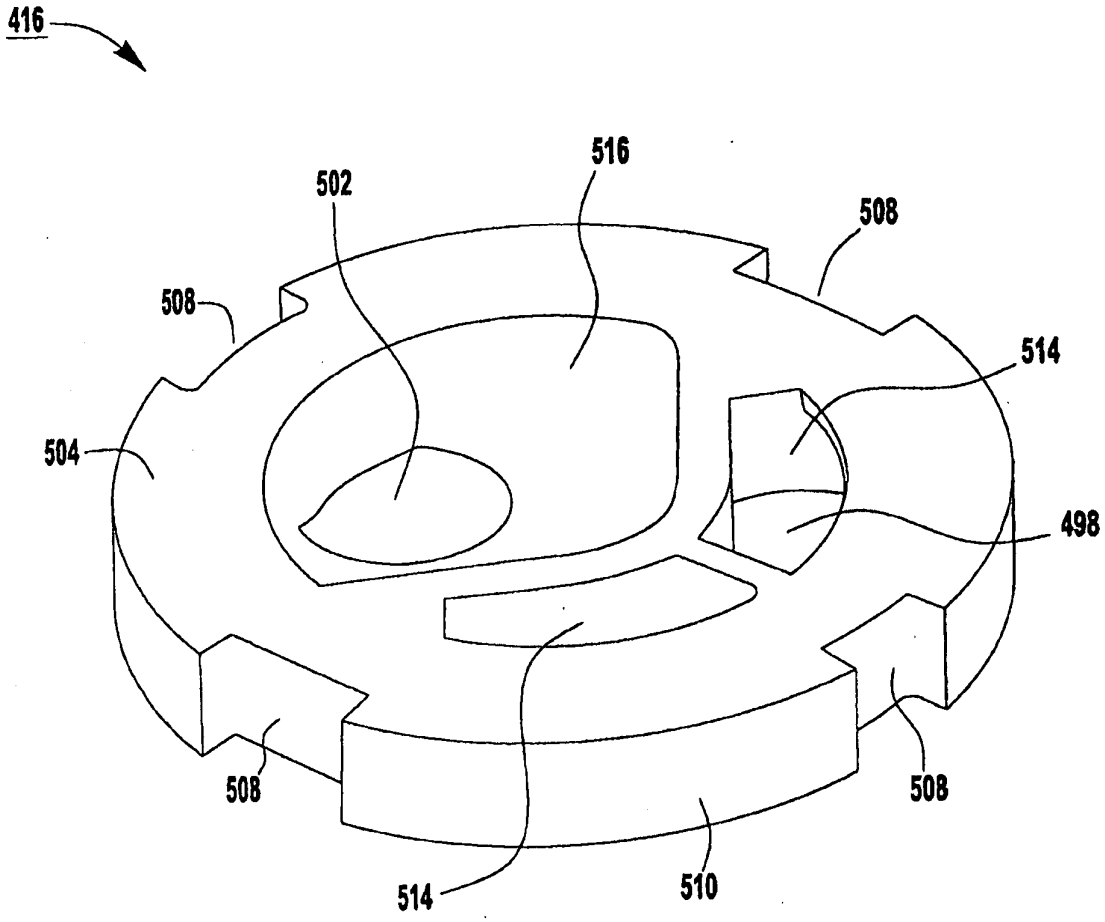


图 19A

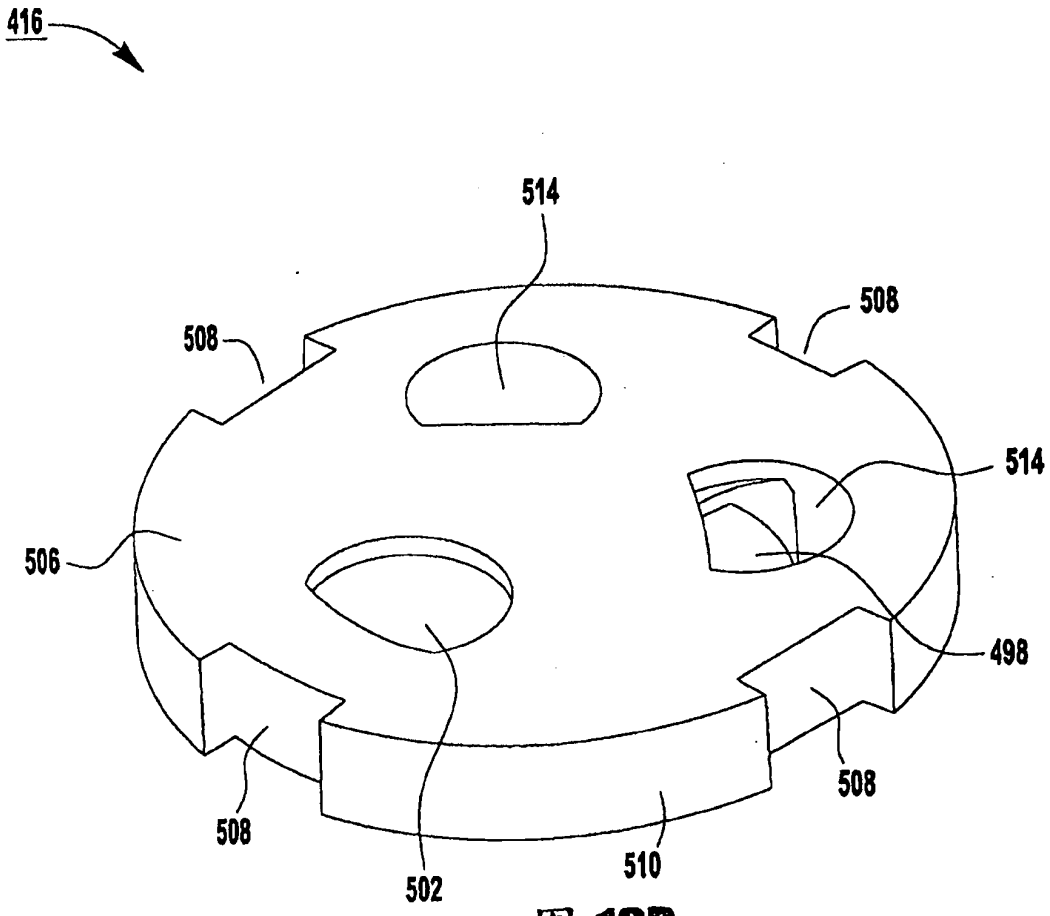


图 19B

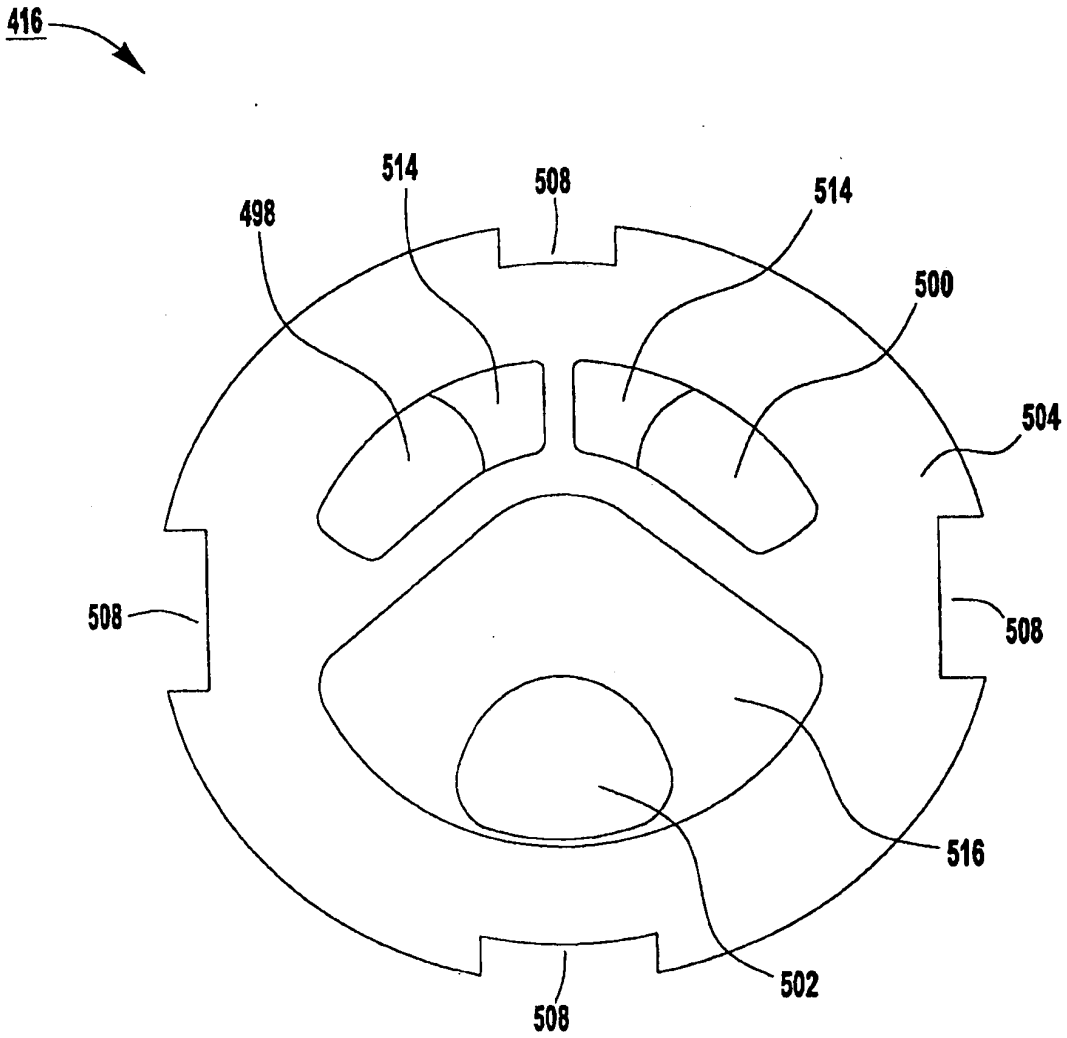


图 19C

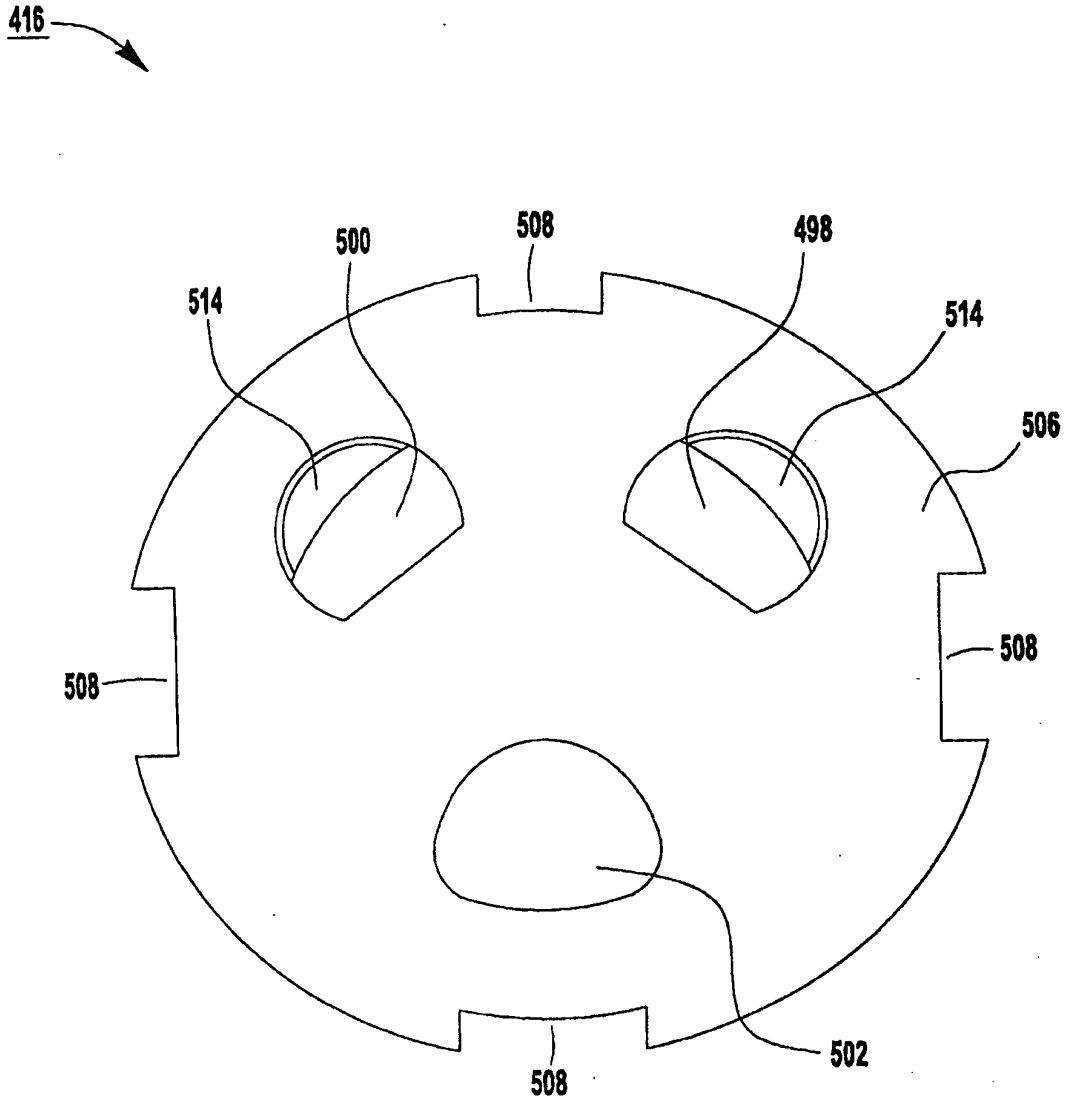


图 19D

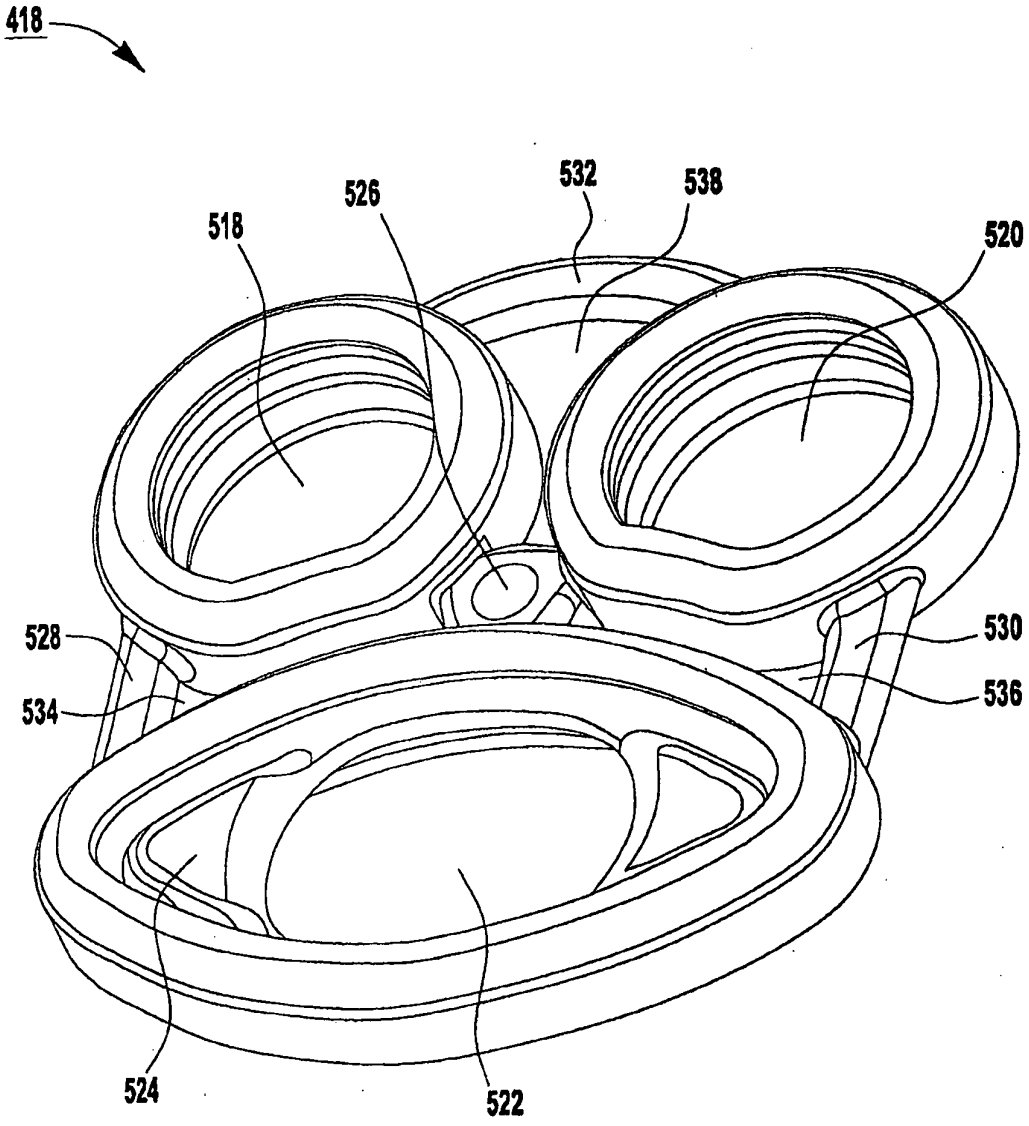


图 20A

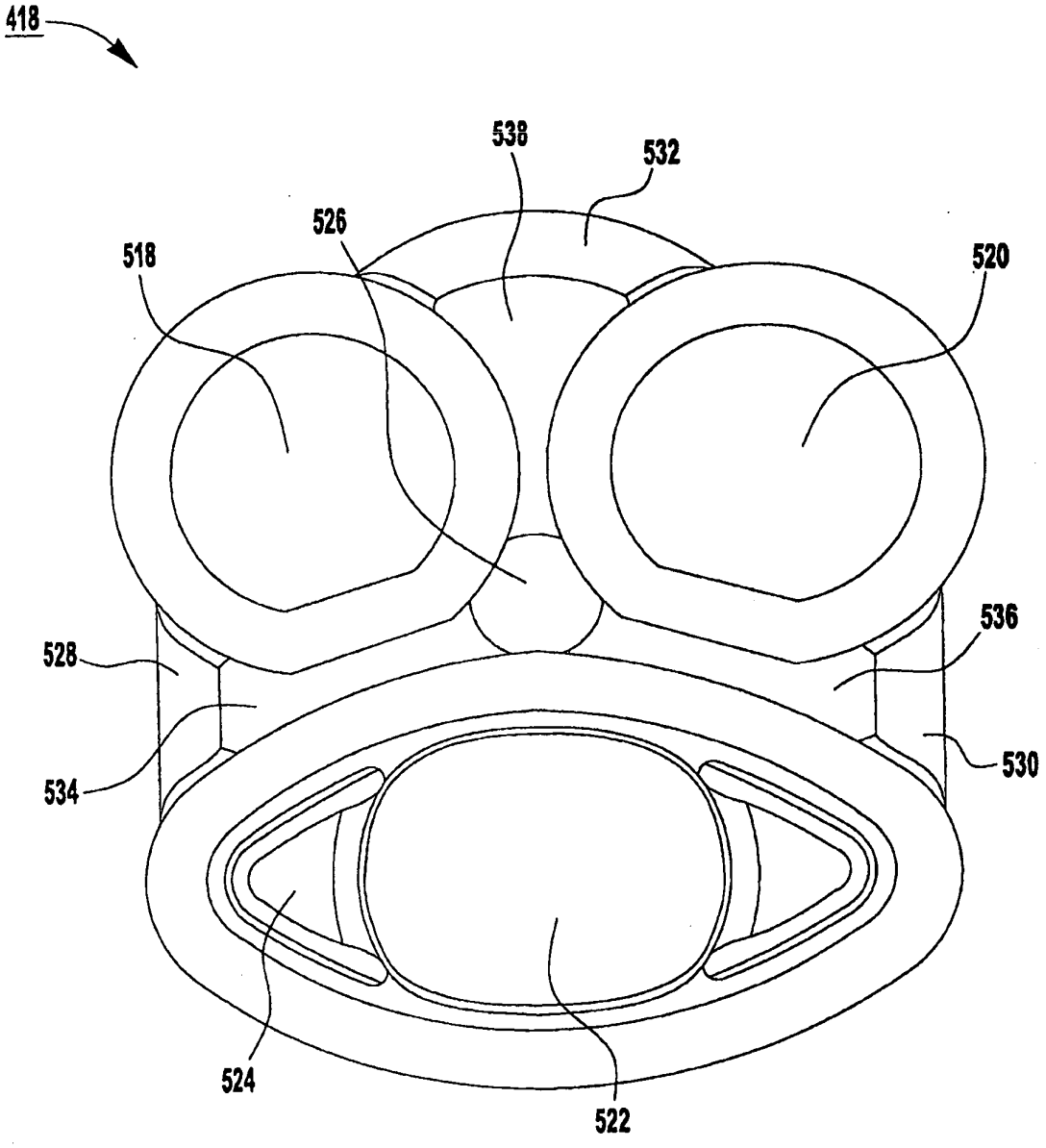


图 20B

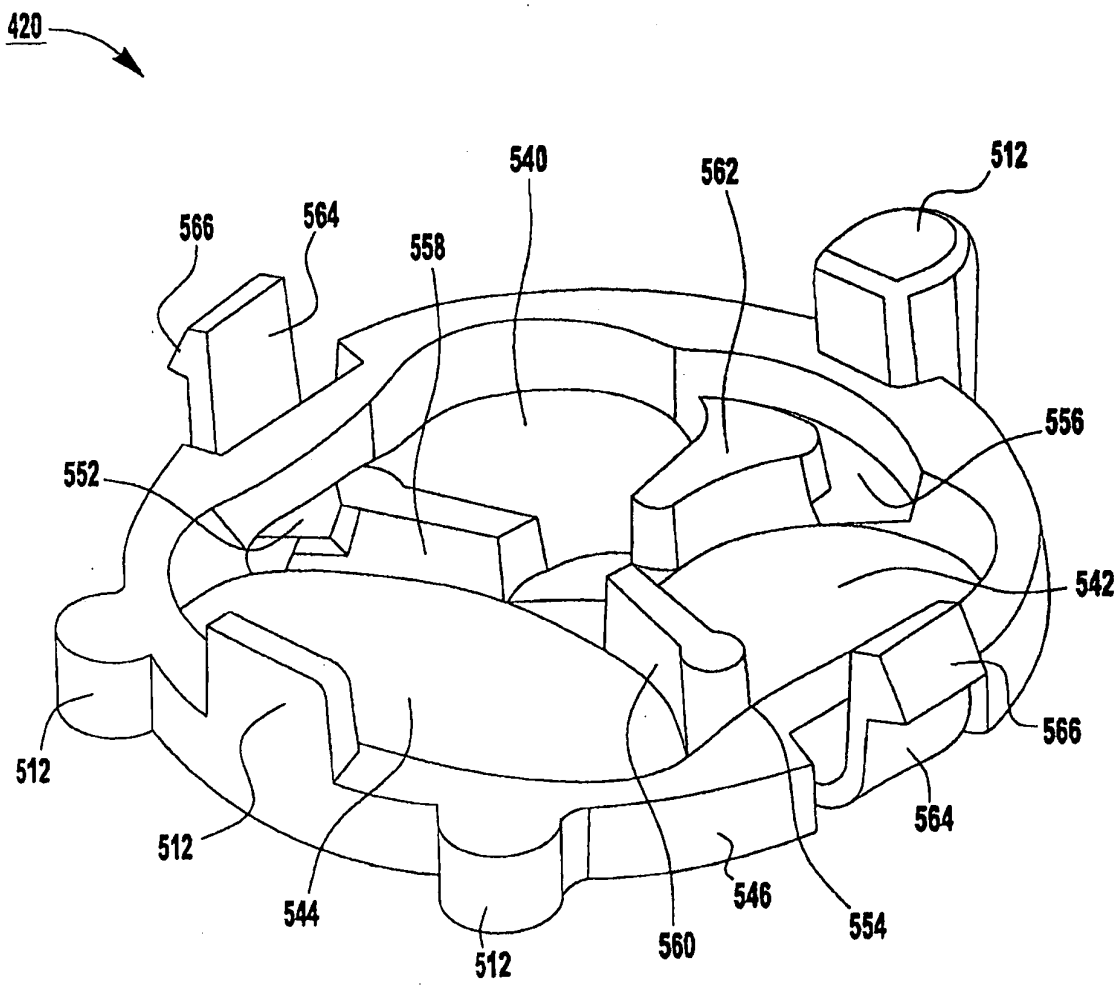

420
540
562
512
566
564
558
556
552
542
512
566
512
564
544
546
554
512
560

图 21A

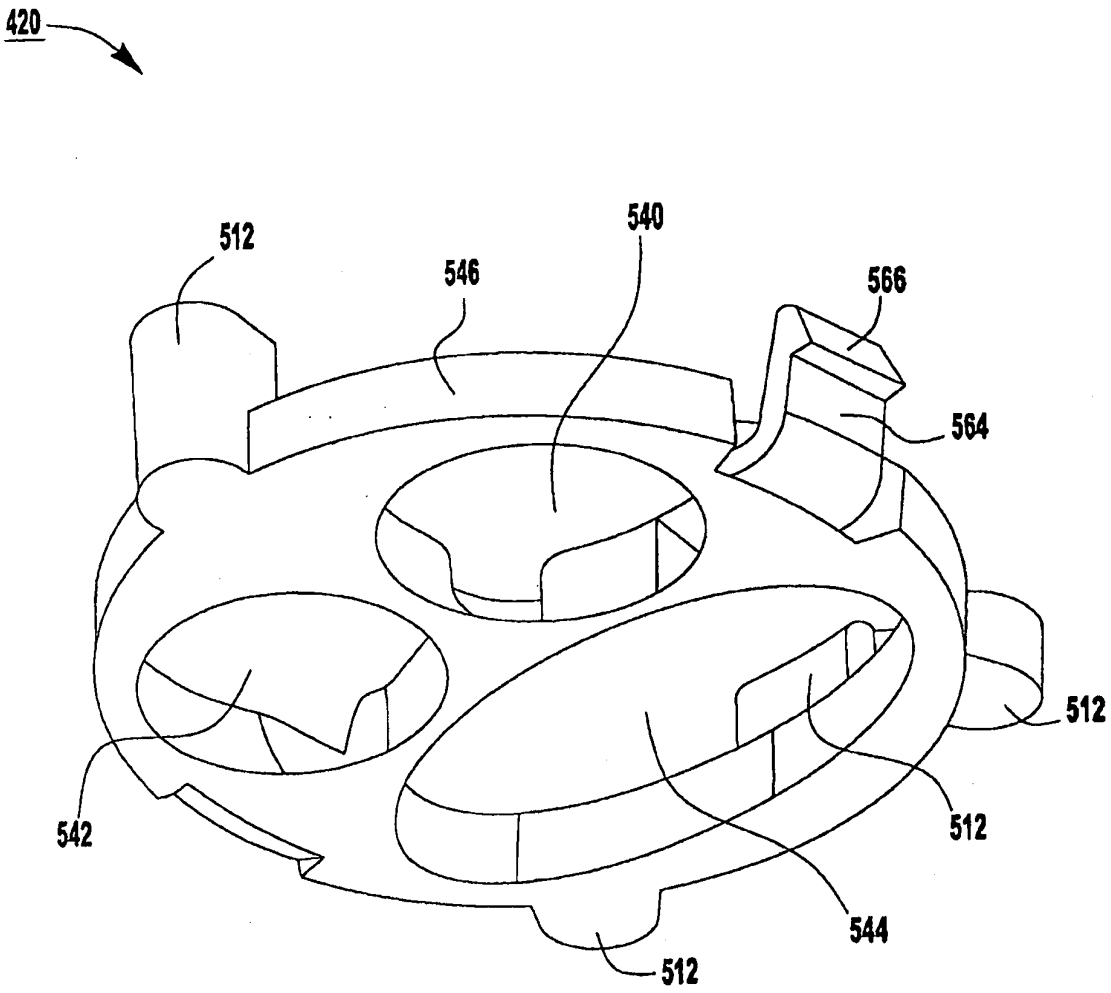


图 21B

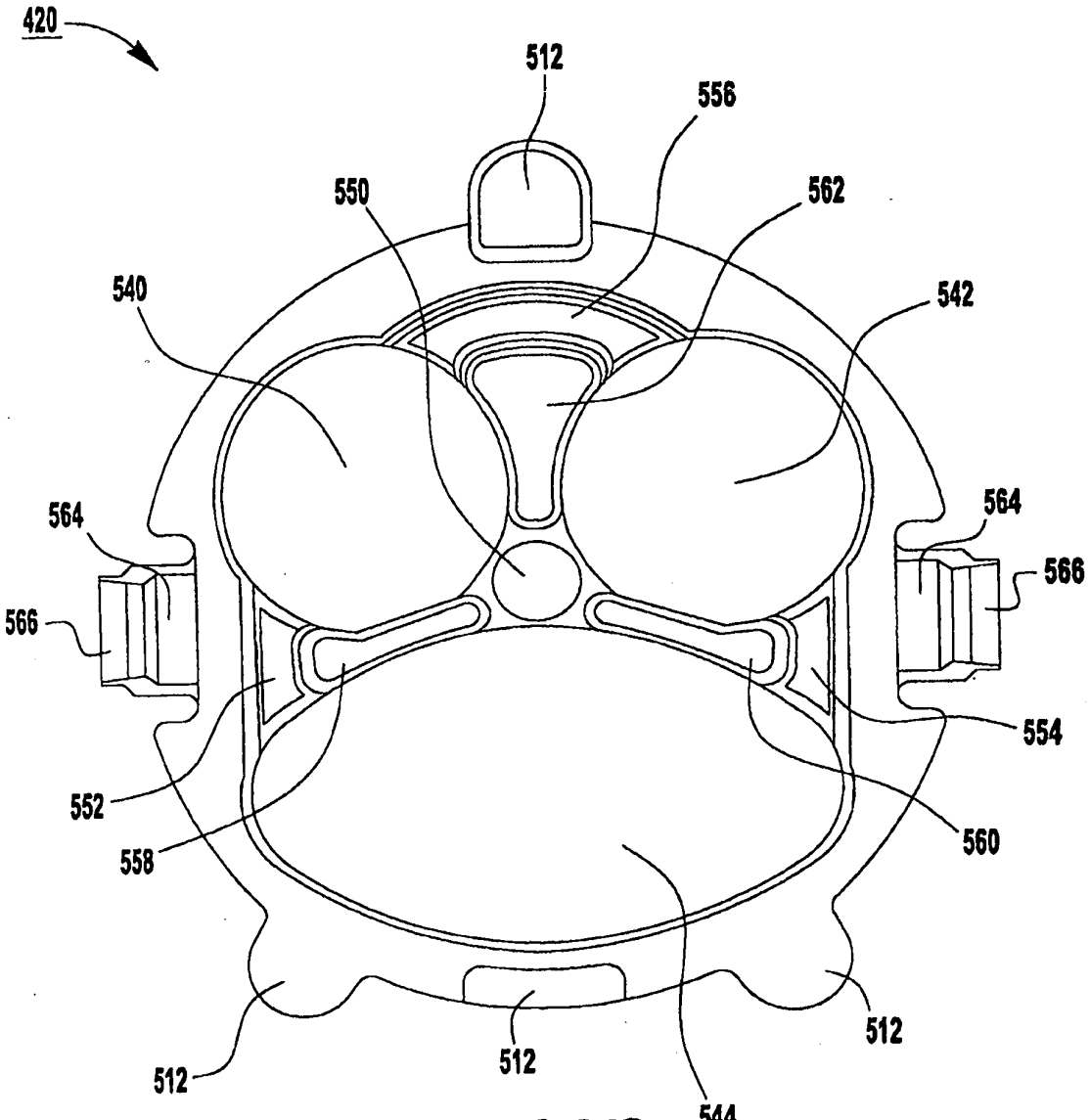

420
512
556
550
562
540
542
564
564
566
566
554
552
560
558
512
512
512
544

图 21C

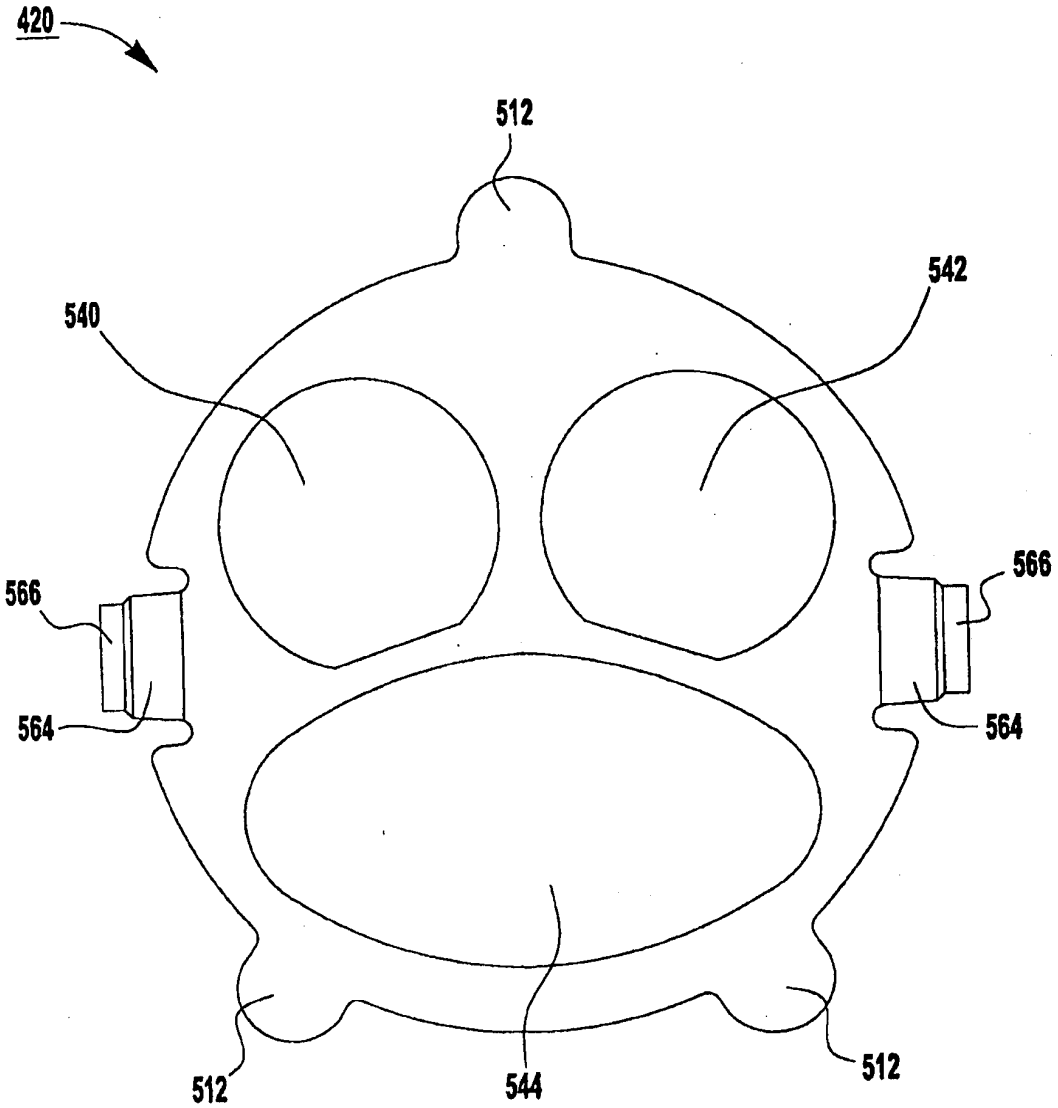


图 21D

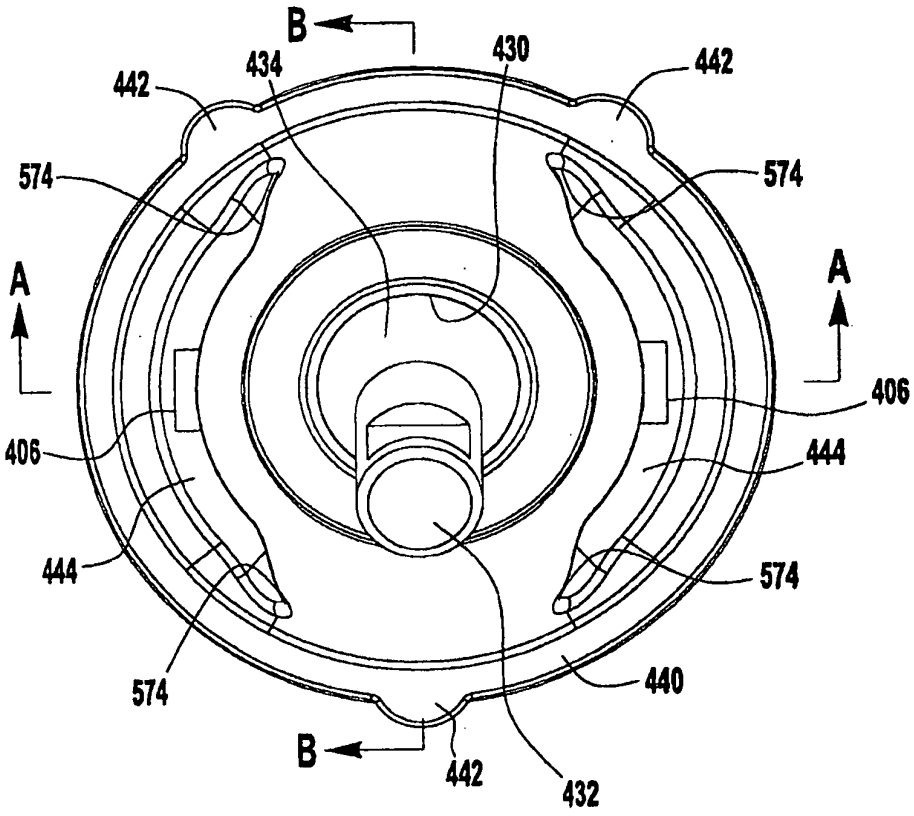
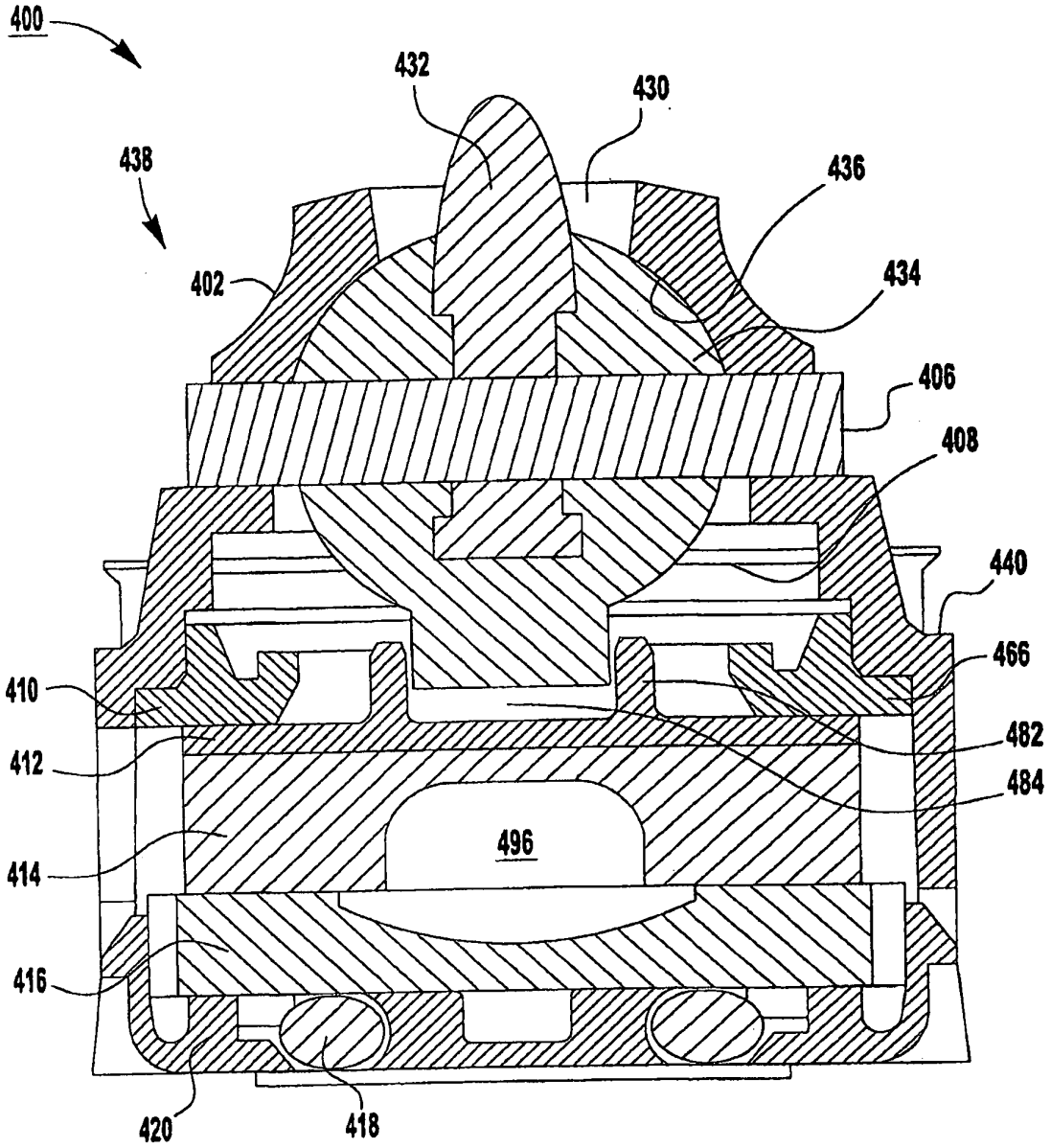
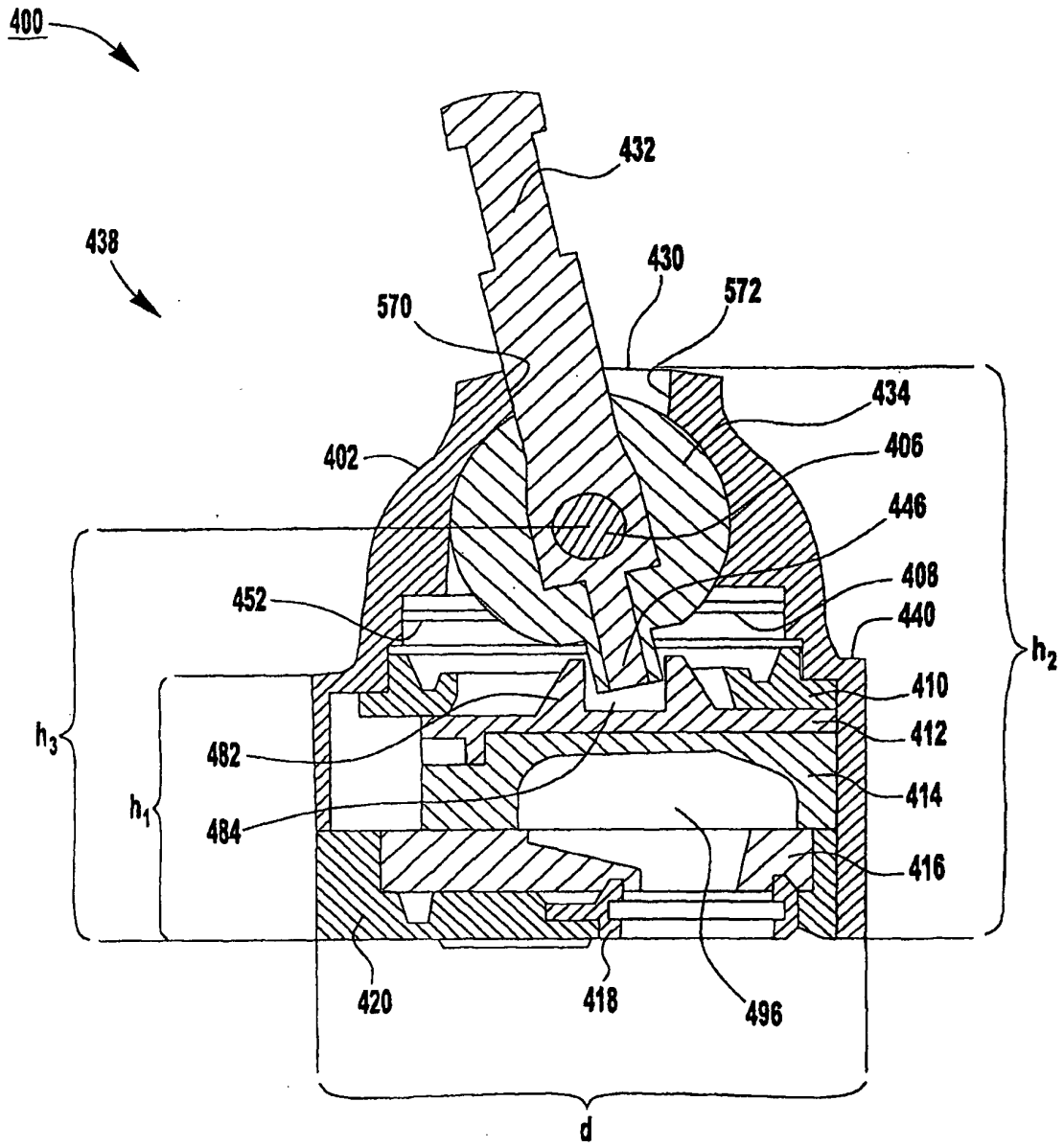


图 22A


400
432
430
438
436
402
434
406
408
440
466
410
482
412
484
496
414
416
420
418

剖面 A-A

图 22B


400
438
432
430
572
570
434
406
402
446
408
452
440
410
412
482
414
484
416
420
418
496
h_1
h_2
h_3
d

剖面 B-B

图 22C

(57) Abstract: A one-handle valve cartridge has a low point of contact for installing the valve cartridge in a valve body. A retention nut bears down on the low point of contact to secure the valve cartridge in the valve body.