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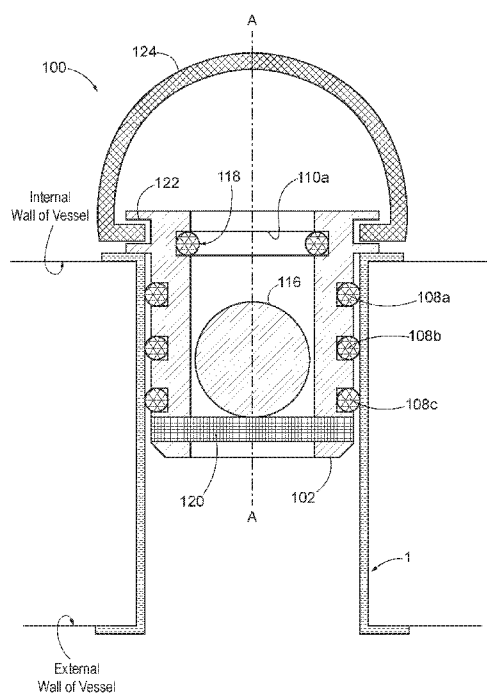


FIG. 5C

(57) Abstract: A valve for use with a vessel drain tube includes a body extending along a longitudinal axis. The body has an outer surface and an inner surface defining a bore extending longitudinally from a first end to a second end. The valve includes an external seal on the outer surface of the body for sealing with the drain tube, at least one internal seal on the inner surface extending into the bore, a retaining member extending at least partially into the bore and being spaced from the internal seal, and a sealing member displaceable between the internal seal and the retaining member. The sealing member is configured to seal with the internal seal in a valve closed, first configuration and to not seal with the internal seal in a valve open, second configuration.



MARINE DRAIN VALVE

BACKGROUND

1. Field

[0001] The present application relates to boats and watercraft and, more particularly, to a drain valve for draining water from interior compartments of boats and watercraft.

2. State of the Art

[0002] During operation of boats and other watercraft, water can accumulate in interior compartments of the boat. Further, boat operators will often clean these interior compartments with water (or other fluid) which can also result in accumulations of water (or other fluid) within the interior compartments of the boat. Consequently, drains and drain plugs are often installed in the interior compartments of boats so that water accumulated therein can be drained outside of the boat.

[0003] For example, in a typical boat, a drain tube is used to drain water from the passenger compartment through the bottom or hull of the boat to the exterior of the boat. The drain tube generally consists of a cylindrical brass or aluminum tube 1 (See Fig. 1A) extending fully across the thickness of the bottom of the hull and having rolled flanges 1a at opposite ends of the tube, which retain the tube in the hull and sealed therewith. The tube 1 can be plugged with a bailer plug 2 or 3 (Figs. 1B and 1C) to prevent water from entering the interior compartment of the boat when the boat is operating in the water. Usually, the drain tubes 1 are fitted to the boats as original equipment and are present on the boat before delivery to an end user. Examples of bailer plugs are “Snap-Tite”, “Turn-Tite”, and “Trail-n-Bail” plugs supplied by Moeller Marine Products of Sparta, TN. Bailer plugs 2 and 3 are typically radially expandable so that they can fit and seal a range of drain pipe diameters, such as 1 to 1.25 inch diameter. When the boat is out of the water, as shown in Fig. 2, a user can drain water from the interior compartment of the boat by removing the plug 3, as shown in Fig. 3, so that the water in the passenger compartment drains through the

open drain tube 1. Also, the drain tubes are designed so that they exit at a location that is above the water line when the boat is docked and unloaded of passengers or when the boat is underway. Thus, users can remove the drain plug from the drain tube when the boat is docked and when the boat is underway to drain water from the interior compartment of the boat.

[0004] One problem associated with drain assemblies of the prior art is that the boat operator may forget to replace the plug after draining the water out of the interior compartment of the boat prior to returning the boat back into the water, or prior to or shortly after re-entering the boat when docked or after draining the boat while underway. For example, it is common for boat operators to open the drains after the boat has been placed on the trailer to allow the water to drain out of the interior compartments after the boat has been removed from the water. If the boat operator forgets to replace the plug, water can then enter the interior compartments of the boat the next time the boat is positioned in the water. In fact, water can enter through the drain in sufficient quantities that the boat can sink. Also, it is common for boat operators to leave the drain valves in their boat after they dock their boat, such that rain water may enter and accumulate in the boat.

[0005] One solution to these problems is a one-way drain assembly that incorporates a flapper valve. This device includes an aperture that extends through a wall of the boat wherein a valve member is mounted within the aperture in a pivoting fashion. Preferably, the valve member can only pivot so as to open the aperture in response to water flowing from the boat compartment to the exterior of the boat. Further, the valve member is configured so that when water is flowing from the exterior of the boat into the interior of the boat, the valve member closes off the aperture and prevents the water from entering the boat.

[0006] While the flapper type drain valve reduces the likelihood of water entering the interior compartments of the boat after the boat operator has failed to reinstall a plug, these devices suffer from some problems. In particular, these devices are typically made of a plastic that degrades as a result of exposure to UV light. Consequently, sunlight often damages these devices to a point where the valve member breaks and does not close off the aperture when needed. Further, these devices are also exposed to oil and other foreign matter within the water, which inhibits the correct pivoting motion of the flapper valve member to the point where the valve member does not

adequately seal the boat. For example, the foreign matter may cause the flapper to get stuck in a fixed position which either inhibits proper operation of the drain or allows water to flow through the drain into the boat.

[0007] Hence, even though the flapper-type drain valves represent an improvement over the standard drains that simply incorporate a plug, it still suffers from serious shortcomings in its ability to prevent water from entering interior compartments of the boat when the boat is positioned in a body of water.

[0008] Also, U.S. Patent 6,357,376 describes a boat drain assembly that can be positioned within an opening in a wall of a boat. The assembly includes a member adapted to be positioned within the opening. The member has an upper end that is positioned substantially flush with an inner surface of the boat wall and defines an interior opening that extends across substantially the entire opening in the boat wall and is adapted for water to flow from an interior compartment of the boat to a central passageway defined by the member. The central passageway extends through the wall of the boat when the member is positioned in the opening. The central passageway includes a reduced aperture portion that has a cross sectional area which is less than the cross sectional area of the central passageway.

[0009] The assembly also includes a ball that is positioned within the central passageway and is captured therein so as to be positioned adjacent the reduced aperture and retained within the central passageway within the wall of the boat. The ball floats in the central passageway when water is flowing through the reduced aperture from the interior compartment of the boat to the exterior of the boat and wherein the ball is urged into the reduced aperture when water is urged to flow from the exterior of the boat into the interior compartment to thereby inhibit the flow of water from the exterior of the boat into the interior of the boat through the central passageway.

[0010] However, the valve assembly in U.S. Patent 6,357,376 requires that a user drill a hole through the wall of the boat for the valve assembly to be received in and requires that the length of the valve assembly be at least as long as the thickness of the wall of the boat. Otherwise, if the length of the central passageway did not extend fully across the thickness of the wall of the boat, it

would be possible in the case of hollow wall boats that water could fill the hollow wall of the boat rather than pass through the wall via the valve assembly. Moreover, due to the variation in the thickness of boat hulls among different boats as well as variations in thicknesses of boat hulls throughout the same boat, the length of the valve assembly cannot be standardized. Also, screws are needed to secure the valve assembly to the wall of the boat, requiring the user to drill yet more holes in the boat, which may cause stress cracks and leaks in the wall of the boat.

[0011] Thus, there is a need for an improved drain valve for marine vessels.

SUMMARY

[0012] According to one aspect, further details of which are provided herein, a marine drain valve for use with a marine drain tube that extends through a wall of a marine vessel includes a body extending along a central axis. The body has a cylindrical outer surface and has a cylindrical inner surface defining a bore extending longitudinally through the body from a first end of the body that may be configured to be positioned in an interior compartment of the vessel, to a second end of the body that is configured to be positioned in the drain tube. The body has a length that is less than a length of the drain tube, and the elongated body is configured for placement partly within the drain tube.

[0013] The valve also includes at least one external seal extending from the cylindrical outer surface of the body, at least one internal seal extending from the inner cylindrical surface into the bore, a sealing member disposed within the bore, and a retaining member retaining the sealing member in the bore between the at least one internal seal and the retaining member. The sealing member is longitudinally displaceable in the bore between the at least one internal seal and the retaining member and is configured to seal with the at least one internal seal in a first configuration in which the valve is closed and is configured to not seal with the at least one internal seal in a second configuration in which the valve is open.

[0014] In one embodiment the outer cylindrical surface defines at least one circumferential groove and the at least one external seal includes an o-ring that is seated in a corresponding

circumferential groove. The inner cylindrical surface may define at least one circumferential groove and the at least one internal seal includes an o-ring that is seated in a corresponding circumferential groove. The outer cylindrical surface may define a plurality of circumferential grooves spaced longitudinally from each other, and each circumferential groove may have an inner diameter different from each other. Also, the inner diameters may increase in the axial direction from the second end to the first end. The outer diameters of the o-ring seals seated in the corresponding circumferential grooves increase in the axial direction from the second end to the first end.

[0015] In one embodiment, the sealing member is a buoyant member. The sealing member may be a ball or sphere. In one embodiment, the sealing member is retained in the bore between the at least one internal seal and the retaining member. In one embodiment, the retaining member extends diametrically across the bore.

[0016] In one embodiment, the body may have an upper portion and a lower portion. The upper portion may be formed as a flange having an outer diameter larger than an outer diameter of the lower portion. The valve may also include a handle coupled to the upper portion of the body.

[0017] According to another aspect, further details of which are described herein, a method of installing a marine drain valve in a marine drain tube that extends through a wall of a marine vessel includes providing an afore-mentioned drain valve and introducing the second end of the body of the valve into the drain tube and sealing the at least one external seal with the drain tube.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Fig. 1A shows a prior art marine drain tube.

[0019] Fig. 1B shows a prior art bailer plug.

[0020] Fig. 1C shows another prior art bailer plug.

- [0021]** Fig. 2 shows a portion of an interior compartment of a boat partially filled with water and the drain plug of Fig. 1C sealed in a drain tube.
- [0022]** Fig. 3 shows the portion of the interior compartment of the boat of Fig. 2 with the drain plug removed.
- [0023]** Fig. 4 shows an isometric view of a drain valve with internal and external seals of the valve omitted.
- [0024]** Fig. 5A shows a view of the valve, including the valve body of Fig. 4 along section 5A-5A, shown with internal and external seals. The valve is shown in a valve open configuration.
- [0025]** Fig. 5B shows a side elevation view of the body of the valve of Fig. 4. The valve is shown in a valve open configuration.
- [0026]** Fig. 5C shows the valve of Fig. 5A in a seated and fully installed configuration in a drain tube of a marine vessel.
- [0027]** Fig. 6A shows a view of the valve, including the valve body of Fig. 4 along section 6A-6A, shown with internal and external seals. The valve is shown in a valve open configuration.
- [0028]** Fig. 6B shows a side elevation view of the body of Fig. 4 rotated ninety degrees from the view of Fig. 5B. The valve is shown in a valve open configuration.
- [0029]** Fig. 7 shows a top plan view of the body shown in Fig. 4.
- [0030]** Fig. 8A shows an isometric view of an alternate embodiment of a drain valve.
- [0031]** Fig. 8B shows the drain valve of Fig. 8A with internal seals, external seals, and handle of the valve shown in Fig. 8A omitted.
- [0032]** Fig. 8C shows the drain valve of Fig. 8A along section 8C-8C in Fig. 8A, with the internal and external seals of the drain valve omitted for clarity.
- [0033]** Fig. 8D shows the drain valve of Fig. 8A along section 8D-8D in Fig. 8A, with the

internal and external seals of the drain valve omitted for clarity.

[0034] Fig. 8E shows a top view of the drain valve of Fig. 8A.

[0035] Fig. 9A shows an isometric view of another embodiment of a drain valve.

[0036] Fig. 9B shows an isometric view of the drain valve of Fig. 9A with internal seals, external seals, and handle of the valve omitted.

[0037] Fig. 9C shows a side elevation view of the drain valve of Fig. 9B.

[0038] Fig. 9D shows a view of the drain valve of Fig. 9A, without the handle, through a section 9D-9D in Fig. 9A.

[0039] Fig. 9E shows a view of the drain valve of Fig. 9D, with the handle, sealed in a drain tube.

[0040] Fig. 10A shows an isometric view of another embodiment of a drain valve.

[0041] Fig. 10B shows an isometric view of the drain valve of Fig. 10A with internal and external seals and handle of the valve omitted.

[0042] Fig. 10C shows a side elevation view of the drain valve of Fig. 10B.

[0043] Fig. 10D shows a view of the drain valve of Fig. 10A, without the handle, through a section 10D-10D in Fig. 10A.

[0044] Fig. 10E shows a view of the drain valve of Fig. 10D, with the handle, sealed in a drain tube.

DETAILED DESCRIPTION

[0045] Fig. 4 shows an embodiment of a drain valve 100, shown with internal and external seals omitted, in accordance with the disclosure. The valve 100 is configured to substitute for the

aforementioned prior art bailer drain plugs 2 and 3 that fit into dedicated drain tubes 1 that are manufactured into boats. Thus, the valve 100 described herein may simply be used in the drain tube 1 in the place of prior art bailer drain plugs 2 or 3 without requiring a user to drill any new holes in the boat for placement of the valve 100.

[0046] The valve 100 includes a body 102, shown in greater detail in Figs. 5B, 6B, and 7B, which is configured generally as a plug to be received in the drain tube 1 in one configuration, such as the drain tube 1 shown in Fig. 1A. In a configuration where the body 102 is seated in the drain tube, a leaktight seal is formed between the valve 100 and the drain tube 1 so that fluid may only pass selectively through a bore 110 (Figs. 4 to 7) of the body 102, as described in greater detail herein.

[0047] Turning to Figs. 5A and 5B, the body 102 has an upper portion 102a and a lower portion 102b. The lower portion 102b of the valve 100 is configured to be received in and seal with an inner wall of the drain tube when the valve 100 is seated in the drain tube. The upper portion 102a is formed as a flange that is configured to either remain spaced from or engage the rolled flange 1a of the drain tube 1 in the configuration where the valve 100 is fully seated in the drain tube 1, as shown in Fig. 5C. Thus, the upper portion 102a acts as a positive stop limiting how far down into the drain tube the valve 100 can be located by a user.

[0048] The lower portion 102b of the body 102 has an outer cylindrical surface 106 that defines one or more circumferential grooves 104a, 104b, and 104c (Fig. 5B) that receive o-ring seals 108a, 108b, and 108c (Fig. 5A). In one embodiment, the thickness (measured in the axial direction A-A in Fig. 5B) of each circumferential groove is 0.110 inch, and the spacing between the grooves is 0.140 inch. However, the dimensions of each respective circumferential groove may be different to achieve desired sealing results. In the embodiment shown in Fig. 5B, the diameters of the circumferential grooves 104a, 104b, and 104c are staggered so that the diameter of groove 104a is smaller than the diameter of groove 104b, which is smaller than the diameter of groove 104c. When the seals 108a, 108b, and 108c are seated in their corresponding grooves 104a, 104b, and 104c, as shown in Fig. 5A, the outer diameters of the seals 108a, 108b, and 108c are also staggered from each other such that a line tangent to each seal is angled at a sealing taper angle ϕ

with respect to a vertical axis A-A through the center of the valve 100. This sealing taper may improve the sealing and retention of the valve 102 in the drain tube 1. In another embodiment, the grooves 104a, 104b, and 104c (Fig. 5B) and seals 108a, 108b, and 108c are not staggered, and may instead be aligned along axis A-A and have the same diameter.

[0049] Turning to Fig. 6B, the body 102 has an inner annular wall 102c that defines the bore 110 that extends axially along axis A-A from an upper end 112 to a lower end 114 of the body 102. The bore 110 may be coaxial with the upper and lower portions 102a and 102b of the body 102. As shown in Fig. 6A, a buoyant ball 116 is located in the bore 110. The bore 110 has a diameter that is generally of constant dimension along axis A-A, with the exception of a cylindrical groove 110a located between the upper and lower ends 112, 114 of the body 102. As shown in Fig. 5C, the cylindrical groove 110a is in the upper portion 102a, though, in other embodiments, the groove 110a may be in the lower portion 102b. The ball 116 has a diameter that is smaller than the diameter of the bore 110 so that the ball 116 may move freely in the bore 110. The cylindrical groove 110a is configured to receive an o-ring seal 118 (Fig. 6A) having an inner diameter that is smaller than the diameter of the bore 110 and smaller than the diameter of the ball 116, which is located below the seal 118 in the bore 110. Thus, the o-ring 118 intrudes into the bore 110 to block the upward passage of the ball 116 through the bore 110. Specifically, the o-ring seal 118 is configured to seal against the ball 116 in one configuration, further details of which are described herein.

[0050] A retaining member 120 extends diametrically across the bore 110 below the ball 112. In an embodiment, the retaining member 120 may be a pin or rod-like member assembled with the body 102 or integrally formed therewith. The retaining member can alternatively be a reduced diameter lip positioned at the lower end 114 of the bore 110. The retaining member 120 is fixed with respect to the inner wall 102c of the body 102. When the o-ring seal 118 is located in the cylindrical groove 110a and the retaining member is present, the ball 116 is captured within the

bore 110 so that the ball 116 has a range of motion between the o-ring seal 118 and the retaining member 120.

[0051] The valve 100 may be used as follows for a boat configured with the drain tube 1. When a boat in which the drain tube is installed is out of the water, any existing bailer plug (e.g., plug 2 or 3, Figs 1B, 1C) is removed from the drain tube as shown in Fig. 3. The valve 100 is oriented so that the lower end 114 is oriented down and the upper end 112 is oriented above the lower end 114 so that the lower end 102b is facing the drain tube 1. The lower portion 102b of the valve 100 is introduced into the drain tube 1 and pushed until it is firmly in place or until the underside of the flange of the upper portion 102a contacts the flange 1a of the drain tube 1. When so placed, the valve 100 is in a fully seated configuration in the drain tube 1.

[0052] In the fully seated configuration of the valve 100, the upper end 112 of the bore 110 is in fluid communication with the interior compartment of the boat and the lower end 114 of the bore 110 is in fluid communication with the exterior of the boat. The interior compartment and the exterior of the boat may come into fluid communication through the bore 110 of the body 102 of the valve 100 when the valve 100 is in an open configuration, as shown in Figs. 5A to 6B.

[0053] The ball 116 is configured to be axially displaceable in response to varying buoyancy forces applied to the ball 116 resulting from the net differential pressure applied to the ball 116 from water above and below the ball in the bore 110, if any. The buoyancy forces can change as a result of water level changes in the bore 110 during operation of the boat. For example, when the boat is on a trailer and out of the body of water in which it may be used, there will be no buoyancy forces acting on the ball 116 and the weight of the ball (as well as the downward force from any water in the interior compartment of the boat acting on the ball 116) will urge the ball 116 downward into contact with the retaining member 120, as shown in Figs. 5A to 6B, which shows the valve 100 in an open configuration. When in the open configuration, any water above the valve can flow down the bore 110 from the interior compartment to the outside of the boat. When the boat is returned to the water after the water from the interior compartment is drained, such as when a user launches the boat from a trailer into the water, the only downward force on the ball 116 is its weight. Eventually, as users enter the boat the level of the drain 1 is lowered into the water until

the water level in the drain tube and in the bore 110 rises causing the buoyant ball 116 eventually to float and rise towards the o-ring seal 118. If the water level rises sufficiently, the ball 116 engages the o-ring seal 118 and the buoyant forces acting on the ball from the water pressure below the ball 116 causes the ball 116 to seal with the o-ring seal 118, configuring the valve 100 in a closed configuration that prevents fluid flow from the outside of the boat into the interior compartment (and vice versa). Accordingly, in the closed configuration, the valve 100 is checked in a direction from the exterior of the boat to the interior of the boat. When the boat is moving and is underway, the water level in the drain tube falls due to the drain tube rising out of the water and the ball 116 to unseal with the o-ring seal 118, permitting any fluid in the inner compartment of the boat to drain through the bore 110 and out of the drain tube 1.

[0054] The body 102 of the valve 100 may be made from various materials. In one embodiment, the body 100 is made from rubber and may be molded. The retaining member 120 may also be made from rubber and may be integrally molded with the rubber body 102. In one embodiment, the body 102 may be made from plastic and may be molded. Such plastics may include PVC, and PVDF, and the retaining member 120 may be integrally formed with the body out of plastic or may be made of metal and formed as a separate pin and assembled to the plastic body. The seals 108a, 108b, and 108c may be formed of various elastic materials, such as butadiene rubber, butyl rubber, chlorosulfonated polyethylene, epichlorohydrin rubber, ethylene propylene diene monomer, ethylene propylene rubber, fluoroelastomer, nitrile rubber, silicone rubber, perfluoroelastomer, polyacrylate rubber, neoprene, polyisoprene, polysulfide rubber, polytetrafluoroethylene, sanifluor, and styrene-butadiene rubber.

[0055] To facilitate installation and removal of the valve from the drain tube, a handle 124, shown in Fig. 5C, may be coupled to the upper portion 102a by holes 122 formed therein. The handle 124 may be a curved piece of metal or plastic and may be rotatable about holes 122 so that it can fold flush with the upper portion 102a (e.g., perpendicular to the position shown in Fig. 5C).

[0056] Figs. 8A to 8E show features of another embodiment of a drain valve 200. In Figs. 8A to 8E, elements corresponding to those of drain valve 100 are incremented by “100”. The drain valve 200 includes a body 202 having an upper portion 202a and a lower portion 202b. The body

202 defines a longitudinally extending through-bore 210 that extends through the upper and lower portions 202a and 202b. The body 202 has an upper end 212 and a lower end 214. A foldable handle 224 is coupled to the upper portion 202a of the body 202.

[0057] The lower portion 202b of the body 202 may be configured similarly to the lower portion 102a of valve 100. For example, the lower portion 202b of the body 202 has an outer cylindrical surface 206 that defines one or more circumferential grooves 204a, 204b, and 204c (Figs. 8B and 8C) that receive corresponding o-ring seals 208a, 208b, and 208c (Fig. 8A). In one embodiment, the thickness (measured in the axial direction B-B in Fig. 8B) of each circumferential groove is 0.110 inch, and the spacing between the grooves is 0.140 inch. However, the dimensions of each respective circumferential groove may be different to achieve desired sealing results. In the embodiment shown in Fig. 8C, the diameters of the circumferential grooves 204a, 204b, and 204c are staggered so that the diameter of groove 204a is smaller than the diameter of groove 204b, which is smaller than the diameter of groove 204c. When the seals 208a, 208b, and 208c are seated in their corresponding grooves 204a, 204b, and 204c, as shown in Fig. 8A, the outer diameters of the seals 208a, 208b, and 208c are also staggered from each other, which may improve the sealing and retention of the valve 202 in the drain tube 1. In another embodiment, the grooves 204a, 204b, and 204c and seals 208a, 208b, and 208c are not staggered, and may instead be aligned along axis B-B and have the same diameter.

[0058] The valve 200 also includes a retaining member 220 (Figs. 8A and 8C) that extends into the bore 210 to retain a ball 216 (Figs. 8C, 8D, 8E) that is in the bore 210. The body 202 also defines a cylindrical bore 210a that receives an o-ring seal 218 (Figs. 8A and 8E) to seal with the ball 216 in the bore and to retain the ball 216 between the retaining member 220 and the o-ring seal 218. The movement of the ball 216 and the operation thereof in draining water from the boat is identical to that described hereinabove for ball 116 in connection with valve 100 and is not repeated here for sake of brevity.

[0059] The valve 200 can be installed in the drain tube 1 in the same manner described herein for valve 100 and as shown in Fig. 5C. In that regard, with momentary reference to Fig. 5C, it will be appreciated that when the water level surrounding the upper portion 102a is at or below the top

of the upper portion 102a, the water cannot flow into the bore 110. Thus, puddling around the upper portion 102a may occur even after the flow of water through the valve 100 ceases.

[0060] One notable difference between valve 100 and valve 200 is the configuration of the upper portion 202a of valve 200, which defines at least one groove or aperture 225 (Figs. 8B to 8E), which is configured to direct fluid that is below the upper end 212 of the body to drain into the bore 210 and through the drain tube 1. Also, the cylindrical bore 210a that receives o-ring seal 218 may be located in the lower portion 202b at a depth below the groove or aperture 225. This can accommodate a depth “d” (Fig. 8C) of groove 225 that is at or below the level of the flange 1a of the drain tube 1 (or below the internal wall of the vessel) when the valve 200 is fully seated in the drain tube. When so configured, the groove 225 can mitigate puddling of water around the upper portion 202a and direct such water surrounding the upper portion 202a through the groove 225 into the bore 210 and then out of the drain tube 1 when the valve 200 is installed in the drain tube 1, as shown in Fig. 8C.

[0061] In the embodiment of the valve 200 shown in Figs. 8A to 8E, four grooves 225 are defined in the upper portion 202a. As shown in Fig. 8E, the grooves 225 are circumferentially spaced about ninety degrees from each other. Each groove 225 is “V” shaped, although they may have other shapes, such as “U” shaped. Also, instead of a groove with an opening to the upper end 212 of the body 202, radially directed bore holes may be formed in the upper portion 202a below the upper end 212.

[0062] In the embodiment shown in Figs. 8A to 8E, each groove 225 extends radially from an outer side 226 of the upper portion 202a to an inner side 228 of the upper portion 202a. In at least one embodiment, the groove has a depth “d” from the upper surface 224 to a base 230. The depth “d” may be larger than the thickness “t” (Fig. 8C) of the upper portion 202a between the upper surface 224 and a lower surface 232 of the upper portion 202a. In embodiments, the depth “d” may extend longitudinally as far as an upper side of cylindrical groove 210a. Thus, in at least one embodiment shown in Figs. 8A to 8E, the groove 225 may extend in the longitudinal direction completely through the upper portion 202a and partially through the lower portion 202b. Also, the depth “d” may not be uniform from the outer side 226 to the inner side 228, but may instead vary

with radial distance. For example, in one embodiment, the depth “d” may increase towards the inner side 228.

[0063] The upper portion 202a of the body 202 has an outer diameter that is larger than the outer diameter of the lower portion 202b of the body 202. The upper portion 202a can thus act as a flange that can either remain spaced from or engage the rolled flange 1a of the drain tube 1 in the configuration where the valve 200 is fully seated in the drain tube 1, as shown in Fig. 8C. Thus, the upper portion 202a can act as a positive stop limiting how far down into the drain tube 1 the valve 200 can be located by a user.

[0064] Figs. 9A to 9E show features of another embodiment of a drain valve 300. The drain valve 300 has features that correspond to those of drain valve 100, but which are noted with reference numbers that are incremented by “200”.

[0065] The drain valve 300 includes a body 302 having an upper portion 302a and a lower portion 302b. The body 302 defines a longitudinally extending through-bore 310. The body 302 extends from an upper end 312 (Figs. 9B to 9D) to a lower end 314 (Figs. 9B to 9D). A foldable handle 324 (Figs. 9A and 9E) is coupled to the upper portion 302a of the body 302.

[0066] The lower portion 302b of the body 302 may be configured in the same manner as the lower portion 102a of valve 100. For example, the lower portion 302b of the body 302 has an outer cylindrical surface 306 (Figs. 9B and 9C) that defines one or more circumferential grooves 304a, 304b, and 304c (Fig. 9C) that receive corresponding o-ring seals 308a, 308b, and 308c (Figs. 9A and 9D). In one embodiment, the thickness (measured in the axial direction C-C in Fig. 9C) of each circumferential groove is 0.110 inch, and the spacing between the grooves is 0.140 inch. However, the dimensions of each respective circumferential groove may be different to achieve desired sealing results. In the embodiment shown in Fig. 9C, the diameters of the circumferential grooves 304a, 304b, and 304c are staggered so that the diameter of groove 304a is smaller than the diameter of groove 304b, which is smaller than the diameter of groove 304c. When the seals 308a, 308b, and 308c are seated in their corresponding grooves 304a, 304b, and 304c, as shown in Fig. 9D, the outer diameters of the seals 308a, 308b, and 308c are also staggered from each other,

which may improve the sealing and retention of the valve 302 in the drain tube 1. In another embodiment, the grooves 304a, 304b, and 304c and seals 308a, 308b, and 308c are not staggered, and may instead be aligned along axis C-C and have the same diameter.

[0067] The valve 300 may also include at least one retaining member 320 (Figs. 9D and 9E) that extends into the bore 310 to retain a ball 316 that is in the bore 310. The body 302 also defines a cylindrical bore 310a that receives an o-ring seal 318 (Figs. 9A, 9D, and 9E) that seals with the ball 316 and retains the ball 316 in the bore 310 between the retaining member 320 and the o-ring seal 318. The movement of the ball 316 and the operation thereof in draining water from the boat is identical to that described hereinabove for ball 116 in connection with valve 100 and is not repeated here for sake of brevity.

[0068] Unlike the upper portions 102a and 202a of drain valves 100 and 200, the outer diameter of the upper portion 302a of body 302 of valve 300 is not larger than the outer diameter of the lower portion 302b. Thus, the upper portion 302a is not formed as a flange that can act as a positive stop when the valve 300 is seated in drain tube 1. Instead, valve 300 is configured so that the upper end 312 of the body 302 can be located above, flush with, or slightly recessed below the flange 1a of the drain tube 1 when the valve 300 is seated in the drain tube 1.

[0069] The upper portion 302a of the body 302 has an outer side surface 326 (Fig. 9C) that has a diameter that is less than (or equal to) the diameter of the outer surface 306 of the lower portion 302b of the body 302. As shown in Fig. 9A, the outer side surface 326 is radially offset from the outer surface 306 forming an annular shoulder so that the handle 324 can be folded flush with or below the upper end 312 of the body 302.

[0070] Also, as shown in Figs. 9C to 9E, the valve 300 includes a retaining member 320 in the form of at least one projection 320 in the bore 310 of the body 302. Two projections are shown in Fig. 9C to 9E. The projections 320 do not extend completely across the horizontal direction of the bore 310 in Figs. 9C to 9E. The projections 320 may be integrally formed with the body 302, such as by injection molding, or may be separately assembled elements, such as pins. The projections 320 function in the same manner as pin or rod-like member 120 of valve 100 to support a ball 316

when water is draining out of the boat through the valve 300.

[0071] The upper portion 302a of the body 300 defines at least one groove or aperture 325, which is configured to direct fluid that is below the upper end 312 of the body 302 to drain into the bore 310 and through the drain tube 1. Also, the cylindrical bore 310a that receives o-ring seal 318 may be located in the lower portion 302b at a depth below the groove or aperture 325 to accommodate a depth “d” of groove 325 that is at or below the level of the flange 1a of the drain tube 1 or the internal wall of the vessel when the valve 300 is fully seated in the drain tube 1. When so configured, the groove 325 can mitigate puddling of water around the upper portion 302a of the body 302 and direct such water surrounding the upper portion 302a through the groove 325 into the bore 310 and then out of the drain tube 1 when the valve 300 is installed in the drain tube 1, as shown in Fig. 9E.

[0072] In the embodiment of the valve 300 shown in Figs. 9A and 9B two grooves 325 are defined in the upper portion 302a. The grooves 325 are diametrically opposite each other, although such a configuration is not required. Each groove 325 is “c” shaped, although they may have other shapes, such as “V” shaped and “U” shaped. Also, instead of a groove that is open to the upper end 312, radially directed bore holes may be formed in the sides of the upper portion 302a below the upper end 312 and above the cylindrical groove 310a. It will be appreciated that the grooves 325 also may provide access for a user to insert a finger to raise the handle 324 from the folded position shown in Fig. 9A.

[0073] Figs. 10A to 10E show features of another embodiment of a drain valve 400. In Figs. 10A to 10E, elements corresponding to valve 100 are incremented by “300”. Drain valve 400 is identical to drain valve 300 with the exception that a rod 420 substitutes for the projections 320 as a retaining member. Otherwise, the operation of valve 400 is identical to valve 300.

[0074] There have been described and illustrated herein several embodiments of a valve and a method of using the valve. While particular embodiments have been described, it is not intended that the invention be limited thereto, as it is intended that the invention be as broad in scope as the art will allow and that the specification be read likewise. Thus, while particular materials have

been disclosed, it will be appreciated that other materials may be used as well. In addition, while particular dimensions have been disclosed, it will be understood that other dimensions can be used as required by the application. Moreover, while particular sealing configurations have been disclosed in reference to the lower portion of the valve, it will be appreciated that other sealing configurations could be used as well. It will therefore be appreciated by those skilled in the art that yet other modifications could be made to the provided invention without deviating from its spirit and scope as claimed.

WHAT IS CLAIMED IS:

1. A marine drain valve for use with a marine drain tube that extends through a wall of a marine vessel, the valve comprising:

a body extending along a central axis, the body having a cylindrical outer surface and having a cylindrical inner surface defining a bore extending longitudinally through the body from a first end of the body to a second end of the body configured to be positioned in the drain tube, the body having a length that is less than a length of the drain tube, the elongated body configured for placement partly within the drain tube;

at least one external seal extending from the cylindrical outer surface of the body;

at least one internal seal extending from the cylindrical inner surface into the bore;

a retaining member extending at least partially into the bore, the retaining member being spaced longitudinally from the at least one internal seal; and

a buoyant sealing member disposed between the at least one internal seal and the retaining member, the sealing member being longitudinally displaceable in the bore between the at least one internal seal and the retaining member and configured to seal with the at least one internal seal in a valve closed, first configuration and is configured to not seal with the at least one internal seal in a valve open, second configuration,

wherein the outer cylindrical surface defines a plurality of circumferential grooves spaced longitudinally from each other, each circumferential groove having an inner diameter different from each other, wherein the inner diameters increase in the axial direction from the second end to the first end, and

wherein the at least one external seal includes an o-ring that is seated in a corresponding circumferential groove.

2. The valve according to claim 1, wherein the inner cylindrical surface defines at least one circumferential groove and the at least one internal seal includes an o-ring that is seated in a corresponding circumferential groove.
3. The valve according to claim 1, wherein the at least one external seal includes a plurality of o-rings, each o-ring seated in a corresponding one of the plurality of circumferential grooves, and wherein the outer diameters of the o-rings seated in the corresponding circumferential grooves increase in the axial direction from the second end to the first end.
4. The valve according to claim 1, wherein the retaining member extends diametrically across the bore.
5. The valve according to claim 1, wherein the sealing member is a ball.
6. The valve according to claim 1, wherein the sealing member is retained in the bore between the at least one internal seal and the retaining member.
7. The valve according to claim 1, wherein the body has an upper portion and a lower portion, the upper portion formed as a flange having an outer diameter larger than an outer diameter of the lower portion.
8. The valve according to claim 7, further comprising:
 - a handle coupled to the upper portion of the body.

9. A method of installing a marine drain valve in a marine drain tube that extends through a wall of a marine vessel, the method comprising:

providing a valve comprising:

a body extending along a central axis, the body having a cylindrical outer surface and having a cylindrical inner surface defining a bore extending longitudinally through the body from a first end of the body to a second end of the body configured to be positioned in the drain tube, the body having a length that is less than a length of the drain tube, the elongated body configured for placement partly within the drain tube;

at least one external seal extending from the cylindrical outer surface of the body;

at least one internal seal extending from the cylindrical inner surface into the bore;

a retaining member extending at least partially into the bore, the retaining member being spaced longitudinally from the at least one internal seal; and

a buoyant sealing member disposed between the at least one internal seal and the retaining member, the sealing member being longitudinally displaceable in the bore between the at least one internal seal and the retaining member and configured to seal with the at least one internal seal in a valve closed, first configuration and is configured to not seal with the at least one internal seal in a valve open, second configuration; and

introducing the second end of the body of the valve into the drain tube and sealing the at least one external seal with the drain tube,

wherein the outer cylindrical surface defines a plurality of circumferential grooves spaced longitudinally from each other, each circumferential groove having an inner diameter different from each other, wherein the inner diameters increase in the axial direction from the second end to the first end, and

wherein the at least one external seal includes an o-ring that is seated in a corresponding circumferential groove.

10. The method according to claim 9, wherein the inner cylindrical surface defines at least one circumferential groove and the at least one internal seal includes an o-ring that is seated in a corresponding circumferential groove.
11. The method according to claim 9, wherein the at least one external seal includes a plurality of o-rings, each o-ring seated in a corresponding one of the plurality of circumferential grooves, and wherein the outer diameters of the o-rings seated in the corresponding circumferential grooves increase in the axial direction from the second end to the first end.
12. The method according to claim 9, wherein the retaining member is a buoyant member.
13. The method according to claim 12, wherein the retaining member is a ball.
14. The valve according to claim 9, wherein the sealing member is retained in the bore between the at least one internal seal and the retaining member.
15. The method according to claim 9, wherein the body has an upper portion and a lower portion, the upper portion formed as a flange having an outer diameter larger than an outer diameter of the lower portion.
16. The method according to claim 15, further comprising:
 - a handle coupled to the upper portion of the body.
17. The valve according to claim 1, wherein the first end of the body is configured to be positioned in an interior compartment of the vessel.

18. The valve according to claim 1, wherein the first end of the body is configured to be positioned in the drain tube.

19. The valve according to claim 1, wherein the body defines at least one aperture extending through a wall of the body between a first end at longitudinal position above an upper end of the drain tube to a second location that is below the upper end of the drain tube and above the at least one inner seal.

20. The valve according to claim 19, wherein the first end of the aperture is at the cylindrical outer surface of the body and the second end of the aperture is at the cylindrical inner surface of the body.

21. The method according to claim 9, wherein the first end of the body is configured to be positioned in an interior compartment of the vessel and wherein introducing the second end of the body includes positioning the first end of the body in an interior compartment of the vessel.

22. The method according to claim 9, wherein introducing the second end of the body includes positioning the first end of the body in either an interior compartment of the vessel, flush with an inner end of the drain tube, or below the inner end of the drain tube.

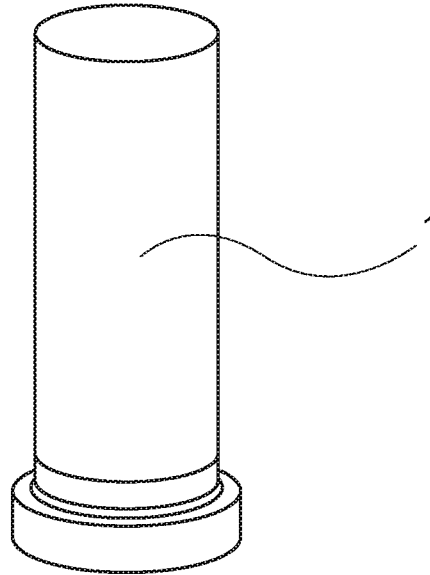


FIG. 1A
(Prior Art)

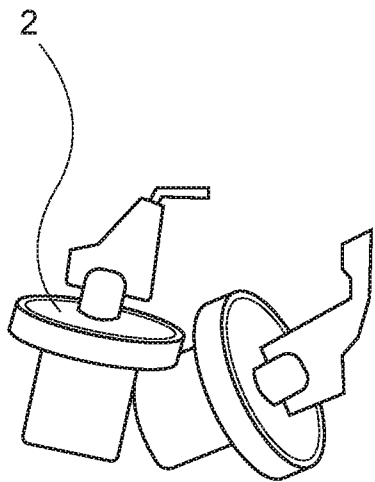


FIG. 1B
(Prior Art)

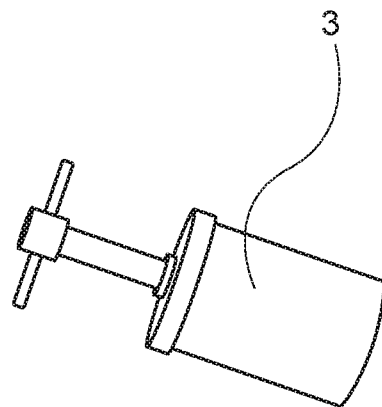


FIG. 1C
(Prior Art)

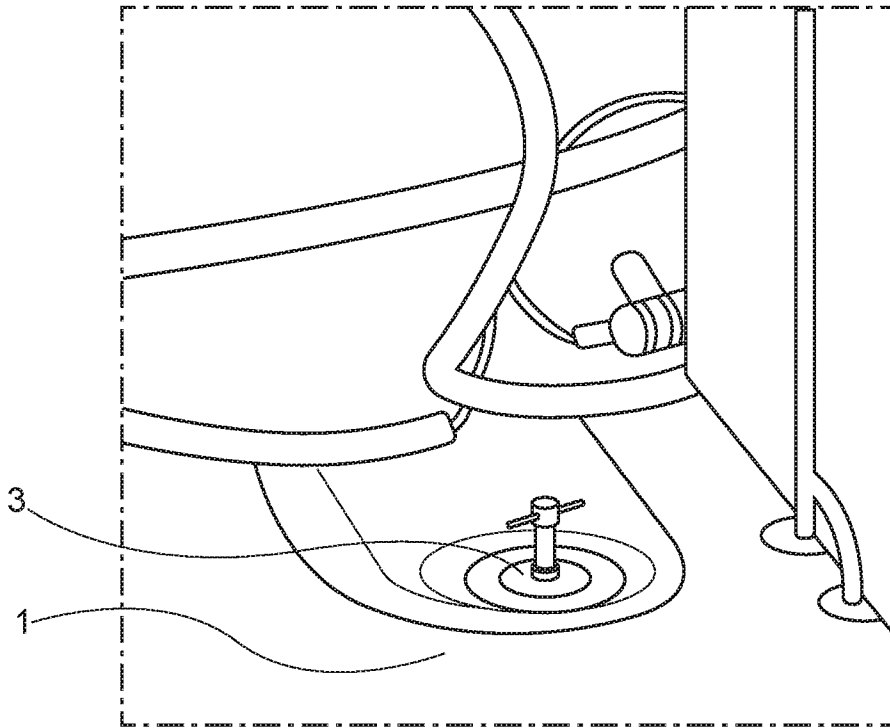


FIG. 2

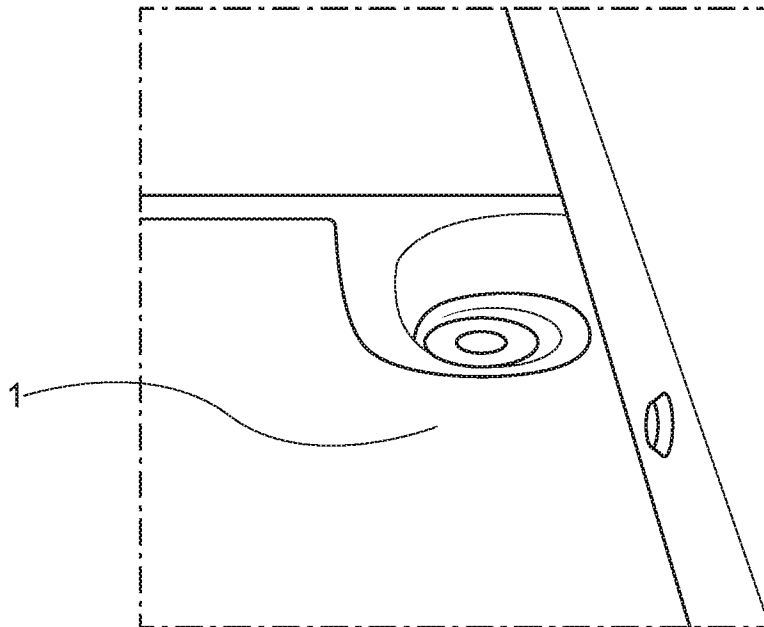


FIG. 3

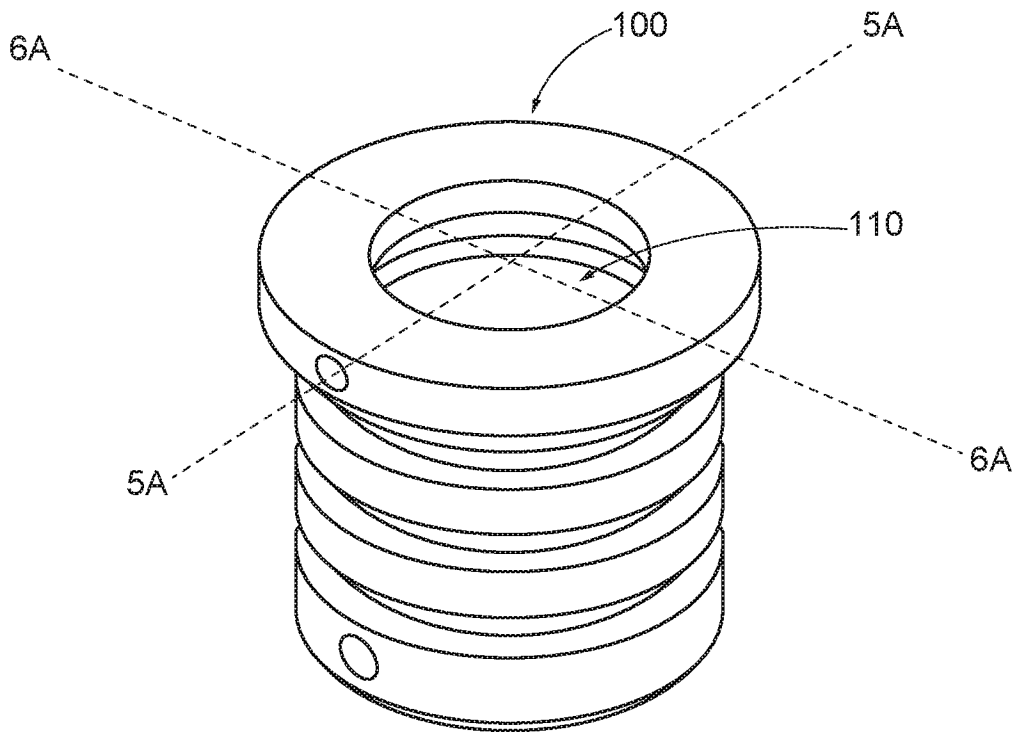


FIG. 4

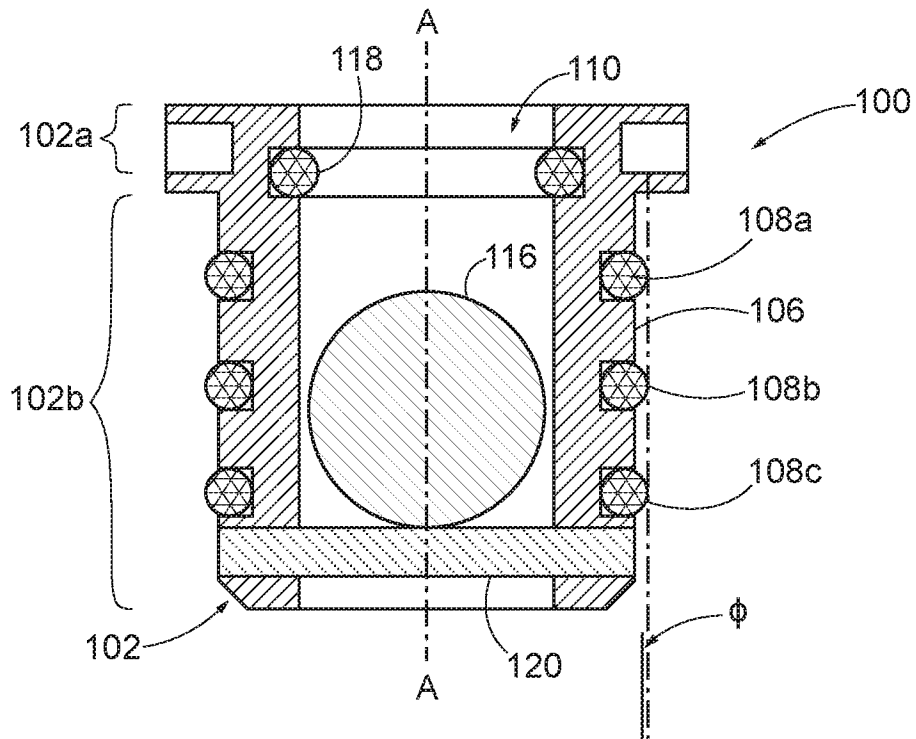


FIG. 5A

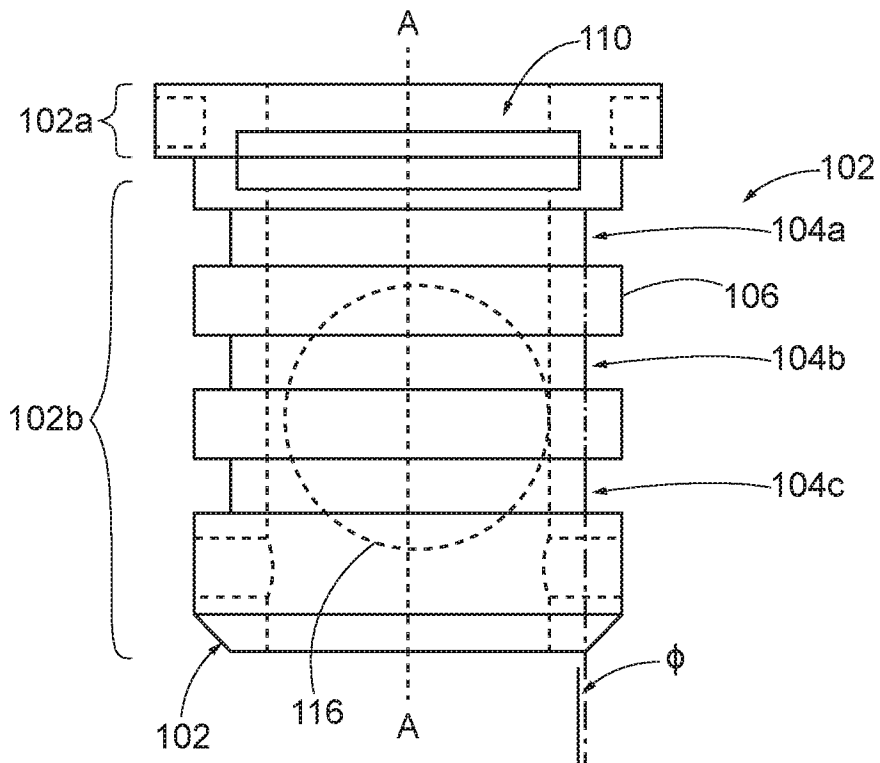


FIG. 5B

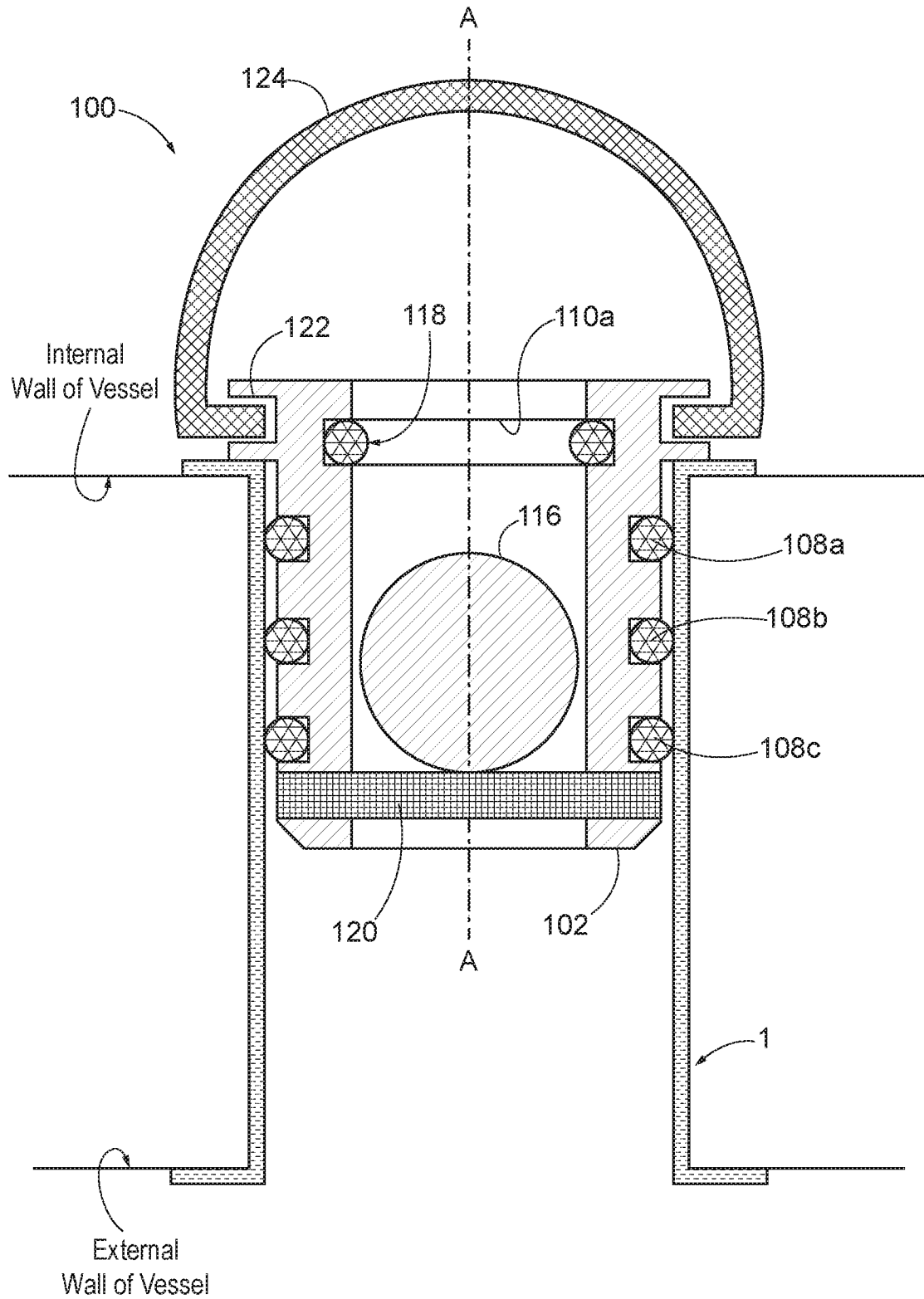


FIG. 5C

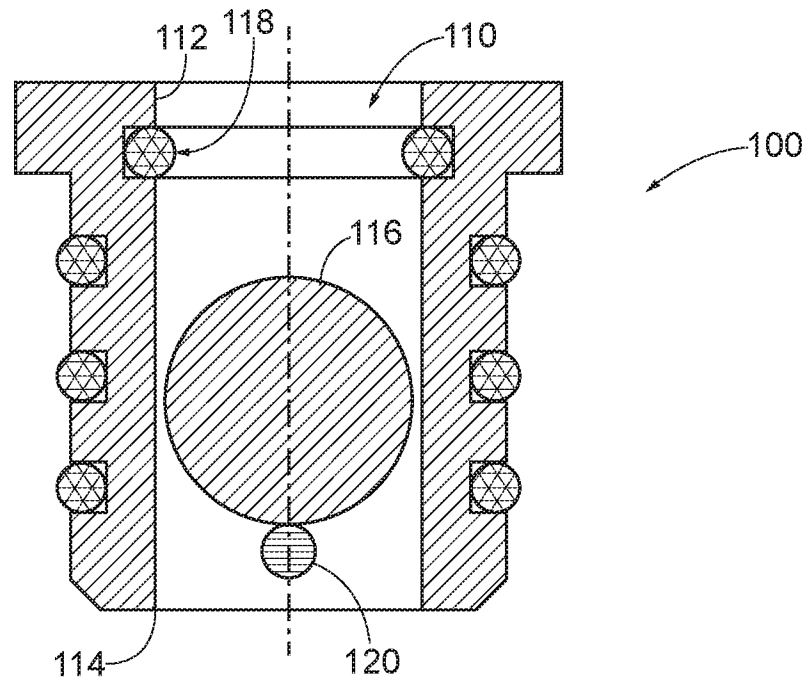


FIG. 6A

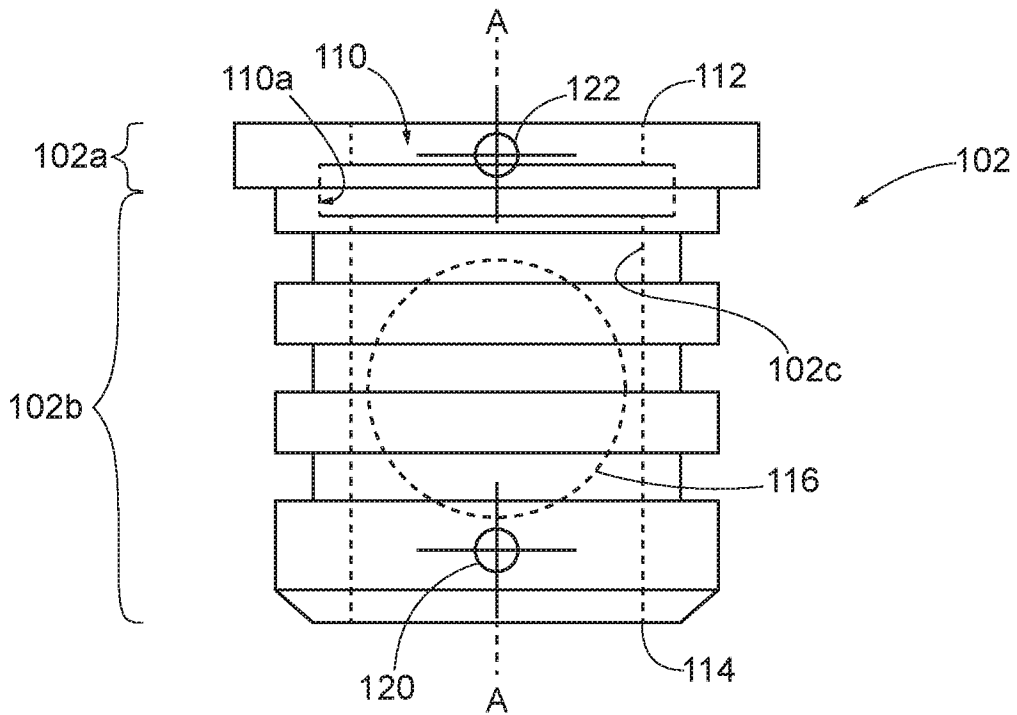


FIG. 6B

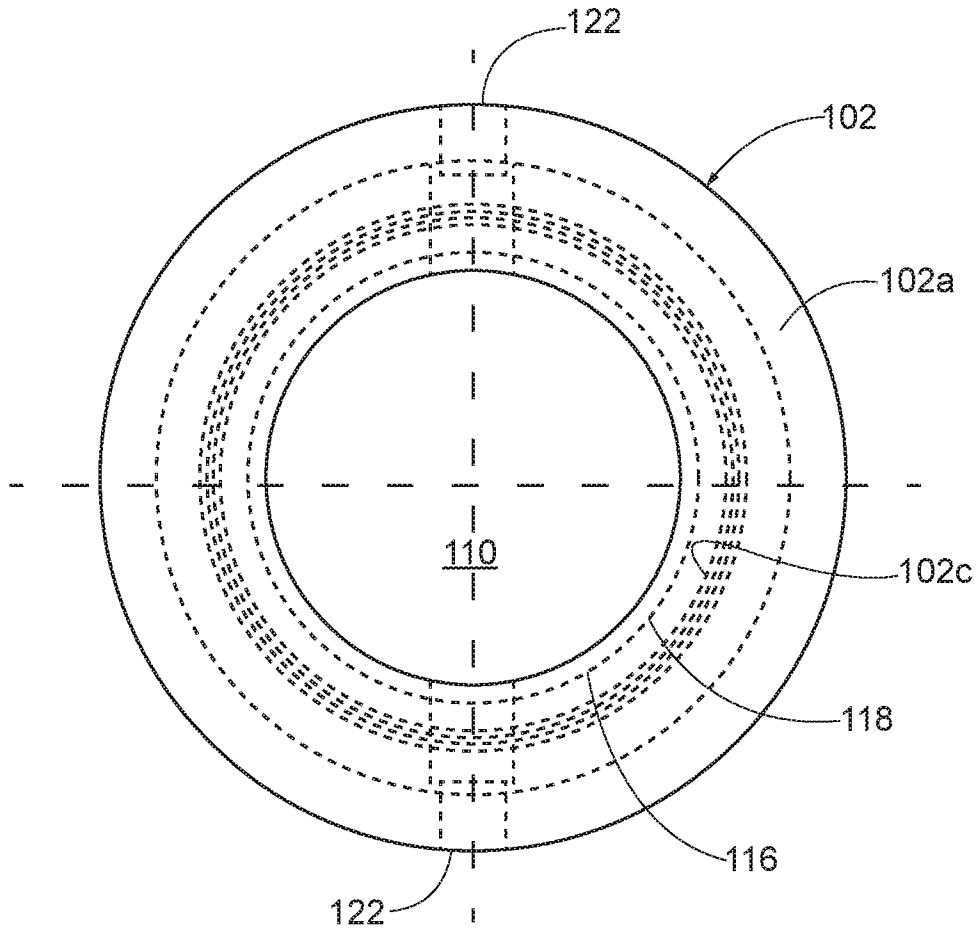


FIG. 7

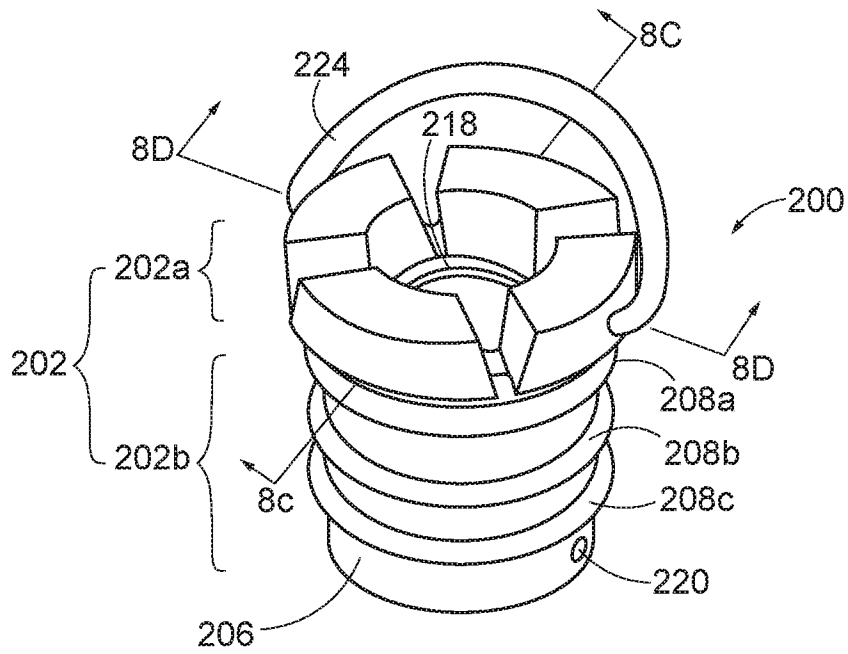


FIG. 8A

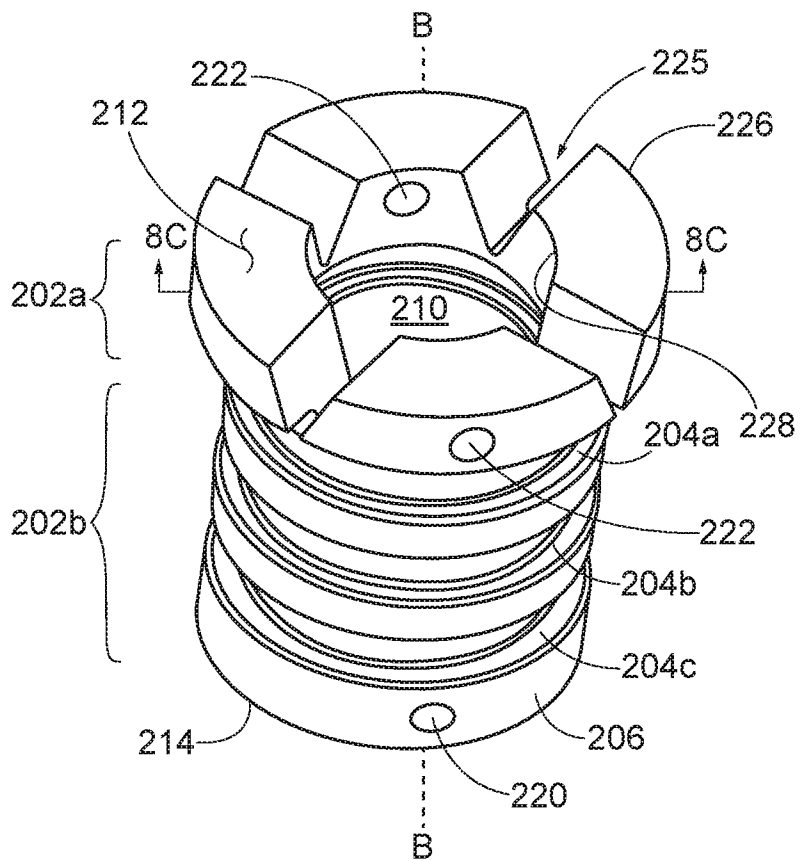


FIG. 8B

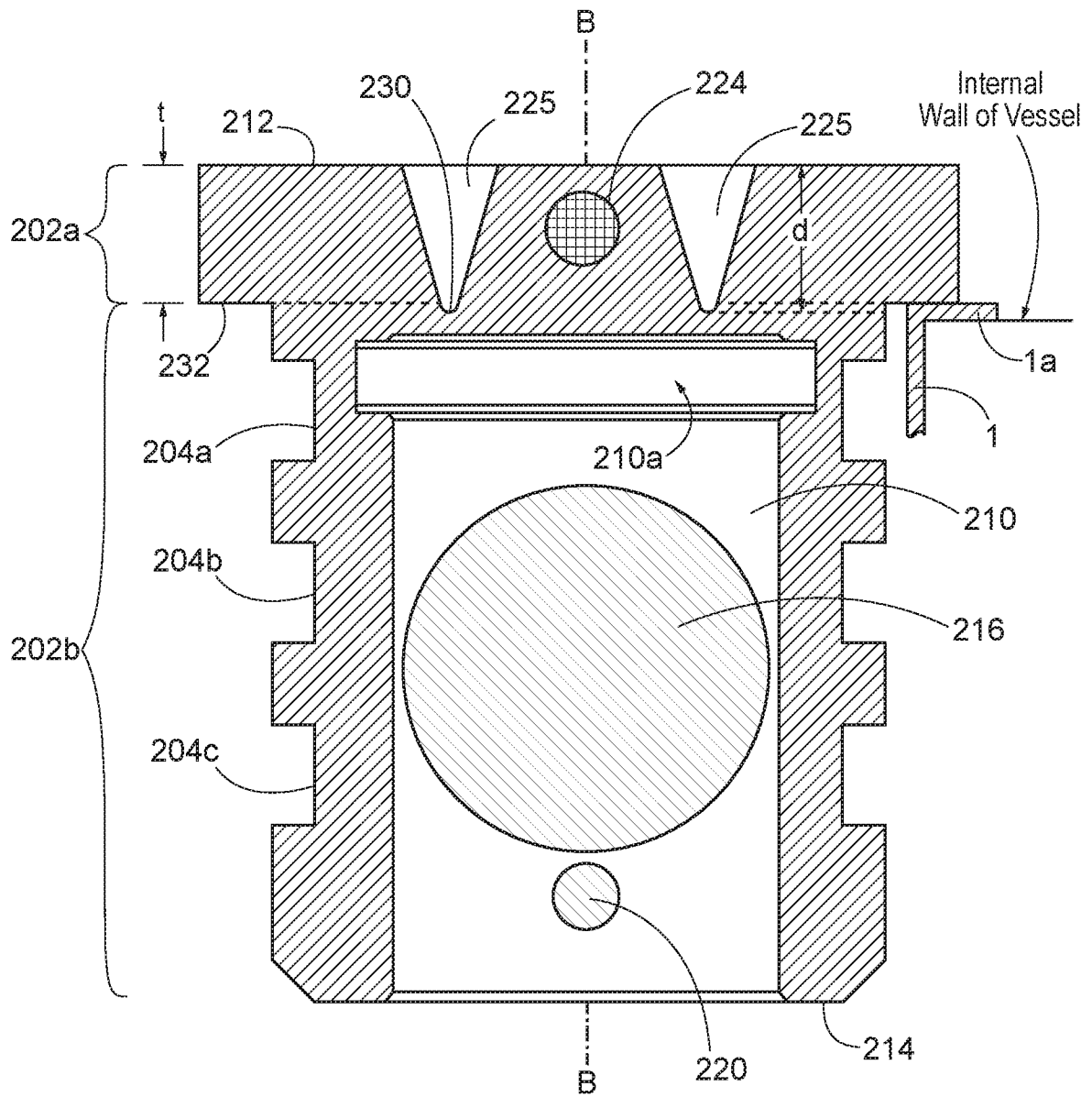


FIG. 8C

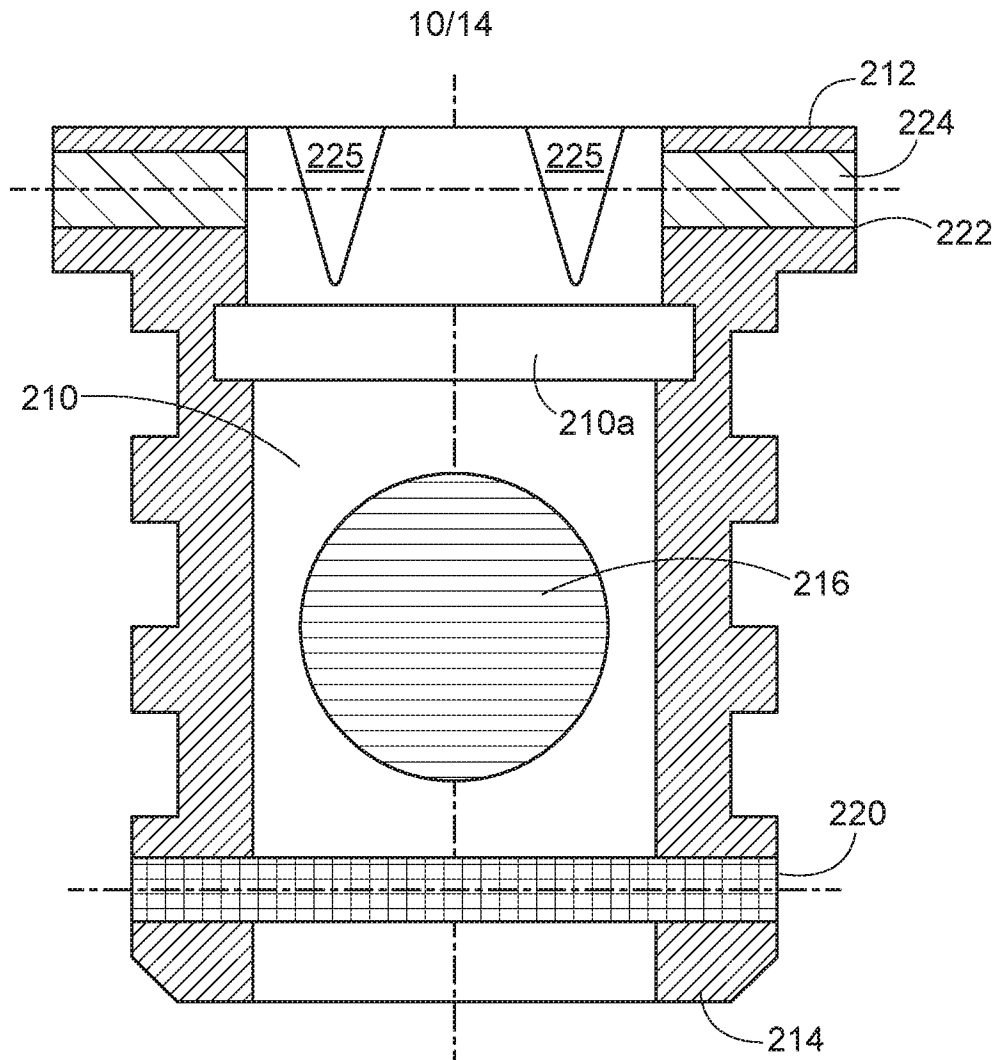


FIG. 8D

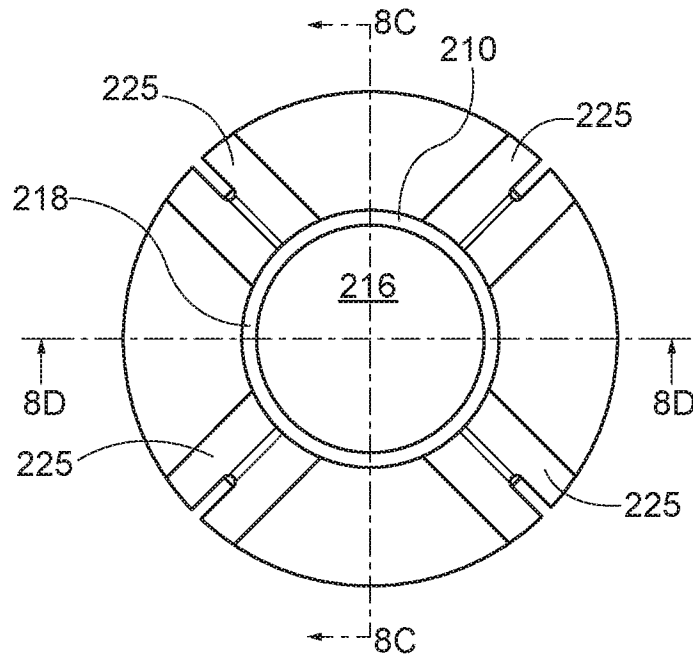
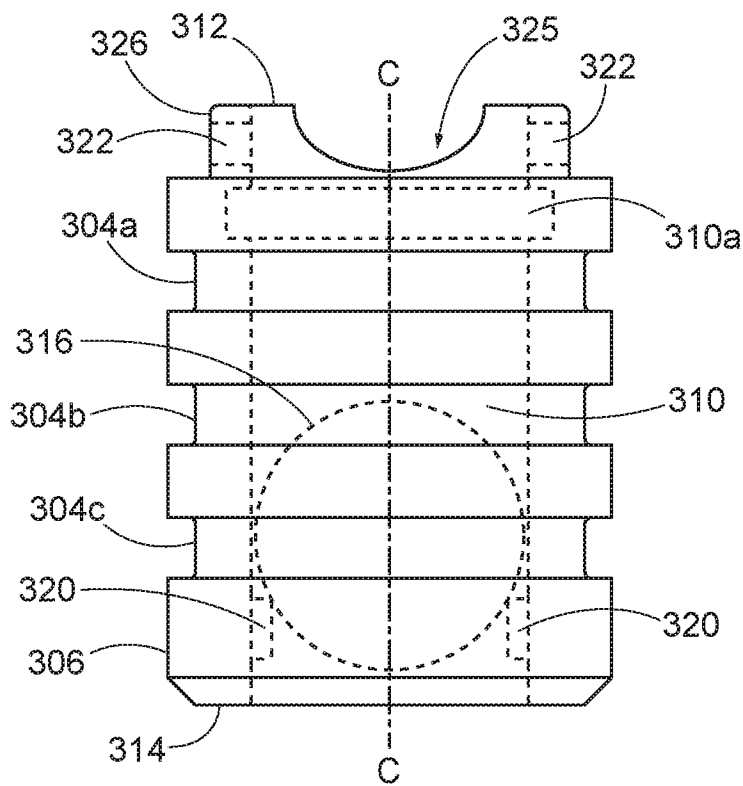
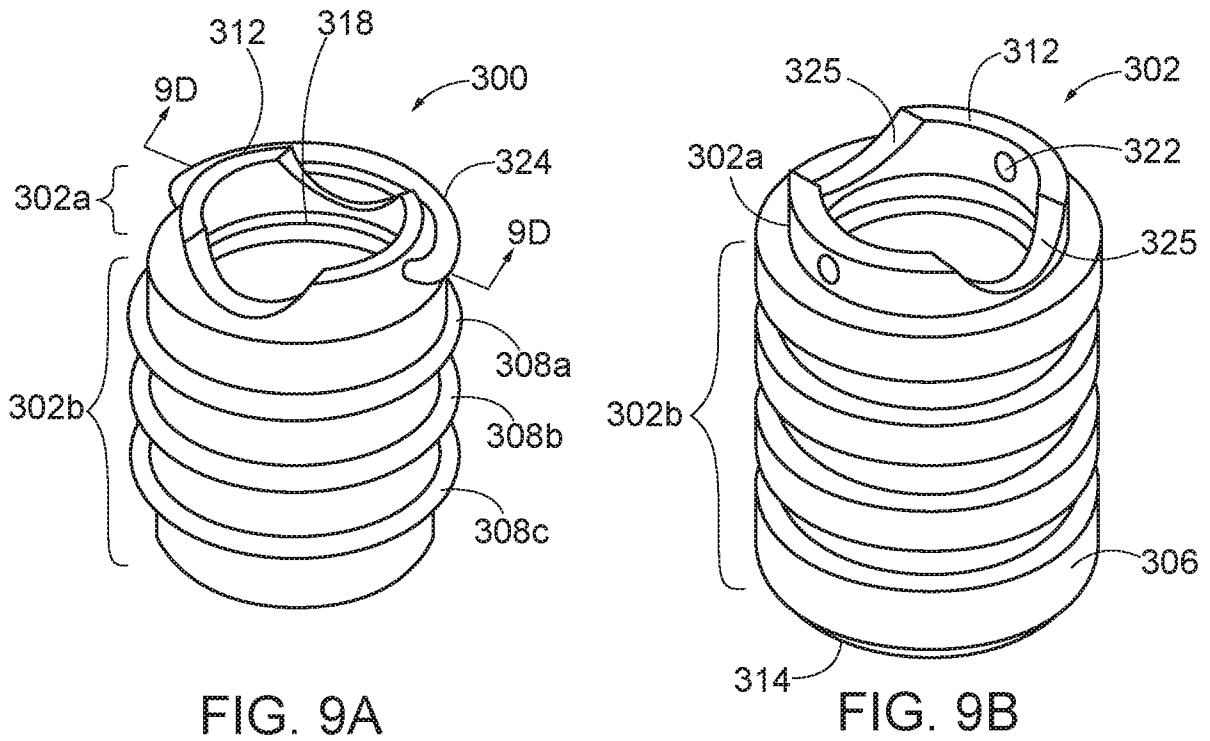


FIG. 8E



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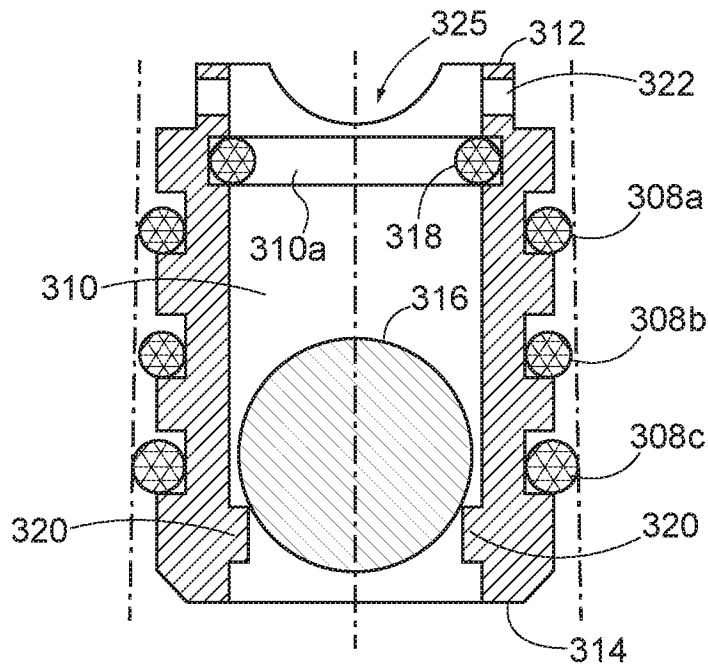


FIG. 9D

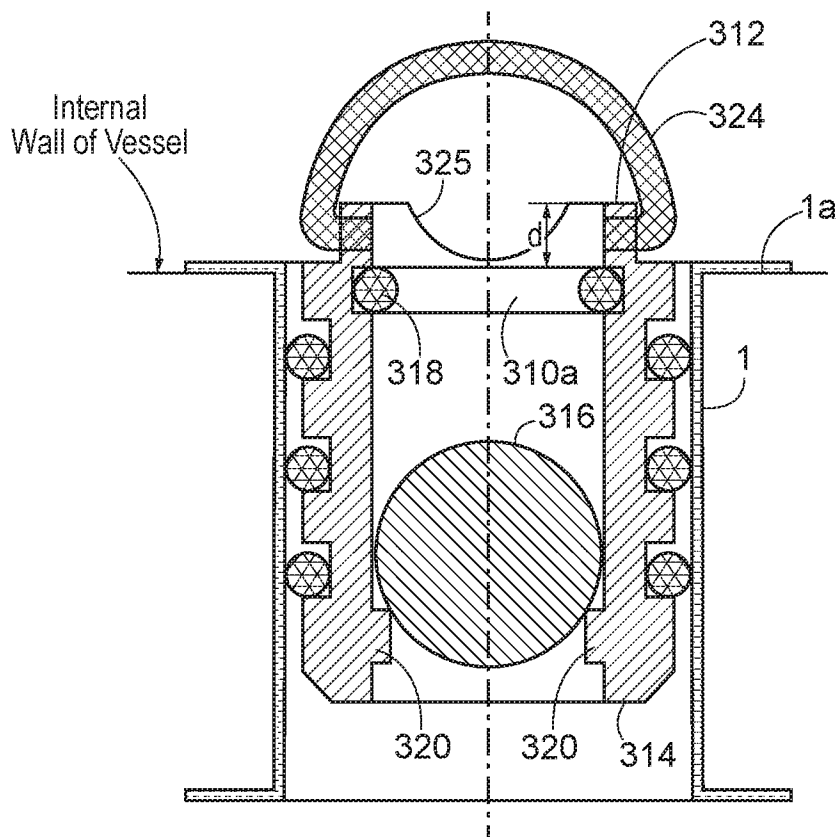


FIG. 9E

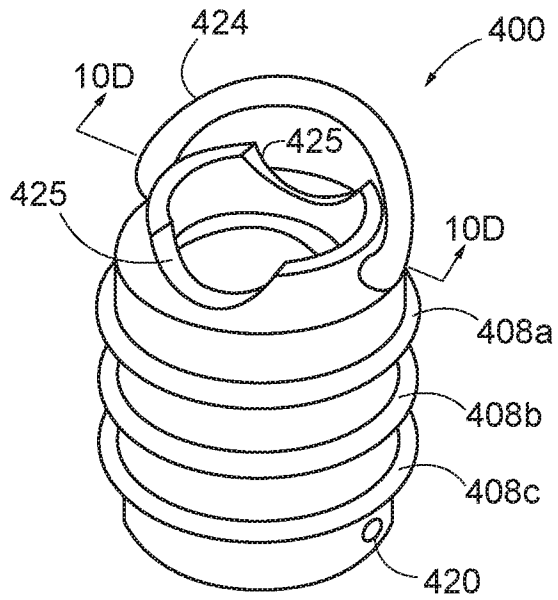


FIG. 10A

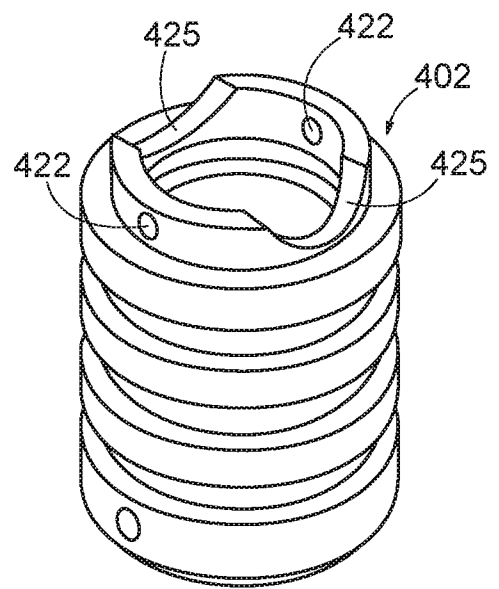


FIG. 10B

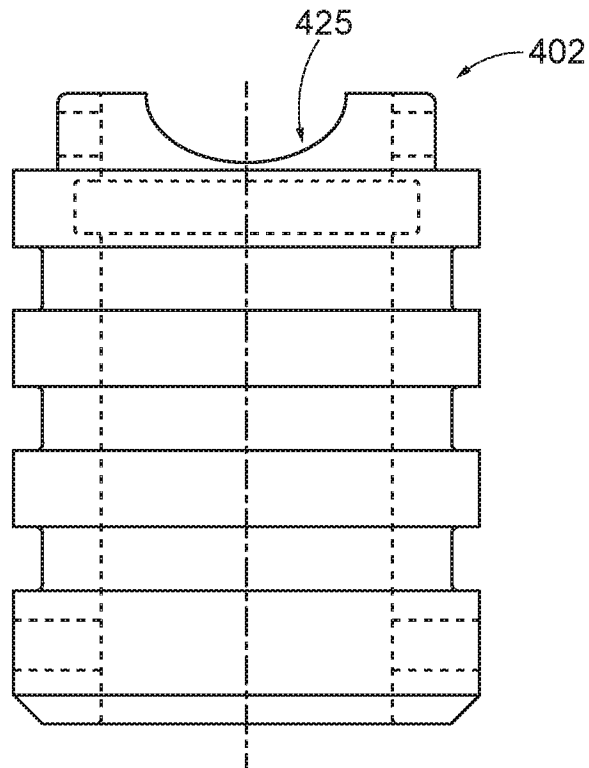


FIG. 10C

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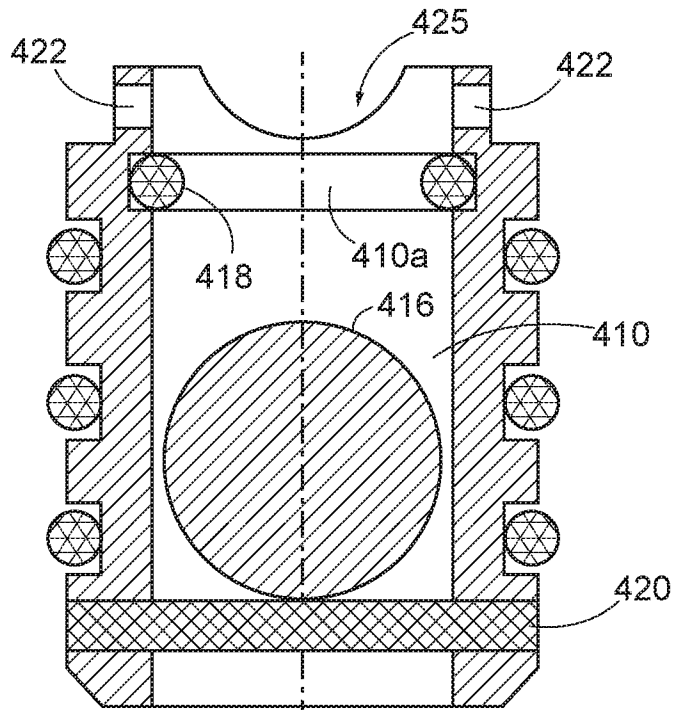


FIG. 10D

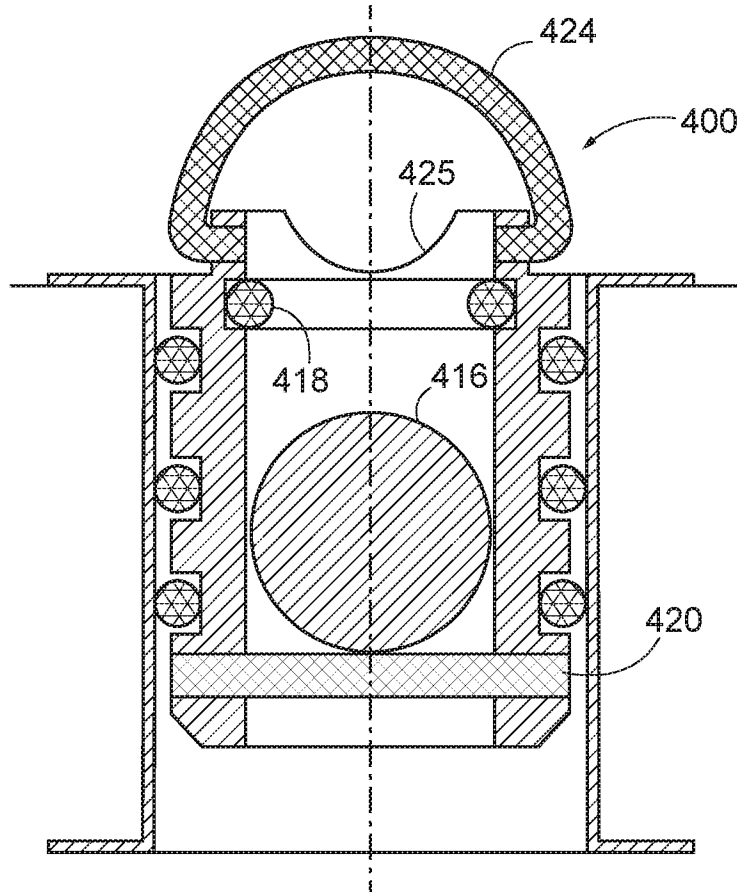


FIG. 10E

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 18/33847

A. CLASSIFICATION OF SUBJECT MATTER
 IPC(8) - A47K 1/14, B63B 13/00, F16K 15/04, F16L 55/11 (2018.01)
 CPC - Y10T 137/7904, F16K 15/183, B63B 13/00, B63B 17/0018 (2018.01)

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)

See Search History Document

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

See Search History Document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010/0263745 A1 (SYMES) 21 October 2010 (21.10.2010), entire document	1-22
A	US 6,357,376 B1 (PURIO) 19 March 2002 (19.03.2002), entire document	1-22
A	US 2009/0107383 A1 (COTTON) 30 April 2009 (30.04.2009), entire document	1-22
A	US 3,812,810 A (MOELLER) 28 May 1974 (28.05.1974), entire document	1-22
A	US 6,227,132 B1 (GARCIA) 8 May 2001 (08.05.2001), entire document	1-22

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

12 JULY 2018

Date of mailing of the international search report

24 AUG 2018

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