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(54) **Ball and socket closure for specimen collection container incorporating a resilient elastomeric seal**

Kugelgelenkverschluss mit Elastomerdichtung für Probenaufnahmebehälter

Fermeture à rotule avec un joint d'étanchéité en élastomère pour récipient de collection d'échantillons

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Description

FIELD OF THE INVENTION

[0001] The present invention is directed generally to a closure for a container. More specifically, the present invention relates to a ball and socket closure for use with specimen containers for biological and non-biological samples.

BACKGROUND OF THE INVENTION

[0002] Medical specimens, for example, biological and non-biological fluids, solids and semi-solids, are routinely collected and analyzed in clinical situations for various purposes. In particular, biological fluids such as blood, urine, and the like are typically collected in a specimen collection container which is in the shape of an open-ended tube. Such a tube is generally in the form of an elongate cylindrical member having one end open and an opposing end permanently closed by an integral semi-spherical portion, with the tube defining an interior which collects and holds the specimen.

[0003] After a biological sample has been drawn and/or collected in the tube, the tube with the sample is typically transported to a clinical testing laboratory for analysis. For example, blood samples may undergo routine chemistry, hormone, immunoassay or special chemical testing. In order to conduct such testing, the sample is normally transferred from the primary tube in which the sample was collected into one or more secondary tubes for testing and analysis, oftentimes to effect simultaneous testing in two or more different areas. In order to minimize contamination, evaporation and spilling during transportation, analysis and storage, it is important to maintain the open end of the tube with a closure.

[0004] The open end of a specimen container is typically sealed by a resilient cap, a removable rubber stopper, or plastic film during transport and analysis. Such closures provide means for sealing the open end of the tube, but are not capable of being efficiently removed, stored and replaced without causing contamination and with the use of one hand, as is often desired in clinical environments. Furthermore, when using analytical testing equipment for testing biological samples, it is typically necessary to maintain the samples in an open container to allow a probe from the testing equipment to be inserted into the container. In view of these needs, it is desirable to have a closure that can be easily and repeatedly opened and closed for manual or automated access.

[0005] One particularly useful type of closure for containers is a ball and socket type closure. While a number of ball and socket type closures for various containers are known, none are entirely effective for use in specimen collection containers, where an adequate seal is essential.

[0006] US-A-5547099 discloses a cover assembly for a container, including a cylinder base body with an axial bore therethrough, a lower portion for engaging an entry of the container, and an annular flange extending inwardly and radially into the axial bore; a shield mounted on an upper portion of the base body and having a central opening aligned with the axial bore of the base body; and a valve unit including a coil spring provided within the axial bore and placed on the annular flange, a hollow cylinder-shaped valve seat provided axially in the axial bore of the base body and inserted into the coil spring such that the valve seat can communicate with the container. The valve seat has an outwardly and radially extending press member which is biased by the coil spring toward the shield, and a blocking valve with a spherical external face and an axial hole extending therethrough. The blocking valve is provided resiliently between the valve seat and the shield and is connected pivotally to the shield such that the blocking valve is pivotable relative to the shield between a first position which permits access into the container and a second position which denies access into the container. The cover assembly is intended for use as the cover assembly of a petrol tank of a vehicle.

[0007] GB-A-448119 discloses a closure member for bottles, collapsible tubes and like containers, suitably of plastic material or of metal, the closure member being pieced with a conduit and provided with external means for manipulation and with means whereby the closure member is compelled always to rotate about one axis.

[0008] US-A-2030696 discloses a dispensing container having a hollow cylindrical neck portion; a seat in the lower end of the neck portion, the seat simulating the surface of an inverted conic frustum; a cork washer mounted on the seat; a substantially spherical closure member having an opening therethrough disposed in the hollow cylindrical neck engaging the washer throughout the area of an annulus located within the boundaries of the washer and pressing it into tight engagement with the seat thus providing a good closure; means for actuating the closure member to aline the opening therein with the axis of the neck; and means for connecting the neck portion to a container.

[0009] As noted above, while a number of ball and socket type closures for various containers are known, none are entirely effective for use in specimen collection containers, where an adequate seal is essential.

[0010] Accordingly it is desirable to provide a closure for a specimen collection container which can be easily and repeatedly opened and closed and which can effectively provide an adequate seal.

SUMMARY OF THE INVENTION

[0011] It is an object of the present invention to provide a closure for a specimen collection container which can be easily manufactured.

[0012] It is a further object of the present invention to provide a closure capable of being easily and repeatedly

opened and closed.

[0013] It is yet a further object of the present invention to provide a closure for a specimen collection container which can be repeatedly opened and closed while maintaining an adequate seal.

[0014] According to the present invention, there is provided a closure for sealing an open end of a specimen collection container from the environment, comprising:

a generally spherical-shaped ball including a passageway extending therethrough and including an axle permitting rotative movement of said ball thereabout between an open position and a closed position, said passageway being aligned with said open end of said collection container when said ball is in said open position and being out of alignment with said open end of said collection container when said ball is in said closed position; and

a socket mountable on said open end of said collection container for accommodating said rotative movement of said ball between said open position and said closed position, said socket including a ball receiving portion having a ball receiving internal surface for accommodating said rotative movement of said ball, and a resilient elastomeric seal for maintaining said ball within said ball receiving portion upon rotative movement thereof and for providing a sealed engagement between said ball and said open end of said collection container; wherein said socket further includes a ball seat supporting said elastomeric seal, said ball seat including a depending cylindrical portion for engagement with said open end of said collection container;

characterised in that said ball seat and said ball socket are separate components, and in that said depending cylindrical portion is adapted to engage an internal surface of said open end of said collection container.

[0015] The ball seat and the resilient elastomeric seal may be separate components or may be integral with each other. Preferably, the resilient elastomeric seal is in the form of a perimetrical ring which is o-shaped, and which is contained within the ball seat.

[0016] The ball seat includes a depending cylindrical portion for engagement with an internal surface of the open end of the collection tube. The depending cylindrical portion may include outwardly directed annular ribs for engagement with the collection tube.

[0017] Preferably, the ball receiving portion is longitudinally coupled to the ball seat, which coupling urges the ball into sealing engagement with the resilient elastomeric seal. The ball receiving portion and the ball seat may include cooperating threaded surfaces for threaded connection therebetween. Further, the cooperating threads may include a stop for preventing threaded disengagement of the ball receiving portion from the ball seat.

[0018] In an alternate embodiment, the resilient elastomeric seal includes a perimetrical ring capable of engaging a perimeter of the open end of the collection tube, and the ball receiving portion includes an annular flange for engagement with an external surface of the open end of the collection container. The annular flange may snap fit over the open end of the collection container, or may include internal threads on an internal surface thereof for threaded engagement with cooperating threads on an external surface of the open end of the collection container. Such threaded engagement of the ball receiving portion and the external surface of the collection container urges the ball into sealing engagement with the resilient elastomeric seal. Further, such cooperating threads may include a stop for preventing threaded disengagement of the ball receiving portion from the collection container.

[0019] In preferred embodiments, the ball receiving internal surface of the socket includes an axle-support for receiving the axle of the ball for accommodating rotative movement of the ball. The axle-support of the socket and the axle of the ball may be parallel and eccentric with respect to each other. Preferably, the axle of the ball includes a pair of opposed protrusions on opposed surfaces thereof and the axle-support of the socket includes a generally spherical internal surface having a pair of opposed cavities, with the opposed protrusions of the ball engaging the opposed cavities of the socket. Further, the pair of opposed protrusions may be generally cylindrical-shaped with the pair of opposed cavities including a pair of generally cylindrical bores for engagement therewith. Alternatively, the pair of opposed cavities of the socket may include a pair of tapered surfaces with the pair of opposed protrusions of the ball include a pair of corresponding drafted surfaces for engagement therewith.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

Figure 1 represents a perspective view of a specimen collection assembly including a closure depicted in an open state.

Figure 2 represents a perspective view of the specimen collection assembly of Figure including the closure depicted in a closed state.

Figure 3 represents a perspective view of the closure of Figure 1 shown unassembled.

Figure 4 represents a cross-sectional view of the closure according to Figure 1.

Figure 5 represents a perspective view of a closure in a preferred embodiment of the present invention

shown unassembled.

Figure 6 represents a cross-sectional view of the preferred closure of Figure 5 in an open state taken along line 6-6 of Figure 1.

Figure 7 represents a cross-sectional view of the preferred closure of Figure 5 in an open state taken along line 7-7 of Figure 6.

Figure 8 represents a cross-sectional view of the preferred closure of Figure 5 in a closed state taken along line 8-8 of Figure 2.

Figure 9 represents a cross-sectional view of the preferred closure of Figure 5 in a closed state taken along line 9-9 of Figure 8.

Figure 10 represents a perspective view of a further embodiment of the closure of the present invention shown unassembled.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] The present invention may be described as a ball and socket closure for use with specimen collection containers. For purposes of the present invention, the term specimen collection container is used to represent any type of container useful for collecting, transferring, analyzing or storing a biological or non-biological sample, for example primary and secondary specimen tubes for blood collection and analysis.

[0022] The present invention takes the form of a ball and socket closure for a collection container capable of providing an adequate seal, and which is capable of preventing or minimizing transfer of contaminants between the external environment and the internal contents of the container.

[0023] With specific reference to the embodiment of Figures 1 and 2, a closure 10 is shown positioned over a blood collection tube 100, respectively, in an open and closed position. Closure 10 is adapted for interfitting engagement with collection tube 100 at open end 110 thereof. Collection tube 100 may be any type of collection tube known in the art, and may be constructed of any known material such as glass or, more preferably, a suitable plastic. Preferably, collection tube 100 is a false-bottom tube, including open end 110 at the top thereof and an opposed open bottom end 120, with a conical bottom 130 located between open end 110 and bottom end 120. Conical bottom 130 provides collection tube 100 with an upper chamber 115 for holding small volumes of liquid. Such a structure allows for easy access to liquid contained in upper chamber 115 when utilizing a manual transfer pipette or an automated sample probe from a clinical analyzer. By incorporating conical bottom 130, collection tube 100 can be used with standard holders and analyzer equipment without the need for such a pipette or probe to travel the full length of collection tube 100 to access the sample contained therein.

[0024] Closure 10 includes a generally spherical-shaped socket 40 and a cylindrical protrusion 47 depending from a bottom end of closure 10. Cylindrical protrusion 47 is adapted for interfitting engagement within open end 110 of collection tube 100, thereby providing means for attaching closure 10 to collection tube 100. Cylindrical protrusion 47 may be adapted for interfitting engagement with collection tube 100 in any known manner, for example by snap-fit, frictional fit, threaded engagement, and the like. In this manner, closure 10 may be firmly fitted and attached to collection tube 100 in a liquid-tight manner, and may be easily removed from collection tube 100 if desired.

[0025] As shown in Figure 3 and 4, closure 10 further includes a generally spherically-shaped ball 20 fitted within socket 40. Ball 20 includes a passageway 21 extending therethrough. Preferably, passageway 21 is in the form of a cylindrical bore, which extends through ball 20 from a first open end 23 of ball 20 to an opposed second open end 24 of ball 20. Passageway 21 provides an opening through ball 20 for permitting access between the outside environment and upper chamber 115 of collection tube 100, as will be discussed in more detail herein.

[0026] The internal diameter of passageway 21 should be large enough to allow access of a probe therethrough and to allow fluid flow therethrough. It is important, however, that the overall outside diameter of closure 10 must not be too large. For example, if the outside diameter of closure 10 or socket 40 is significantly larger than the outside diameter of a standard collection tube, collection tube 100 with closure 10 assembled thereon may not properly fit or function in conventional testing equipment. More particularly, closure 10 is particularly useful in testing environments where conventional covers would need to be removed from a collection container prior to testing of the sample. As such, collection tubes typically conform to a standard size to be useful with such equipment. As closure 10 of the present invention may be used during analysis without the need to remove the entire closure 10 from collection tube 100, closure 10 preferably is capable of fitting within the boundary of such standard size testing equipment without the need for removal thereof. Therefore, the outside diameter of closure 10 or socket 40 is preferably less than approximately 19.05 millimeters in order to properly function with standard equipment. With such an outside diameter, the internal diameter of passageway 21 is preferably approximately 10.5 millimeters. In alternate embodiments, closure 10 may be of a sufficient diameter such that, when coupled to collection tube 100, closure 10 is capable of supporting collection tube 100 in various testing equipment such as storage racks, carousels, etc.

[0027] As noted above, ball 20 fits within socket 40 to

form closure 10. Socket 40 includes a ball receiving portion 90 and a resilient elastomeric seal 70. Socket 40 further includes a first open end 43 defining a perimetrical opening at the top of ball receiving portion 90 which is open to the external environment, and a second open end 44 at the bottom end thereof which is open to the interior of collection tube 100. First open end 43 may include a contoured pouring surface for facilitating pouring of the contents of collection tube 100.

[0028] Ball receiving portion 90 of socket 40 includes a ball-receiving internal surface 41, for interfitting engagement with the outside surface of ball 20. Internal surface 41 includes a generally semi-spherical-shaped hollow opening which accommodates the shape of ball 20. Ball 20 fits within ball receiving portion 90 of socket 40 in a contacting relation between the external surface of ball 20 and the perimeter of first open end 43 of ball receiving portion 90, so as to establish sealing engagement between ball 20 and socket 40 at first open end 43.

[0029] As shown in Figures 3 and 4, socket 40 includes a resilient elastomeric seal 70 positioned for engagement between ball 20, ball receiving portion 90 and open end 110 of collection tube 100. Elastomeric seal is constructed of a resilient elastomeric material, for example, rubber, silicone, or the like. Elastomeric seal 70 is generally ring-shaped having an upper generally flat annular surface 71 and a depending cylindrical portion 73. The upper annular surface 71 provides a support surface for accommodating the ball 20 in sealing engagement and for maintaining ball 20 within ball receiving portion 90 upon rotative movement of ball 20 within socket 40. Depending annular portion 73 provides a seal between ball 20 and open end 110 of collection tube 100.

[0030] In such an embodiment, ball receiving portion 90 may include an annular flange 95 for engagement with an external surface of collection tube 100 when closure 10 is mounted thereon. Annular flange 95 may engage collection tube 100, for example, in a snap fit engagement, a friction fit engagement, a threaded engagement, or the like. Such engagement of annular flange 95 with the external surface of collection tube 100 urges ball 20 into sealing engagement with elastomeric seal 70. In preferred embodiments, annular flange 95 includes internal threads 92 on an internal surface thereof, for threaded engagement with cooperating threads 112 on the external surface of open end 110 of collection tube 100. Further, such cooperating threads may be capable of preventing disengagement of annular flange 95 and collection tube 100. Such means for preventing disengagement is preferably a stop.

[0031] Figures 5-9 depict the closure 10 in an embodiment of the present invention, wherein socket 40 further includes an annular ball seat 80. Ball seat 80 includes ball accommodating upper portion 81 and cylindrical portion 47 depends from a lower portion of ball seat 80, thereby providing means for attaching closure 10 to collection tube 100. Ball seat 80 provides a seat for ball 20 permitting rotation between an open and closed position within socket 40. Ball seat 80 further supports an elastomeric o-ring 70' forming an elastomeric seal.

[0032] Ball receiving portion 90 is longitudinally coupled to ball seat 80 by any known method, for example by a snap fit, frictional fit, or threaded engagement. Such longitudinal coupling urges ball 20 into sealing engagement with o-ring 70'. Preferably, ball receiving portion 90 and ball seat 80 include cooperating threaded surfaces 92 and 82, respectively, for threaded connection therebetween. Further, such cooperating threads may be capable of preventing disengagement of cooperating threaded surfaces 92 and 82, to prevent threaded disengagement of ball receiving portion 90 and ball seat 80. Such means for preventing disengagement is preferably a stop.

[0033] Alternatively, as shown in Figure 10, ball receiving portion 90 may include clasps 97 for interlocking engagement with ball seat clips 87 on an external surface of ball seat 80. Such interlocking engagement prevents ball receiving portion 90 and ball seat 80 from becoming unattached.

[0034] As indicated, ball 20 is interfitted within socket 40 for rotative movement therein. Ball 20 further includes an axle 30. Axle 30 permits rotative movement of ball 20 within socket 40 about an axis between an open position and a closed position, as will be discussed in more detail herein. Axle 30 is preferably defined by a pair of opposed protrusions 31a and 31b on opposed surfaces of ball 20, as best seen in Figures 7 and 9. Opposed protrusions 31a and 31b may be cylindrical-shaped protrusions, or alternatively, may include drafted surfaces 32a and 32b, to correspond with tapered surfaces 52a and 52b of socket 40, as will be discussed in further detail herein. Alternatively, axle 30 may be defined by a pair of opposed cavities on opposed surfaces of ball 20, which opposed cavities engage with opposed protrusions within socket 40.

[0035] Internal surface 41 includes axle-support 50 for receiving axle 30 of ball 20. Axle-support 50 is comprised of recessed cavities 51a and 51b at diametrically opposed sides thereof. Such opposed cavities 51a and 51b provide for interfitting engagement with opposed protrusions 31a and 31b of ball 20. Further, opposed cavities 51a and 51b may include tapered surfaces 52a and 52b, respectively, therein for engagement with drafted surfaces 32a and 32b of ball 20. With ball 20 fitted within socket 40 in this manner, axle 30 provides for rotative movement of ball 20 thereabout within axle-support 50 of socket 40. In an alternate embodiment where ball 20 includes opposed cavities acting as axle 30 as noted above, axle support 50 may include opposed protrusions for interfitting engagement with such opposed cavities of ball 20.

[0036] Rotative movement of ball 20 about axle 30 can be effected manually by providing ball 20 with externally accessible means for rotation such as tab 22 extending from the surface of ball 22. Tab 22 provides

a protrusion for effecting movement of ball 20 within socket 40 by an operator's finger or thumb. Tab 22 may include a contoured pouring surface on a surface thereof for facilitating pouring of the contents of collection tube 100.

[0037] Rotation of ball 20 about axle 30 results in the alignment of first open end 23 of ball 20 with first open end 43 of socket 40 as well as alignment of second open end 24 of ball 20 with second open end 44 of socket 40. As such, a path is established by way of passageway 21 extending through ball 20 between the outside environment and upper chamber 115 of collection tube 100. Thus, rotation of ball 20 about axle 30 accomplishes movement of ball 20 between an open position when passageway 21 is in alignment with the interior of collection tube 100 through the alignment of first open ends 23 and 43 and second open ends 24 and 44 (shown in Figures 6 and 7), and a closed position when passageway 21 is out of alignment with the interior of collection tube 100 due to first open ends 23 and 43 and second open ends 24 and 44 being out of alignment with each other (shown in Figures 8 and 9).

[0038] Ball 20 is constructed and positioned within socket 40 so as to define an environment-contacting surface 27 and an opposed specimen- or liquid-contacting surface 29. When closure 10 is in a closed position, environment-contacting surface 27 is exposed to the external environment while liquid-contacting surface 29 is exposed to the interior of collection tube 100, i.e. upper chamber 115. When closure 10 is in an open position, environment-contacting surface 27 and liquid-contacting surface 29 are positioned within the semi-spherical-shaped hollow opening of ball receiving portion 90 which forms internal surface 41. In preferred embodiments, environment-contacting surface 27 includes means for identifying when ball 20 is in a closed position. Such identifying means may include indicia distinguishing between an open position and a closed position. For example, environment-contacting surface 27 may include a marking or wording thereon, or may include color coding signifying that the ball is in the closed position.

[0039] Alternately, such means for identifying when ball 20 is in a closed position includes the incorporation of a stop-indicating element on internal surface 41 of socket 40 for engagement with environment-contacting surface 27 when ball 20 is rotated to the closed position. For example, internal surface 41 of socket 40 may include dimple 42 at a location adjacent first open end 43 of socket 40. Dimple 42 may include a small protrusion extending from the internal surface 41 of socket 40. As will be discussed in more detail herein, dimple 42 provides an audible and tactile "click stop" feedback to the operator when environment-contacting surface 27 of ball 20 passes thereover, indicating that ball 20 has been fully rotated to the closed position. Alternatively, dimple 42 may include a protrusion 42a extending along a length of internal surface 41 of socket 40, as shown in Figure 17. Such protrusion 42a provides an operator with an audible and tactile "click-stop" feedback to indicate that ball 20 has been fully rotated to both the open and closed positions, as will be discussed.

[0040] As indicated above, axle 30 of ball 20 is defined by opposed protrusions 31a and 31b, and axle-support 50 of socket 40 is defined by opposed cavities 51a and 51b. When closure 10 is assembled, axle 30 is received in axle-support 50, i.e., opposed protrusions 31a and 31b are supported within opposed cavities 51a and 51b. Closure 10 may be adapted for symmetric rotation of ball within socket 40 about axle 30. Alternately closure 10 may be adapted for non-symmetric rotation of ball 20 within socket 40 about axle 30, as described in detail in United States Application Serial No. 08/928064 (EP-A-0 901 827) entitled "Ball and Socket Closure for Specimen Collection Container" filed concurrently herewith. In order to effect non-symmetric rotation of ball 20 within socket 40, axle 30 and axle-support 50 are parallel and eccentric with respect to each other. Such non-symmetric rotation provides for improved liquid-tight sealing of closure 10 between ball 20 and socket 40.

[0041] Further, as noted above, when closure 10 is in an open position, environment-contacting surface 27 and liquid-contacting surface 29 are positioned within the sphere-shaped hollow opening of socket 40 which forms internal surface 41. Environment-contacting surface 27 is preferably recessed from the general spherical shape of ball 20, such that when closure 10 is in an open position, annular space 37 is provided between environment-contacting surface 27 and internal surface 41 of socket 40, thus maintaining a non-contacting relation therebetween. This non-contacting relation prevents contamination between environment-contacting surface 27 and interior surface 41.

[0042] In a further embodiment of the present invention, closure 10 may include a locking mechanism for preventing rotational movement of ball 20 within socket 40, for example a clip, strap, band, or the like, for securing ball 20 in a closed position during transport or storage, or in an open position during use. Alternatively, rotative movement of ball 20 within socket 40 may be effected through the longitudinal coupling of ball receiving portion 90 and ball seat 80. For example, as noted, the longitudinal coupling of ball receiving portion 90 and ball seat 80 urges ball 20 into sealing engagement with elastomeric seal 70. By coupling ball receiving portion 90 and ball seat 80 in a tight manner, ball 20 is tightly urged into sealing engagement with elastomeric seal 70, thereby preventing rotative movement of ball 20 within socket 40. This can be accomplished, for example, by providing ball receiving portion 90 and ball seat 80 with cooperating threads, which threads can be tightened to longitudinally urge ball 20 into sealing engagement with elastomeric seal 70 and prevent movement of ball 20 within socket 40 or loosened to permit such rotative movement.

[0043] In use, closure 10 including ball 20 fitted within socket 40 is provided for engagement at open end 110

of collection tube 100 with ball receiving portion 90 and ball seat 80 in tightly threaded engagement to prevent movement of ball 20 within socket 40. This threaded engagement is loosened by partially unthreading ball receiving portion 90 from ball seat 80, to permit rotational movement of ball 20 within socket 40. Rotational movement of ball 20 within socket 40 about axle 30 accomplishes opening and closing of closure 10. For example, when closure 10 is in the closed position as shown in Figures 2, 8 and 9, environmental-contacting surface 27 is positioned within first open end 43 of ball receiving portion 90 and is exposed to the external environment while liquid contacting surface 29 of ball 20 is positioned for exposure to upper chamber 115 of collection tube 100. The external surface of ball 20 contacts elastomeric seal 70 in a sealing engagement, thus preventing any fluid contained within collection tube 100 from passing beyond elastomeric seal 70 and between ball 20 and socket 40. An operator's finger engages tab 22 of ball 20, and applies pressure to tab 22 in a direction toward environmental-contacting surface 27. Such pressure transmits a force to ball 20 about axle 30, thus causing ball 20 to rotate about axle 30 within socket 40. This rotative movement causes liquid-contacting surface 29 to engage elastomeric seal 70, and the continuous rotative movement of ball 20 provides for a wiping action between elastomeric seal 70 and liquid-contacting surface 29. Accordingly, any blood or other contaminant which is present on liquid-contacting surface 29 is wiped from the surface thereof by elastomeric seal 70.

[0044] Full rotation of ball 20 within socket 40 is accomplished by moving tab 22 completely across first open end 43 of socket 40, with tab 22 resting on the perimeter of first open end 43. During this rotation, opposed protrusions 31a and 31b of ball 20 engage opposed cavities 51a and 51b of socket 40. As elastomeric seal 70 is resilient and flexible, elastomeric seal 70 flexes with the longitudinal movement of ball 20, thereby maintaining a contacting relation between elastomeric seal 70 and ball 20 to maintain a liquid-tight seal. Upon full rotation of ball 20 within socket 40, liquid-contacting surface 29 is rotated to a position within internal surface 41 of ball receiving portion 90. The recessed nature of environmental-contacting surface 27 with respect to the overall sphere-shape of ball 20 causes environmental-contacting surface 27 to be rotated to a position within ball receiving portion 90 in a non-contacting relation with internal surface 41 of socket 40.

[0045] Such full rotation of ball 20 within socket 40 by moving tab 22 completely across first open end 43 of socket 40 results in closure 10 being rotated to its open position. This open position effects the alignment of first open end 23 of ball 20 with first open end 43 of socket 30 as well as alignment of second open end 24 of ball 20 with second open end 44 of socket 40, resulting in passageway 21 extending through ball 20 between the outside environment and upper chamber 115 of collection tube 100. This alignment establishes a path for insertion of a probe or for pouring of fluids contained within upper chamber 115, directly through passageway 21.

[0046] After effecting such use, closure 10 can be returned to its closed position by applying pressure to tab 22 in a direction opposite of that to open closure 10, i.e., in a direction toward passageway 21 of ball 22. Such pressure transmits a force to ball 20 about axle 30 in a similar manner as that exerted during opening of closure 10, thus causing ball 20 to rotate about axle 30 within socket 40 in an opposite direction as that used to open closure 10. This rotative movement causes liquid-contacting surface 29 to travel back across elastomeric seal 70, to its original position where it is exposed to upper chamber 115 of collection tube 100.

[0047] Further, such rotational movement causes environmental-contacting surface 27 to travel back across the perimeter of first open end 43 of socket 40 to its original position where it is exposed to the external environment. As environmental-contacting surface 27 is recessed with respect to the overall sphere defining the shape of ball 20, it does not contact inside surface 41 of ball receiving portion 90 during such travel. However, as environmental-contacting surface 27 returns to its original position, an edge of environmental-contacting surface 27 which defines the transition between the overall sphere-shape of ball 20 and the recessed portion of environmental-contacting surface 27 contacts dimple 42 as it passes thereover. Such contacting provides for an audible and tactile "click stop" feedback for the operator, thus providing an indication that ball 20 has been fully rotated within socket 40 to the closed position.

[0048] Still further, once ball 20 is fully rotated within socket 40 to the closed position with environmental-contacting surface 27 of ball 20 being rotated past dimple 42, flat edge 53 of opposed cavities 51a and 51b in socket 40 frictionally engages opposed protrusions 31a and 31b of ball 20. Such engagement exerts a further longitudinal force on ball 20 in a longitudinal direction within ball receiving portion 90 of socket 40, further forcing ball 20 onto elastomeric seal 70 and ball seat 80. Such longitudinal force provides the operator with positive feedback that ball 20 has been fully rotated to the closed position by way of an additional audible and tactile "click stop", and further ensures that a liquid-tight seal is maintained between ball 20 and socket 40 at ball seat 80.

[0049] Ball 20 and socket 40 can be made of any known materials useful for such purposes. Preferably, both ball 20 and socket 40 are constructed of thermoplastic materials. More preferably, both ball 20 and socket 40 are constructed of a rigid material. Most preferably, ball 20 and socket 40 are are made of a material selected from polystyrene or polypropylene.

[0050] Ball 20 and socket 40 can be manufactured using a variety of methods. Preferably, ball 20 and socket 40 are separately manufactured by molding procedures such as injection molding, and then assembled to form closure 10. Alternatively, ball 20 and socket 40 may be manufactured using a "dual-shot" or "two-shot" molding

procedure, wherein ball 20 is fist molded and socket 40 is thereafter molded directly thereover. Various other molding and manufacturing methods are contemplated.

[0051] The closure of the present invention provides a number of improvements over prior art closures and techniques. In particular, the closure of the present invention minimizes splatter of liquid samples contained within a collection container. Additionally, there is no need to remove the closure to access the interior region of the collection container. The closure, however, may be removed from the collection container if desired. While the closure is capable of a firm attachment to the collection container, it is still capable of rotating independently of the container without the need for removal. The use of such an integrated closure permits ease of use for technicians with less risk of contamination in that there is a lower tendency to leave the collection container open since opening and closing of the container can easily be accomplished with a single hand.

[0052] Various other modifications to the foregoing disclosed embodiments will now be evident to those skilled in the art. Thus, the particularly described preferred embodiments are intended to be illustrative and not limited thereto. The true scope of the invention is set forth in the following claims.

[0053] At certain points in this specification the references to "eccentric" are to be understood as meaning "offset". Moreover, where it is indicated that the axle-support of the socket and the axle of the ball are parallel and eccentric with respect to each other, this is to be taken to mean that the axle support of the socket lies off the main (central) axis of the socket, and/or the axle of the ball lies off the main (central) axis of the ball.

Claims

1. A closure (10) for sealing an open end (110) of a specimen collection container (100) from the environment, comprising:

a generally spherical-shaped ball (20) including a passageway (21) extending therethrough and including an axle (30) permitting rotative movement of said ball (20) thereabout between an open position and a closed position, said passageway (21) being aligned with said open end (110) of said collection container (100) when said ball is in said open position and being out of alignment with said open end (110) of said collection container (100) when said ball (20) is in said closed position; and

a socket (40) mountable on said open end (110) of said collection container (100) for accommodating said rotative movement of said ball (20) between said open position and said closed position, said socket (40) including a ball receiving portion (90) having a ball receiving internal surface (41) for accommodating said rotative movement of said ball (20), and a resilient elastomeric seal (70) for maintaining said ball (20) within said ball receiving portion (90) upon rotative movement thereof and for providing a sealed engagement between said ball (20) and said open end (110) of said collection container (100), wherein said socket (40) further includes a ball seat (80) supporting said elastomeric seal (70), said ball seat (80) including a depending cylindrical portion (47) for engagement with said open end (110) of said collection container (100);

characterised in that said ball seat (80) and said ball socket (40) are separate components, and **in that** said depending cylindrical portion (47) is adapted to engage an internal surface of said open end (110) of said collection container (100).

2. A closure (10) as claimed in claim 1, wherein said ball seat (80) and said resilient elastomeric seal (70) are integral.

3. A closure (10) as claimed in claim 1, wherein said ball seat (80) and said resilient elastomeric seal (70) are separate components.

4. A closure (10) as claimed in claim 1, wherein said resilient elastomeric seal (70) comprises a perimetrical ring.

5. A closure (10) as claimed in claim 4, wherein said perimetrical ring is o-shaped.

6. A closure (10) as claimed in claim 1, wherein said depending cylindrical portion (47) of said ball seat (80) includes outwardly directed annular ribs (48) for engagement with said internal surface of said open end (110) of said collection container (100).

7. A closure (10) as claimed in claim 1, wherein said ball receiving portion (90) is longitudinally coupled to said ball seat (80).

8. A closure (10) as claimed in claim 7, wherein said longitudinal coupling of said ball receiving portion (90) urges said ball (20) into sealing engagement with said resilient elastomeric seal (70).

9. A closure (10) as claimed in claim 8, wherein said ball receiving portion (90) and said ball seat (80) include cooperating threaded surfaces for threaded connection of said ball receiving portion (90) to said ball seat (80).

10. A closure (10) as claimed in claim 9, wherein said cooperating threads includes a stop for preventing

threaded disengagement of said ball receiving portion (90) from said ball seat (80).

11. A closure (10) as claimed in claim 1, wherein said resilient elastomeric seal (70) comprises a perimetrical ring capable of engaging a perimeter of said open end (110) of said collection container (100), and said ball receiving portion (90) includes an annular flange (95) for engagement with an external surface of said open end (110) of said collection container (100).

12. A closure (10) as claimed in claim 11, wherein said annular flange (95) snap fits over said external surface of said open end (110) of said collection container (100).

13. A closure (10) as claimed in claim 11, wherein an internal surface of said annular flange (95) and said external surface of said open end (110) of said collection container (100) include cooperating threads (112) for threaded engagement therebetween.

14. A closure (10) as claimed in claim 13, wherein said threaded engagement of said ball receiving portion (90) and said external surface of said open end (110) of said collection container (100) urges said ball (20) into sealing engagement with said resilient elastomeric seal (70).

15. A closure (10) as claimed in claim 13, wherein said cooperating threads (112) include a stop for preventing threaded disengagement of said ball receiving portion (90) from said collection container (100).

16. A closure (10) as claimed in claim 1, wherein said ball receiving internal surface (41) of said socket (40) includes an axle-support (50) for receiving said axle (30) of said ball (20) for accommodating said rotative movement of said ball (20).

17. A closure (10) as claimed in claim 16, wherein said axle-support (50) of said socket (40) and said axle (30) of said ball (20) are parallel and eccentric with respect to each other.

18. A closure (10) as claimed in claim 16, wherein said axle (30) of said ball comprises a pair of opposed protrusions (31) on opposed surfaces of said ball (20) and said axle-support (50) of said socket (40) comprises a generally spherical internal surface including a pair of opposed cavities (51), said opposed protrusions (31) of said ball (20) engaging said opposed cavities (51) of said socket (40).

19. A closure (10) as claimed in claim (18), wherein said pair of opposed protrusions (31) of said ball (20) are generally cylindrical-shaped and said pair of opposed cavities (51) of said socket (40) include a pair of generally cylindrical bores for engagement therewith.

20. A closure (10) as claimed in claim 18, wherein said part of opposed cavities (51) of said socket (40) include a pair of tapered surfaces and said pair of opposed protrusions (31) of said ball (20) include a pair of corresponding drafted surfaces for engagement therewith.

Patentansprüche

1. Verschluss (10) zum Abdichten eines offenen Endes (110) eines Probensammelbehälters (100) vor der Umgebung, umfassend:

eine in der Regel kugelförmige Kugel (20) mit einem Durchlass (21), der sich durch die Kugel erstreckt, und einer Achse (30), die eine Drehbewegung der Kugel (20) zwischen einer offenen und einen geschlossenen Stellung erlaubt, so dass der Durchlass (21) zum offenen Ende (110) des Sammelbehälters (100) ausgerichtet ist, wenn sich die Kugel in der Offenstellung befindet, und nicht zum offenen Ende (110) des Sammelbehälters (100) ausgerichtet ist, wenn sich die Kugel (20) in Verschlussstellung befindet; und

eine am offenen Ende (110) des Sammelbehälters (100) anbringbare Fassung (40) zum Unterbringen der Drehbewegung der Kugel (20) zwischen der offenen und der geschlossenen Stellung, wobei die Fassung (40) ein Kugelaufnahmeteil (90) aufweist mit einer Kugelaufnahme-Innenoberfläche (41) zum Unterbringen der Drehbewegung der Kugel (20) und eine elastische Elastomerdichtung (70) zum Halten der Kugel (20) in dem Kugelaufnahmeteil (90) bei deren Drehbewegung und zum Bereitstellen eines dichtenden Eingriffs zwischen der Kugel (20) und dem offenen Ende (110) des Sammelbehälters (100), wobei die Fassung (40) zudem einen Kugelsitz (80) aufweist zum Haltern der Elastomerdichtung (70), wobei der Kugelsitz (80) einen abhängigen Zylinderrteil (47) aufweist für einen Eingriff mit dem offenen Ende (110) des Sammelbehälters (100);

dadurch gekennzeichnet, dass der Kugelsitz (80) und die Kugelfassung (40) getrennte Komponenten sind und der abhängige Zylinderteil (47) ausgelegt ist für einen Eingriff mit der Innenoberfläche des offenen Endes (110) des Sammelbehälters (100).

2. Verschluss (10) nach Anspruch 1, wobei der Kugel-

sitz (80) und die elastische Elastomerdichtung (70) aus einem Stück sind.

3. Verschluss (10) nach Anspruch 1, wobei der Kugelsitz (80) und die elastische Elastomerdichtung (70) getrennte Komponenten sind.

4. Verschluss (10) nach Anspruch 1, wobei die elastische Elastomerdichtung (70) einen Umfangsring aufweist.

5. Verschluss (10) nach Anspruch 4, wobei der Umfangsring o-förmig ist.

6. Verschluss (10) nach Anspruch 1, wobei der abhängige Zylinderteil (47) des Kugelsitzes (80) nach außen gerichtete ringförmige Rippen (48) zum Eingriff mit der Innenoberfläche des offenen Endes (110) des Sammelbehälters (100) aufweist.

7. Verschluss (10) nach Anspruch 1, wobei der Kugelaufnahmeteil (90) in Längsrichtung mit dem Kugelsitz (80) gekoppelt ist.

8. Verschluss (10) nach Anspruch 7, wobei die Längskopplung des Kugelaufnahmeteils (90) die Kugel (20) in einen dichtenden Eingriff mit der elastischen Elastomerdichtung (70) zwingt.

9. Verschluss (10) nach Anspruch 8, wobei der Kugelaufnahmeteil (90) und der Kugelsitz (80) kooperierende Gewindeflächen für einen Schraubverbund von Kugelaufnahmeteil (90) und Kugelsitz (80) aufweist.

10. Verschluss (10) nach Anspruch 9, wobei das kooperierende Gewinde einen Stopp aufweist, der verhindert, dass sich das Gewinde zwischen dem Kugelaufnahmeteil (90) und dem Kugelsitz (80) löst.

11. Verschluss (10) nach Anspruch 1, wobei die elastische Elastomerdichtung (70) einen Umfangsring aufweist, der in der Lage ist, einen Umfang des offenen Endes (110) des Sammelbehälters (100) zu umgreifen und wobei der Kugelaufnahmeteil (90) einen ringförmigen Flansch (95) zum Eingriff mit der Außenoberfläche des offenen Endes (110) des Sammelbehälters (100) aufweist.

12. Verschluss (10) nach Anspruch 11, wobei der ringförmige Flansch (95) über die Außenoberfläche des offenen Endes (110) des Sammelbehälters (100) einschnappt.

13. Verschluss (10) nach Anspruch 11, wobei eine Innenoberfläche des ringförmigen Flansches (95) und die Außenoberfläche des offenen Endes (110) des Sammelbehälters (100) ein kooperierendes Gewinde (112) zum gegenseitigen Gewindeeingriff aufweisen.

14. Verschluss (10) nach Anspruch 13, wobei der Gewindeeingriff von Kugelaufnahmeteil (90) und Außenoberfläche des offenen Endes (110) des Sammelbehälters (100) die Kugel (20) in einen abdichtenden Eingriff mit der elastischen Elastomerdichtung (70) zwingt.

15. Verschluss (10) nach Anspruch 13, wobei das kooperierende Gewinde (112) einen Stopp aufweist, der verhindert, dass sich das Gewinde zwischen Kugelaufnahmeteil (90) und Sammelbehälter (100) löst.

16. Verschluss (10) nach Anspruch 1, wobei die Kugelaufnahme-Innenoberfläche (41) der Fassung (40) eine Achsenhalterung (50) zur Aufnahme der Achse (30) der Kugel (20) aufweist, so dass Drehbewegung der Kugel (20) untergebracht ist.

17. Verschluss (10) nach Anspruch 16, wobei die Achsenhalterung (50) der Fassung (40) und die Achse (30) der Kugel (20) parallel und exzentrisch zueinander sind.

18. Verschluss (10) nach Anspruch 16, wobei die Achse (30) der Kugel ein Paar gegenüberliegender Vorsprünge (31) auf gegenüberliegenden Oberflächen der Kugel (20) aufweist und die Achsenhalterung (50) der Fassung (40) eine in der Regel kugelförmige Innenoberfläche mit einem Paar gegenüberliegender Vertiefungen (51) aufweist, wobei die gegenüber liegenden Vorsprünge (31) der Kugel (20) in die gegenüberliegenden Vertiefungen (51) der Fassung (40) eingreifen.

19. Verschluss (10) nach Anspruch 18, wobei das Paar gegenüberliegender Vorsprünge (31) der Kugel (20) im Allgemeinen zylindrisch geformt ist und das Paar gegenüberliegender Vertiefungen (51) der Fassung (40) ein Paar von im Allgemeinen zylindrischen Löchern zum Eingriff damit aufweist.

20. Verschluss (10) nach Anspruch 18, wobei das Paar gegenüberliegender Vertiefungen (51) der Fassung (40) ein Paar konisch zulaufender Oberflächen und das Paar gegenüberliegender Vorsprünge (31) der Kugel (20) ein Paar entsprechender schräger Oberflächen zum Eingriff damit aufweist.

Revendications

1. Fermeture (10) pour isoler de façon étanche une extrémité ouverte (110) d'un récipient de recueil d'échantillons (100) de l'environnement extérieur,

comprenant :

une rotule de forme généralement sphérique (20) comprenant un passage (21) la traversant et comprenant un arbre (30) permettant un mouvement de rotation de ladite rotule (20) autour de lui entre une position ouverte et une position fermée, ledit passage (21) étant aligné avec ladite extrémité ouverte (110) dudit récipient de recueil (100) lorsque ladite rotule est dans ladite position ouverte et étant hors d'alignement avec ladite extrémité ouverte (110) dudit récipient de recueil (100) lorsque ladite rotule (20) est dans ladite position fermée ; et un logement de rotule (40) adapté à être monté sur ladite extrémité ouverte (110) dudit récipient de recueil (100) pour permettre ledit mouvement de rotation de ladite rotule (20) entre ladite position ouverte et ladite position fermée, ledit logement de rotule (40) comprenant une partie de réception de rotule (90) comportant une surface interne de réception de rotule (41) pour permettre ledit mouvement de rotation de ladite rotule (20), et un joint en élastomère élastique (70) pour maintenir ladite rotule (20) au sein de ladite partie de réception de rotule (90) lors de son mouvement de rotation et pour créer un engagement étanche entre ladite rotule (20) et ladite extrémité ouverte (110) dudit récipient de recueil (100), ledit logement de rotule (40) comprenant également un siège de rotule (80) supportant ledit joint en élastomère (70), ledit siège de rotule (80) comprenant une partie cylindrique pendante (47) pour engagement avec ladite extrémité ouverte (110) dudit récipient de recueil (100) ;

caractérisée en ce que ledit siège de rotule (80) et ledit logement de rotule (40) sont des pièces distinctes, et **en ce que** ladite partie cylindrique pendante (47) est adaptée à engager une surface interne de ladite extrémité ouverte (110) dudit récipient de recueil (100).

2. Fermeture (10) selon la revendication 1, dans laquelle ledit siège de rotule (80) et ledit joint en élastomère élastique (70) sont d'un seul tenant.

3. Fermeture (10) selon la revendication 1, dans laquelle ledit siège de rotule (80) et ledit joint en élastomère élastique (70) sont des pièces distinctes.

4. Fermeture (10) selon la revendication 1, dans laquelle ledit joint en élastomère élastique (70) comprend un anneau périmétrique.

5. Fermeture (10) selon la revendication 4, dans laquelle ledit anneau périmétrique est torique.

6. Fermeture (10) selon la revendication 1, dans laquelle ladite partie cylindrique pendante (47) dudit siège de rotule (80) comprend des nervures annulaires (48) dirigées vers l'extérieur pour engagement avec ladite surface interne de ladite extrémité ouverte (110) dudit récipient de recueil (100).

7. Fermeture (10) selon la revendication 1, dans laquelle ladite partie de réception de rotule (90) est accouplée longitudinalement audit siège de rotule (80).

8. Fermeture (10) selon la revendication 7, dans laquelle ledit accouplement longitudinal de ladite partie de réception de rotule (90) sollicite ladite rotule (20) en engagement d'étanchéité avec ledit joint en élastomère élastique (70).

9. Fermeture (10) selon la revendication 8, dans laquelle ladite partie de réception de rotule (90) et ledit siège de rotule (80) comprennent des surfaces filetées coopérantes pour connexion par vissage de ladite partie de réception de rotule (90) audit siège de rotule (80).

10. Fermeture (10) selon la revendication 9, dans laquelle lesdits filets de vis coopérants comprennent une butée pour empêcher un désengagement de filets de vis de ladite partie de réception de rotule (90) dudit siège de rotule (80).

11. Fermeture (10) selon la revendication 1, dans laquelle ledit joint en élastomère élastique (70) comprend un anneau périmétrique adapté à engager un périmètre de ladite extrémité ouverte (110) dudit récipient de recueil (200), et ladite partie de réception de rotule (90) comprend un rebord annulaire (95) pour engagement avec une surface externe de ladite extrémité ouverte (110) dudit récipient de recueil (100).

12. Fermeture (10) selon la revendication 11, dans laquelle ledit rebord annulaire (95) s'encliquette sur ladite surface externe de ladite extrémité ouverte (110) dudit récipient de recueil (100).

13. Fermeture (10) selon la revendication 11, dans laquelle une surface interne dudit rebord annulaire (95) et ladite surface externe de ladite extrémité ouverte (110) dudit récipient de recueil (100) comprennent des filets de vis coopérants (112) pour engagement fileté entre eux.

14. Fermeture (10) selon la revendication 13, dans laquelle ledit engagement fileté de ladite partie de réception de rotule (90) et ladite surface externe de ladite extrémité ouverte (110) dudit récipient de recueil (100) sollicite ladite rotule (20) en engagement

d'étanchéité avec ledit joint en élastomère élastique (70).

15. Fermeture (10) selon la revendication 13, dans laquelle lesdits filets de vis coopérants (112) comprennent une butée pour empêcher un désengagement de filets de vis de ladite partie de réception de rotule (90) dudit récipient de recueil (100).

16. Fermeture (10) selon la revendication 1, dans laquelle ladite surface interne de réception de rotule (41) dudit logement de rotule (40) comprend un support d'arbre (50) pour recevoir ledit arbre (30) de ladite rotule (20) afin de permettre ledit mouvement de rotation de ladite rotule (20).

17. Fermeture (10) selon la revendication 16, dans laquelle ledit support d'arbre (50) dudit logement de rotule (40) et ledit arbre (30) de ladite rotule (20) sont parallèles et excentriques l'un par rapport à l'autre.

18. Fermeture (10) selon la revendication 16, dans laquelle ledit arbre (30) de ladite rotule comprend une paire de saillies opposées (31) sur des surfaces opposées de ladite rotule (20) et ledit support d'arbre (50) dudit logement de rotule (40) comprend une surface interne généralement sphérique comprenant une paire de cavités opposées (51), lesdites saillies opposées (31) de ladite rotule (20) engageant lesdites cavités opposées (51) dudit logement de rotule (40).

19. Fermeture (10) selon la revendication 18, dans laquelle ladite paire de saillies opposées (31) de ladite rotule (20) a généralement une forme cylindrique et ladite paire de cavités opposées (51) dudit logement de rotule (40) comprend une paire d'alésages généralement cylindriques pour engagement avec lesdites saillies.

20. Fermeture (10) selon la revendication 18, dans laquelle ladite paire de cavités opposées (51) dudit logement de rotule (40) comprend une paire de surfaces coniques et ladite paire de saillies opposées (31) de ladite rotule (20) comprend une paire de surfaces de dépouille correspondantes pour engagement avec lesdites surfaces coniques.

FIG-1

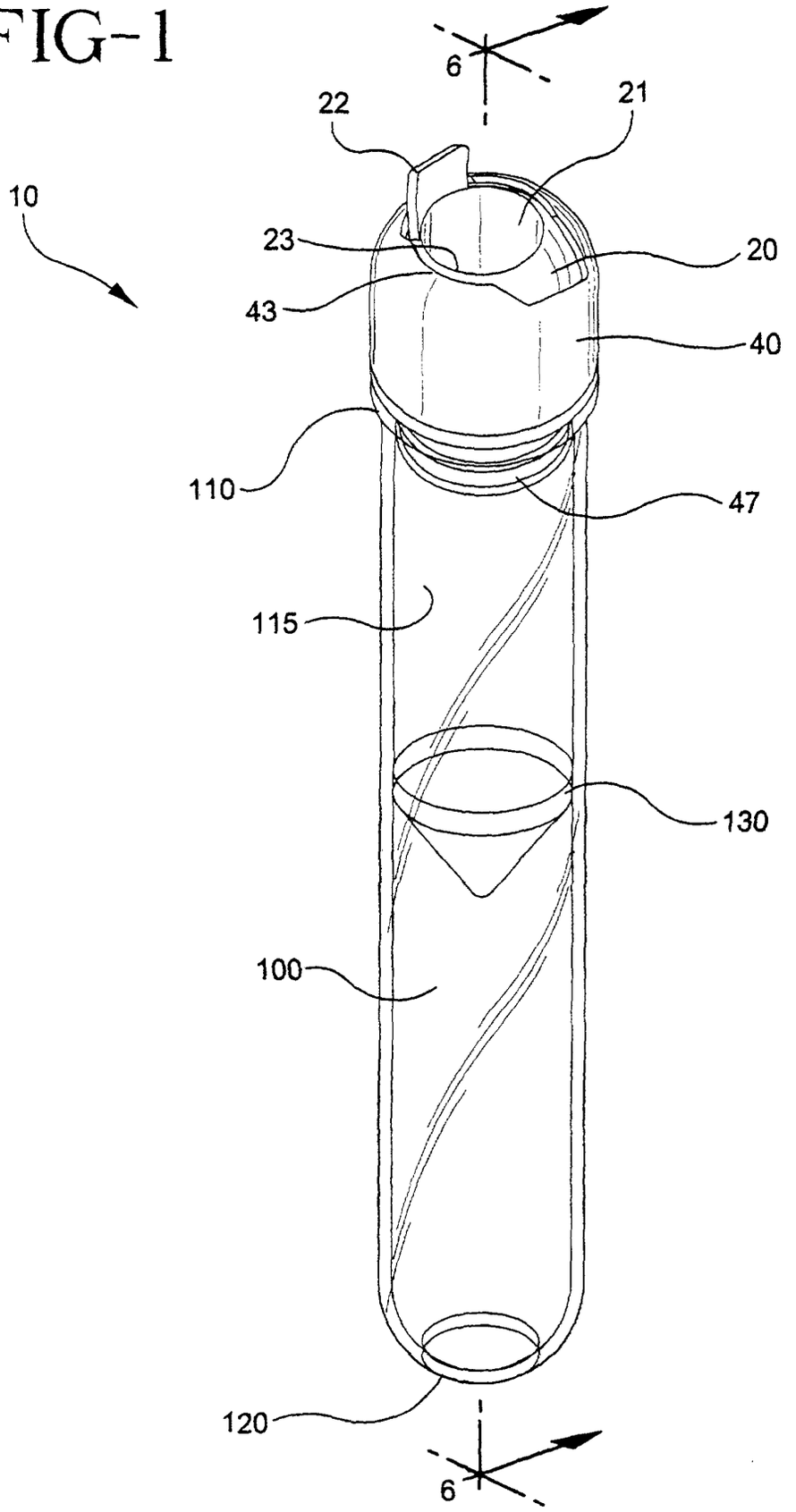

FIG-2

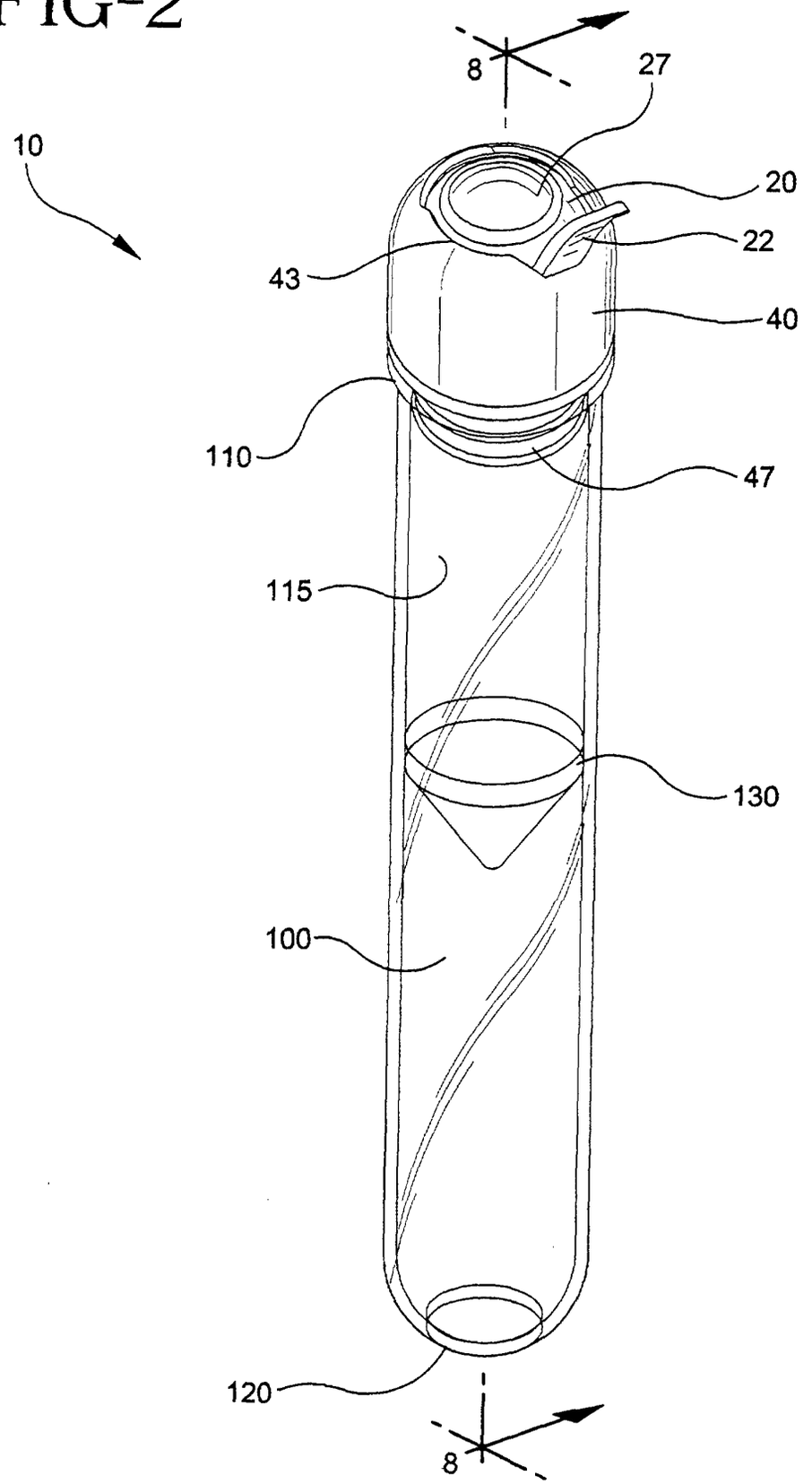

FIG-3

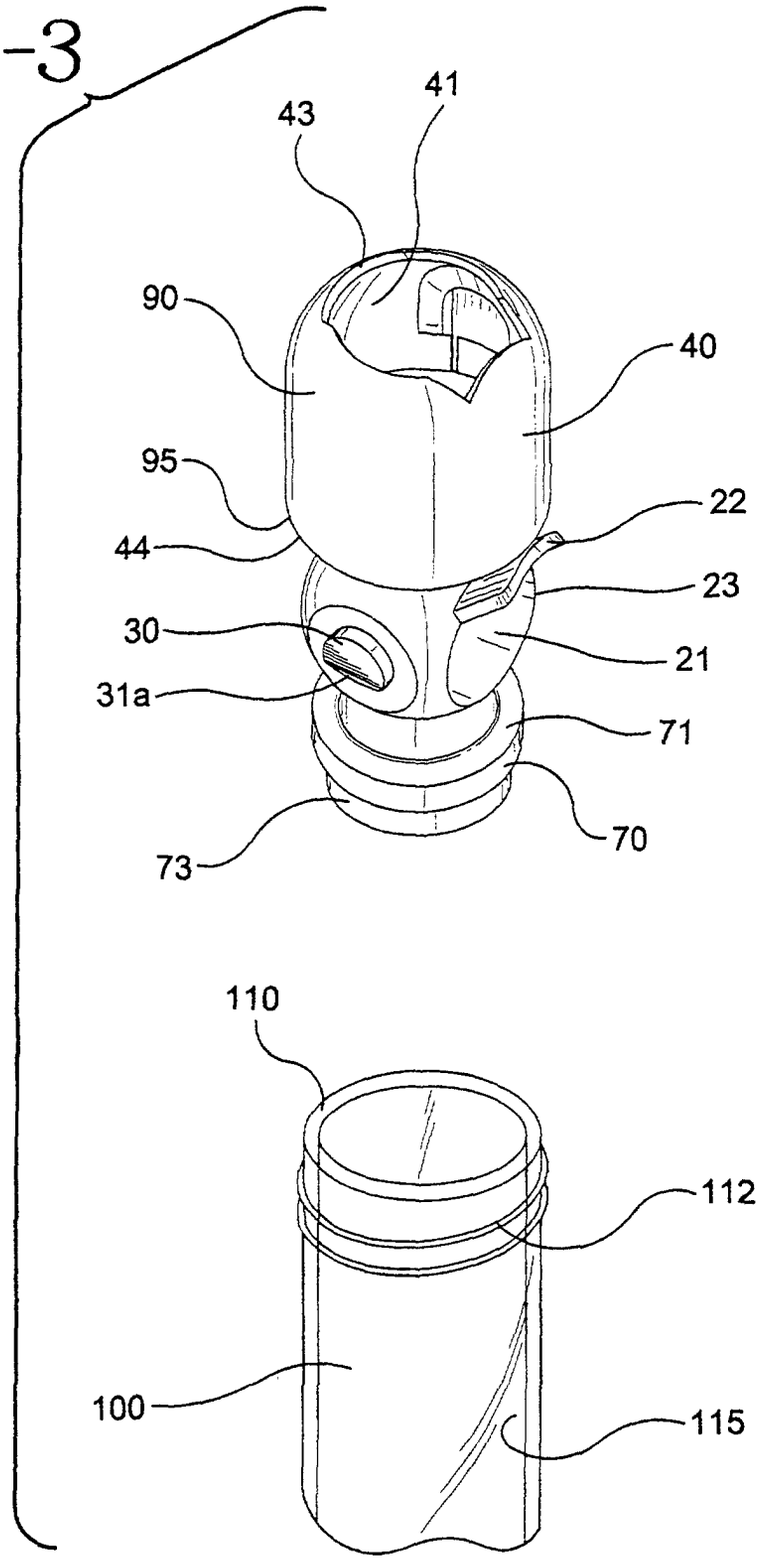

FIG-4

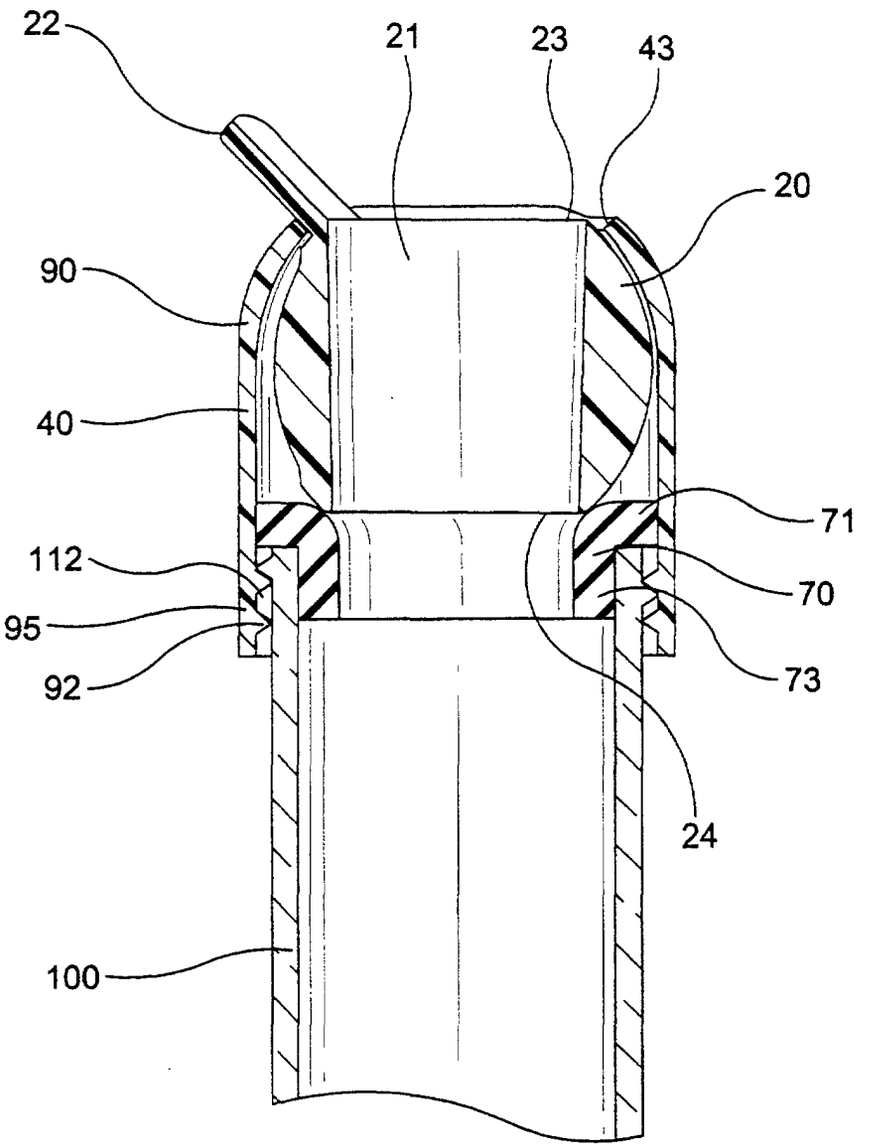

FIG-5

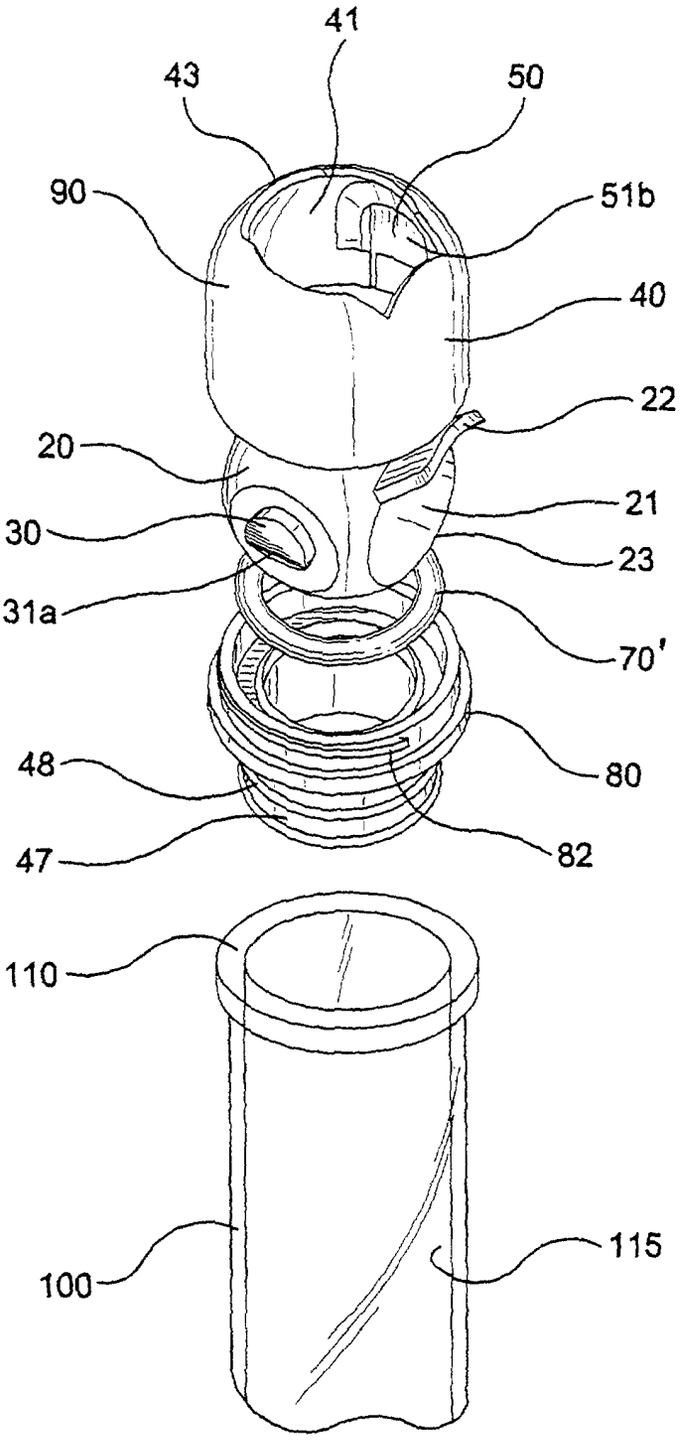

FIG-6

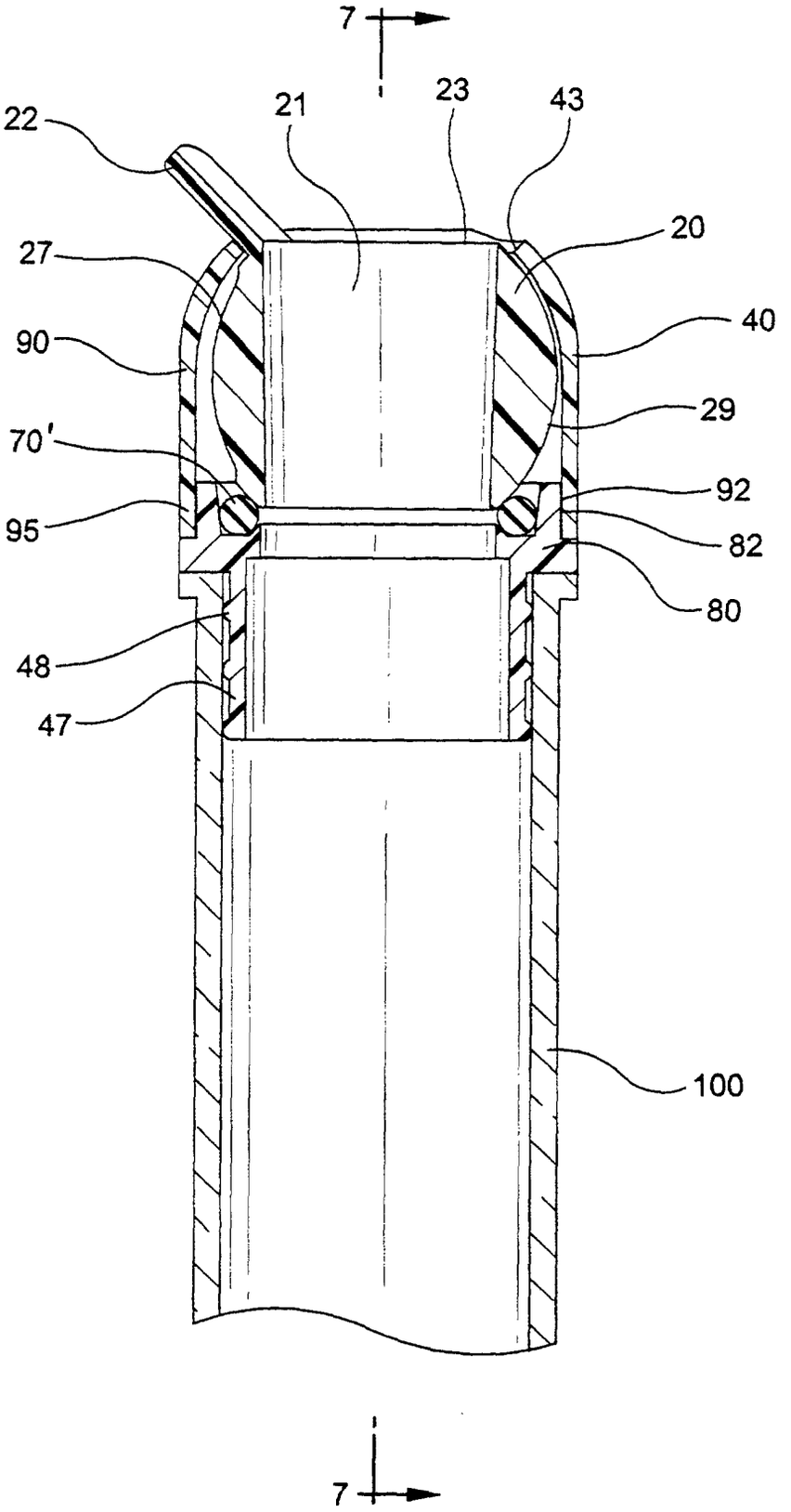

FIG-7

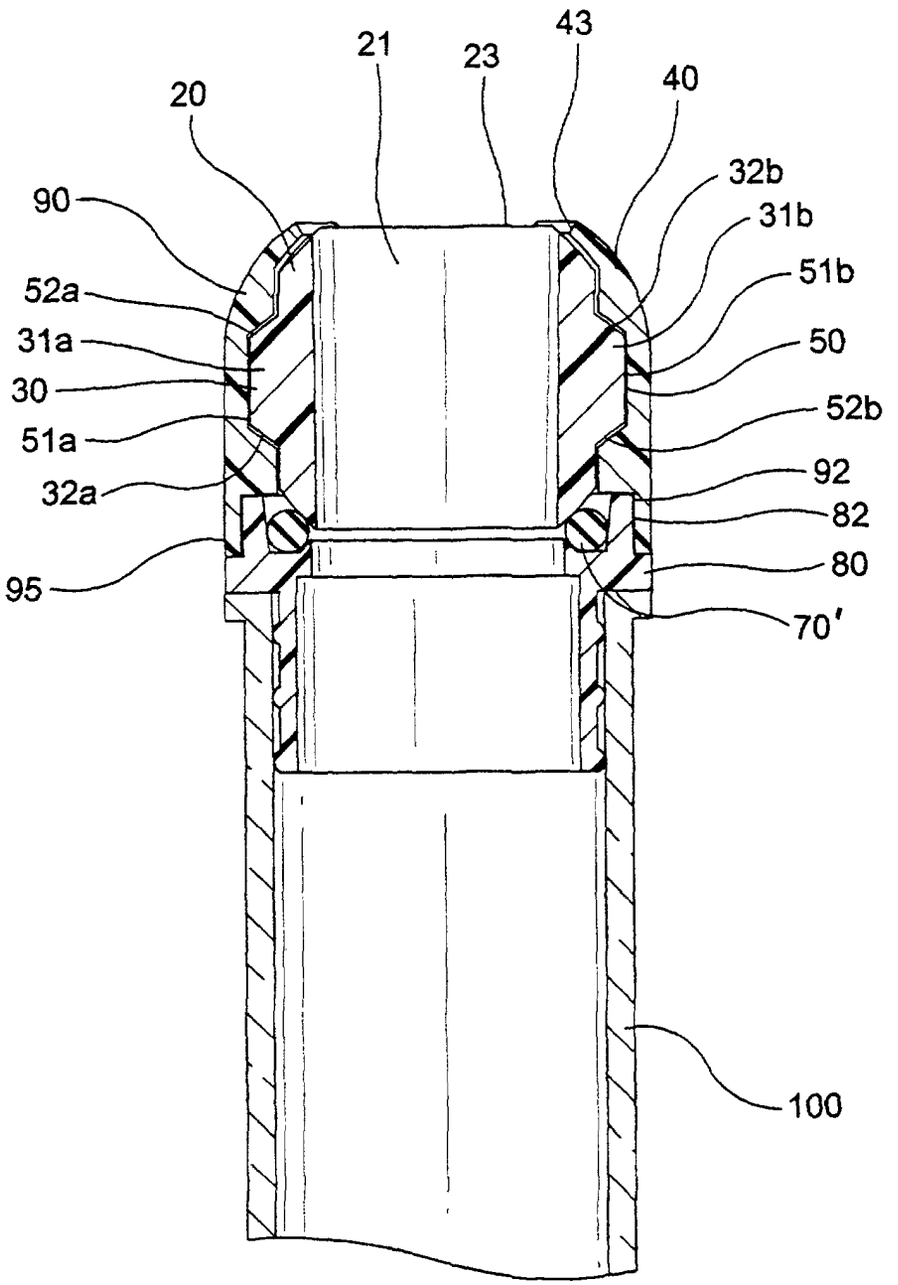
21
23
43
40
20
32b
90
31b
51b
52a
50
31a
52b
30
92
51a
82
32a
80
95
70'
100

FIG-8

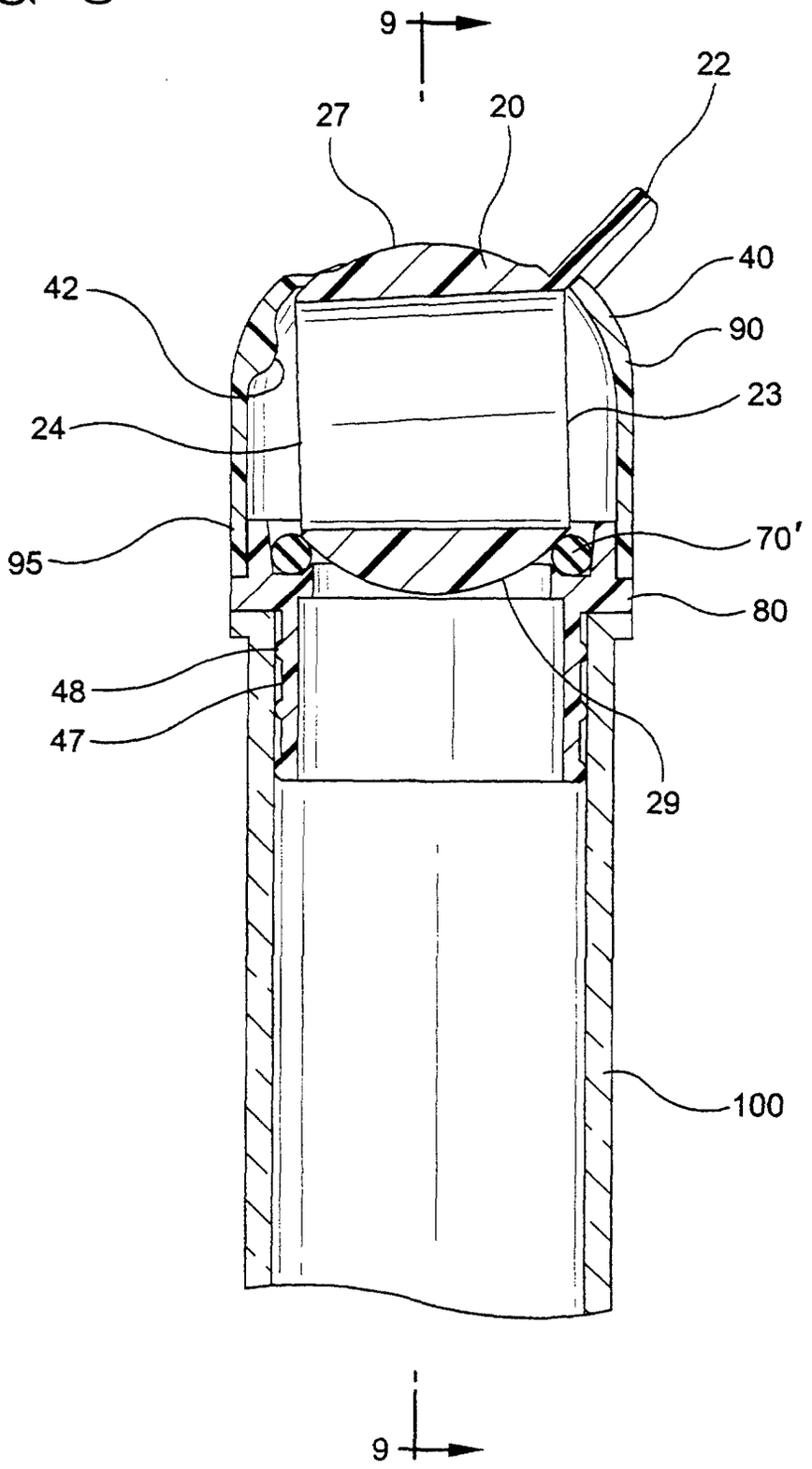

FIG-9

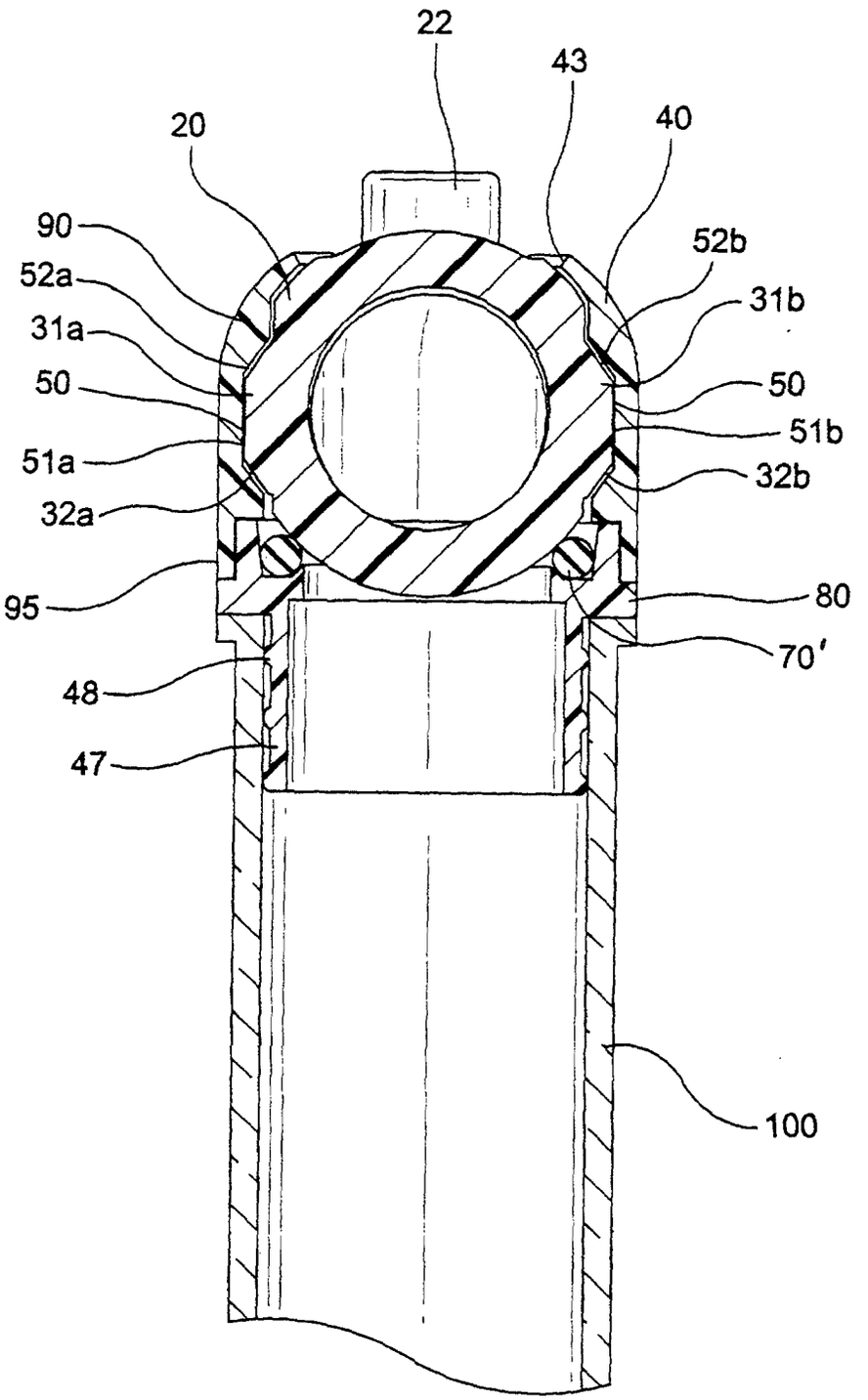
22
43
40
20
90
52a
31a
50
51a
32a
95
48
47
52b
31b
50
51b
32b
80
70'
100

FIG-10