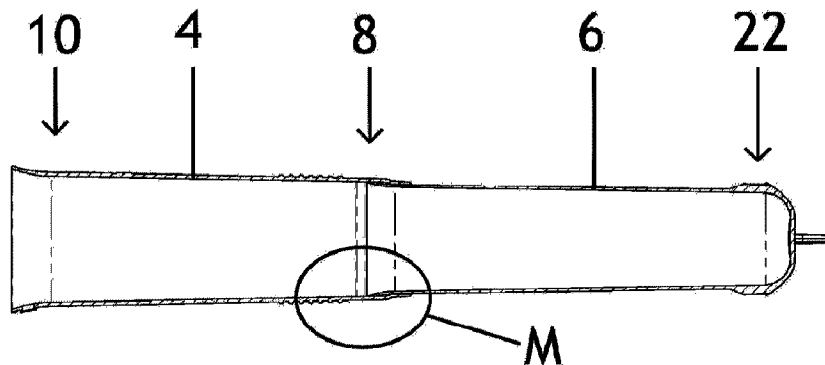




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(54) **Title: MEDICAL QUIVER**



(57) **Abstrégé/Abstract:**

A collapsible quiver (2) has an outer tube (4) and an inner tube (6). When extended the inner end (24) of the inner tube (4) engages the inner surface of the outer tube (6) so there is substantially no discontinuity of the inner surface defined by the first and second tubular members.

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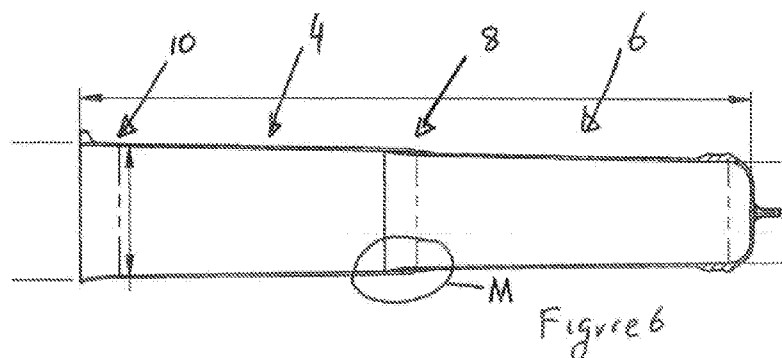
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(57) Abstract: A collapsible quiver (2) has an outer tube (4) and an inner tube (6). When extended the inner end (24) of the inner tube (4) engages the inner surface of the outer tube (6) so there is substantially no discontinuity of the inner surface defined by the first and second tubular members.

Medical quiver

TECHNICAL FIELD

This invention related to receptacles for medical devices and more particularly to receptacles, commonly called quivers, for long medical devices, such as
5 laparoscopes and the like.

BACKGROUND ART

Quivers are receptacles for receiving elongate medical devices, such as laparoscopes. Typically they are used for temporarily storing the device during an operation. The device may be inserted and retrieved a number of times.

10 To reduce package size during transport and storage some medical quivers are collapsible, with two or more tubes arranged end on end to be telescopically collapsible, with an outer end of one tube located within the inner end of an outer tube.

Current telescopic quivers typically have an overlapping annular lip
15 arrangement, with the inner end of the inner tube 6 having radially inwards directed annular flange that overlaps a radially outwards directed annular flange that extends from the outer end of the inner tube 18. Whilst this is a simple arrangement it creates a step or discontinuity in the inner wall surface(s) or the two tubes at their junction. Inserting a medical device into
20 such a quiver can result in the device catching on this step or discontinuity.

DISCLOSURE OF THE INVENTION

In a broad form the invention provides a collapsible quiver comprising

- at least two elongate tubular members, comprising a first elongate tubular member and a second elongate tubular member;
- 25 the first member having first member inner surface and a first open end;
- the second member having a second member inner surface and a second member outer surface;
- 30 at least a part of the second member received within the first member for reciprocal motion in the elongate direction relative to the first member from a retracted position to an extended position in which at least a first end portion of the second member extends out of the first open end;
- 35 the second member having a second end portion at a second end thereof with a first inner surface portion and an outer surface portion and, in the extended position, the outer surface portion engages the first member inner surface of the first member and
- 40 the first inner surface portion and the outer surface portion converge toward the second end that, in the extended position, at the junction of the second end with the first member there is substantially no

discontinuity between the first member inner surface and the first inner surface portion.

5 The second end portion preferably has a first inner surface portion of its inner surface and a second outer surface portion of its outer surface that converge toward second end.

The second member may have a central portion between its first and second ends. The internal area of central portion preferably reduces from the second end to the first end.

10 In one form the second outer surface portion extends alongside the first member inner surface and the first inner surface portion extends toward the outer surface portion. In longitudinal cross section the first inner surface portion may be curved. Preferably the first inner surface portion extends from a second inner surface portion of the second member inner surface. Preferably, in longitudinal section, the first inner surface portion extends
15 tangent to the second inner surface portion.

Preferably the second member outer surface portion engages the first member inner surface when the device is in the extended position to provide a seal that resists passage of fluid between the first and second members. More preferably the second portion is sized so that the first member applies a
20 compressive force to the second member when in the extended position. Where the first and second members have a circular cross section, the outside diameter of the second member may be greater than the inside diameter of the adjacent inside surface of the first member.

25 The first member inner surface and the second member outer surface may be shaped so that movement of the second member from the retracted position to the extended position brings the outer surface portion of the second member and the first member inner surface into engagement or into closer engagement with each other.

30 Where the inner surface of the first member and the outer surface of the second member have cross sectional shapes that are substantially the same along the longitudinal direction, the shapes may be tapered toward the first end. Where these shapes are circular, the tubes may be tapered to each define a cone or a truncated cone.

The first end of the second member is preferably closed.

35 The first member may have an intermediate portion between its first and second ends. The internal area of an intermediate portion preferably reduces from the second to the first end.

40 The first end portion of the first member preferably includes a free end portion that has a cross sectional area less than the cross sectional area of the adjacent an intermediate portion. Preferably the cross sectional shape of the first member is substantially constant with the area changing. Where the first member has a circular cross section, the free end portion of the first member may have a smaller diameter or radius compared to the intermediate portion.

Preferably the free end portion of the first member is connected to the adjacent intermediate portion by a transition portion.

5 The second end portion of the second member preferably has first and second retaining portions. The first and second retaining portions are sized so that, the size of the normal area of the free end portion prevents their passage through the free end portion of the first member. The first retaining portion is sized to pass through the reduced area free end portion of the first member by deflection of at least a part of the free end portion of the first member. The second retaining portion is sized such that, in normal use, it will not pass
10 through the reduced area free end portion.

Preferably the first and second retaining portions each comprises at least one protrusion extending from the outer surface of the second member. Preferably the first retaining portion comprises at least two discontinuous protrusions. Preferably the second retaining portion comprises at least one continuous
15 protrusion.

Preferably there is at least one slot extending longitudinally in at least one or both of the free end portion and the transition portion of the first member. Where the first member includes at least one slot, at least one slot may extend into the adjacent intermediate portion. Where the first member
20 includes at least one slot, preferably at least one slot extends from the free end of the free end portion so as to define at least one finger.

The at least one slot allows for the first member to increase or change its internal area in the region of the respective slot. Where the at least one slot is in the at least the free end portion this allows the free end portion to increase or change its internal the area. Where the at least one slot extends from the
25 free end of the free end portion so as to define at least one finger, this allows the at least one finger to move. Where the free end portion has a circular cross section preferably the at least one finger is deflectable radially outwards.

30 The first and second retaining portions are preferably spaced so that the second retaining portion is adjacent the transition portion and the first retaining portion is outside the first member adjacent the free end.

Where the first and second members are circular in cross section, preferably the first and second retaining portions extend radially more than at least the reduced area free end portion but less than the intermediate portion of the
35 first member. The first retaining portion preferably extends radially less than the second retaining portion.

BRIEF DESCRIPTION OF THE DRAWINGS

40 Figure 1 is a perspective view of a quiver according to a first embodiment of the invention a collapsed state.

Figure 2 is a perspective view of the quiver of figure 1 in an extended state.

Figure 3 is an exploded perspective view of the quiver of figure 1.

Figure 4 is a side view of the quiver of figure 1 in a collapsed state.

Figure 5 is a side view of the quiver of figure 1 in an extended state.

Figure 6 is a sectional view of the quiver of figure 5 taken along line AA.

Figure 7 is a side view of the outer tube of the quiver of figure 1.

5 Figure 8 is a sectional view of the outer tube of figure 7 taken along line BB.

Figure 9 is a detail perspective view of a part of the outer tube of figure 7 circled C in figure 7.

Figure 10 is a side view of the inner tube of the quiver of figure 1.

10 Figure 11 is a side view of the inner tube of the quiver of figure 1 at 90 degrees to figure 10.

Figure 12 is a sectional view of the inner tube of figure 10 taken along line AA in figure 10.

Figure 12a is a cross sectional view of the inner tube of figure 10 taken along line GG in figure 10.

15 Figure 13 is a detail cross sectional view of a part of the inner tube of figure 12a circled J in figure 12a.

Figure 14 is a detail cross sectional view of another part of the inner tube of figure 12a circled K in figure 12a.

20 Figure 15 is a detail cross sectional view of the closed end of inner tube of figure 10 circled I in figure 12.

Figure 16 is a detail cross sectional view of the open end of inner tube of figure 10 circled H in figure 12.

Figure 17 is a detail cross sectional view of the junction of the inner and outer tubes in the extended position of figure 6 circled M in figure 6.

25 Figure 18 is a sectional view of a quiver according to a second embodiment of the invention.

Figure 19 is a detail sectional view of a part of the quiver of figure 18 circled L in figure 18.

BEST MODE OF CARRYING OUT THE INVENTION

30 Referring to figures 1 to 17 there is shown a collapsible quiver 2. The quiver 2 comprises an outer tube 4 and an inner tube 6. The outer tube 4 has central portion 5 and end portions 8 and 10. The inner tube 6 has central portion 12 and end portions 14 and 16.

35 The ends 18 and 20 of outer tube 4 are open and the outer tube 4 is sized to receive the inner tube 6 within it itself. The inner tube 6 is sized to fit into the outer tube 4 via the end 20. In this embodiment the quiver 2 only comprises the two tubes 4, 6 and the end 22 of inner tube 6 is closed with all other ends being open. However, if three or more tubes were used all except one tube at one end of the telescoping set of tubes would be open at both
40 ends. In this embodiment the tubes 4 and 6 have substantially continuous side

walls 11 with no apertures in the side walls. It will be appreciated that continuous side walls are not essential and, if appropriate, apertures may be provided in the side walls for purposes such as material reduction.

- 5 As best seen in figures 1 and 4 the two tubes 4, 6 are of similar lengths and when the end 24 of inner tube 6 has passed into outer tube 4, the end 22 extends out of end 18.

The end portion 10 is flared outwards to assist insertion of the tube 6 into tube 4 and also, in use, to aid insertion of a medical device into the quiver.

- 10 The tubes 4 and 6 have a generally circular cross-section and the central sections 5 and 12 are both tapered towards ends 8 and 14, respectively, so the central sections are of a slightly smaller diameter towards ends 8 and 14 compared to the diameter nearer ends 10 and 16. This aids in insertion of the inner tube 6 into the outer tube 4 and subsequent extension. In the preferred embodiment the taper is about 1 degree to the longitudinal axis 26.

- 15 As best seen in figures 7, 8 and 9 the end portion 8 of the tube 4 comprises a free end portion 26 having a reduced diameter compared to the adjacent central portion 5 of the tube 12. The free end portion 26 and adjacent central portion 5 are joined by an angled or curved step portion 28.

- 20 A plurality of slots 30 extend axially from the free end 18 of the free end portion 26 and are spaced around the circumference. These slots 30 extend axially through the step portion 28 and into the central portion 5 and so define a plurality of fingers 32, which may flex radially relative to the central portion 5. In the embodiment shown there are five slots 30 but there may be more or less, including a single slot. Functionally the slots are more effective if they
25 extend into the transition portion 28 and even more effective if they also extend into the central portion 5, but this not critical. Further, as the function is to enable the free end portion 26 and/or the transition portion 28 to more easily flex outwards, whilst not preferred, the slots themselves may be omitted.

- 30 In the embodiment shown the inner diameter of the free end portion 26 is about 4 to 5% less than the inner diameter of the central portion 5 adjacent to transition portion 28. In this embodiment the wall thickness of the free end portion 26 is slightly less than the wall thickness of central portion 5. However, a tube with a substantially constant wall thickness in that end region
35 may be used.

Referring to figures 10 to 16 the inner tube 6 has a central tapered portion 12, a flared upper portion 16 and a closed portion 14. The central portion 12 is generally circular in cross-section with the wall tapered at about 1 degree to the axis 46.

- 40 As best seen in figure 16, the flared upper portion 16 has wall portion 50 that increases in diameter toward the open end 24. In the embodiment shown the inner surface 60 of wall portion 50, in cross-section, is curved. In the embodiment shown the inner surface of the wall portion 50 has a radius of curvature 54. However the inner surface of the wall portion 50 could, in cross-
45 section, be straight, i.e. a frusto-conical annular wall; a portion of a cone.

5 The wall of the inner tube 6 is of a generally constant thickness but toward the open end 16 it reduces in thickness. In the embodiment shown there is an upper wall portion 56 that has an outer surface 58 that is angled to the inner surface 60 so that the wall thickness reduces toward the end 24 and becomes, in cross-section, substantially a point. It will be appreciated that in practice the end may be rounded or have some thickness. However, relative to the diameter of the tube and/or the size of the medical instrument(s) that the quiver will be used with the end is effectively a point or edge.

10 The outer surface 58 and inner surface 98 (see figure 9) of the wall of the central portion 5 of tube 4 adjacent the step portion 28 are preferably angled to the axis 26 by similar amount. Thus, if the inner wall of outer tube 4 adjacent the step portion 28 is angled at about 1 degree to the axis, the outer surface 58 would also be at about 1 degree to the axis.

15 The tube 6 has two outwardly extending annular ribs 62 and 64 located near or on the portion 16. In the embodiment shown upper rib 62 is located on portion 16 and lower rib 64 is located on central portion 12. Both ribs may be located on portion 16 or central portion 12.

20 In the embodiment shown the lower rib 64 is not continuous (see figures 10 and 11) and is formed of two diametrically opposed arcs 66 and 68. The lower rib 64 may be continuous or may be formed of a single arc, (i.e. an incomplete circle) or more than two arcs.

25 In the embodiment shown the upper rib 62 is a continuous closed ring but may be formed with one or more optional gaps, so as to define a single arc, (i.e. an incomplete circle) or a plurality of arcs. Numerals 63 schematically indicate optional gaps. The location of such optional gaps 63 is not limited to the locations shown.

The other end portion 14 is closed and has loop 70 extending from end wall 72. Loop 70 aids in pulling inner tube 6 out from outer tube 4 to the extended position but may be omitted.

30 The side wall 73 of end portion 14 has three axially spaced annular ribs 74, 76 and 78. These may have a circular periphery (i.e. extend the same amount at all circumferential locations) or may be non circular (i.e. extend different amounts depending on circumferential locations).

35 Two sets of diametrically opposed radially spaced axially extending ribs 80 are provided that intersect ribs 74, 76 and 78. In the embodiment shown each set of ribs 80 comprises three ribs 82, 84 and 86. As best seen in figure 13 these extend parallel to each other but may extend radially. A second set 88 of diametrically opposed radially spaced axially extending ribs are provided that also intersect ribs 74, 76 and 78. In the embodiment shown there is one pair of
40 ribs 90 (see figures 11 and 14) to each set 88. The ribs 90 are located 90 degrees circumferentially from the centre rib 84 of each set 80.

45 As seen in figure 15, the lowermost rib 78 has a larger diameter than uppermost rib 74, both diameters being larger than that of centre rib 76 and also extending radially more than axial rib sets 80 and 88 where they intersect.

Axially extending rib sets 80 extend radially more than axially extending rib sets 88.

After initial manufacture of the two tubes 4, 6, the end 22 of inner tube 6 is inserted into the open end 20 of outer tube 4 until closed portion 14 partially
5 passes through reduced diameter free end portion 26. The ribs 74, 78, 88 extend radially more than the inner diameter of reduced portion 24 and so cause the fingers 32 to flex radially outwards to allow passage.

The separation between ribs 74 and 78 is slightly greater than the length of the free end portion 26 of outer tube 4. This separation is such that the lower
10 rib 78 may pass through the end 8 to lie outside the outer tube 4 whilst upper rib 74 is still located within the outer tube 4, above stepped portion 28. The fingers 32 may then return radially inwards and lie between ribs 74 and 78. Inner rib 78 resists movement of inner tube toward end 20 (i.e. upwards) whilst outer rib 74 resists movement of inner tube away from end 20 (i.e.
15 downwards). The assembled device 10 thus tends to remain in this compact configuration until actively extended.

When the device 10 needs to be used, a user merely grasps the outer tube 4 and pulls on loop 70 to pull inner tube 6 away from end 20. The fingers flex 32
20 outwards and allow rib 74 to pass out of the free end portion 26. The inner tube is withdrawn until rib 64 reaches the fingers 32. The fingers 32 flex outwards to allow the rib 64 to pass through. The use of two discontinuous arcs allows the free end portion to distort slightly from a circular shape to allow passage of the rib 64 more easily than if it were a single continuous rib. The upper rib 62 is located so that it is adjacent or in contact with the
25 transition portion 28 just as the lower rib 64 clears the fingers 32. The fingers thus snap back behind rib 64. The lower surface 65 of rib 62 is preferably chosen to match the transition surface 29 of transition portion 28. In cross section the surface 65 has a radius of curvature but may be planar

The upper rib 62 extends radially more than lower rib 64 and so would require
30 the fingers 32 to flex outwards more to allow passage than for lower rib 64. Further, as the rib 62 is substantially continuous all portions of the free end would need to deflect outwards simultaneously. The dimensions are chosen so that upper rib 62 will not pass transition portion 28 without application of excessive force. The device is thus temporarily locked with the tubes 4 and 6
35 in the extended position. Accordingly, a user merely pulls on the inner tube until it snaps and locks in its extended position.

In this extended position the end 24 of flared portion 16 of inner tube 6 is located within the outer tube 4 just above the stepped portion 28. The
40 diameter of portion 16 is chosen so that the outer surface 58 is either bearing against the inner surface 98 of tube 4 at that location or is very close to the inner surface 98. As best seen in figure 17, this results in substantially no radial step or the like between the inner surface 98 of outer tube 4 and the inner surface 60 of inner tube 6 at their junction point. Accordingly, a medical device inserted into the quiver will not catch on the walls at the junction of
45 the two tubes. Preferably the diameter of surface 58 is chosen to be slightly larger than the diameter of the inner surface 98 at that location. This ensures that the portion 16 in contact with the inner surface 98 is in compression and

bears relatively firmly against the inner surface 98. Since the medical instruments with which the device is used may well have body fluids upon them this also prevents or reduces the likelihood of leakage through the junction of the outer and inner tubes.

- 5 The junction thus presents, to the medical instrument(s) a substantially smooth surface against which the devices will not catch when being inserted or withdrawn.

It will be appreciated that the closed end of a tube need not be on the smallest diameter tube and instead may be on the largest diameter tube; in
10 effect the open and closed ends may be swapped. Where three or more tubes are utilised it is not necessary that the tubes be progressively smaller. For example, a collapsible quiver with three tubes may be made with two end tubes substantially the same diameter and the central tube sized to either fit either within or around the two end tubes.

- 15 After use it is desirable that the quiver can be collapsed, so as to take up less volume in a waste receptacle. Referring to figure 16 it will be noted that the lower rib 64 is provided, in cross-section, with upper and lower faces 92 and 94. These surfaces have a radius of curvature but may be planar. Lower face 94 allows the rib 64 to more easily pass through reduced diameter portion 24
20 away from outer end. Upper face 92 allows the rib 64 to more easily pass through reduced diameter portion 24 toward the outer end, such as after use and when the device needs to be deliberately collapsed. Axial compression force on the two tubes 4, 6 will cause fingers 32 to ride up on face 92, so increasing the size of the opening and allowing the rib 64 and the inner tube 6
25 to move toward the end 20.

- Provision of a "step less" join between the two telescoping tubes may be achieved with other arrangements. Figures 18 and 19 show schematic cross-sections of part of a collapsible quiver 100 comprised of outer tube 102 and
30 inner tube 104. The outer tube 102 has inner portion 106 adjacent another portion 108. The inner diameter of inner portion 106 is greater than that of adjacent portion 108. The inner tube has an outer portion 110 that has an inner diameter 114 that corresponds to inner diameter 116 of portion 108 and, preferably, an outer diameter 118 that corresponds to the inner diameter 120 of portion 106. Thus in the extended position the inner surfaces 122 and 124 of
35 the outer and inner tubes present a substantially continuous surface.

- The inner tube may be formed with an outside diameter substantially the same as that of the inside diameter of portion 108 with a transition between larger diameter portion 110 and smaller diameter portion 112. It will be appreciated that portion 110 will need to be of reduced diameter when in the
40 storage position within small diameter portion 108 and accordingly one or more slots 130 may be provided to allow flexing inwards so as to reduce the effective diameter of the portion 110 and allow it to be located within smaller diameter portion 108.

- The larger diameter portion 106 of outer tube may be provided with radially
45 extending ribs, slots or grooves 132 and the outer portion 110 may be provided with complimentary slots, grooves or ribs 134. Providing ribs in outer tube 102

and slots or grooves in inner tube 104 does not increase the overall diameter of portion 110. The ribs may have an outer surface extending generally perpendicular to the axis, so as to lock the two tubes in the extended position and an angled inner face to allow the two tubes to be collapsed after use.

- 5 Whilst the invention has been described with reference to an embodiment having tubular components with a substantially circular cross-section it will be appreciated that a circular cross-section is not essential to the invention and non-circular cross-sections may be used, such as oval, elliptical, polygonal or free form curve type cross-sections.
- 10 Unless the context clearly requires otherwise, throughout the description and any claims the words “comprise”, “comprising”, and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of “including, but not limited to”.
- The features of the invention described or mentioned in this document may be
- 15 combined in any combination of features where features are not mutually exclusive.

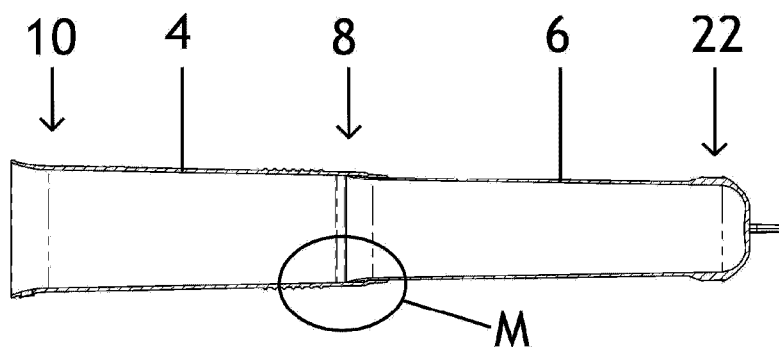
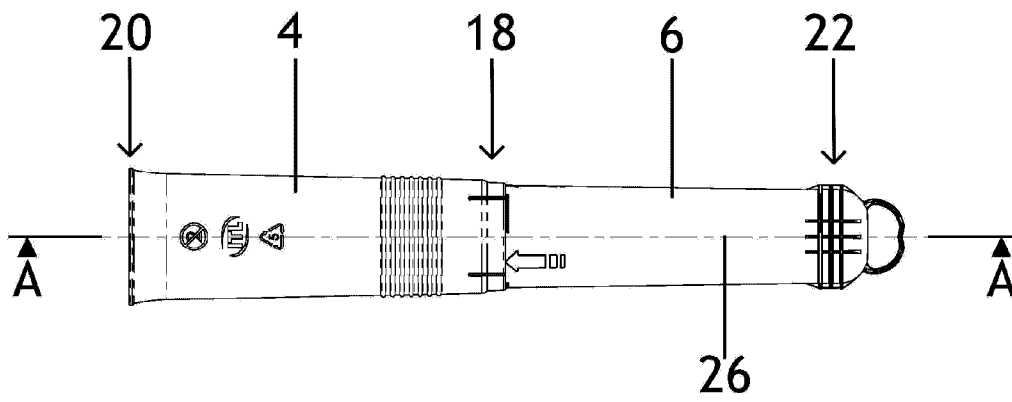
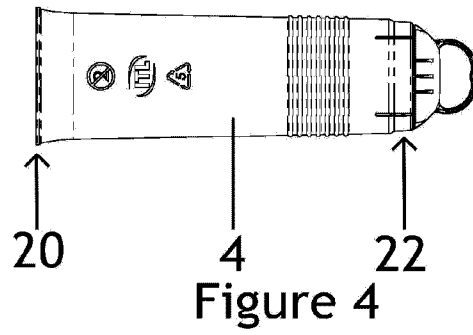
It will be apparent to those skilled in the art that many obvious modifications and variations may be made to the embodiments described herein without departing from the spirit or scope of the invention.

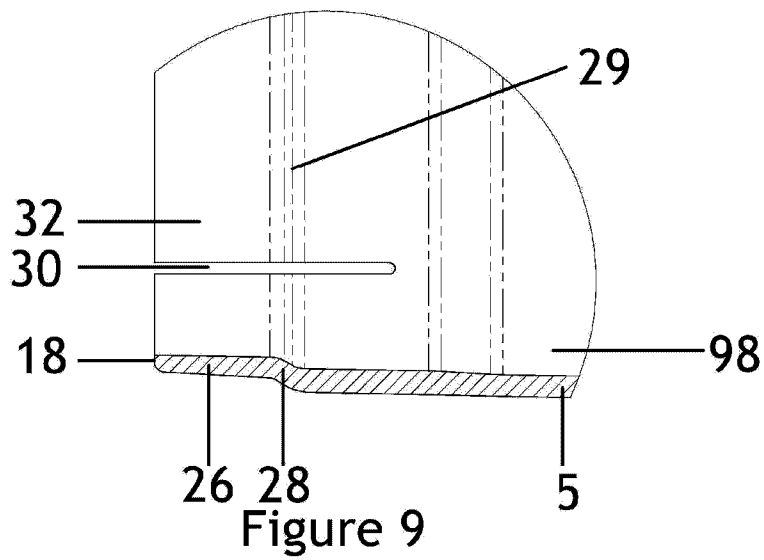
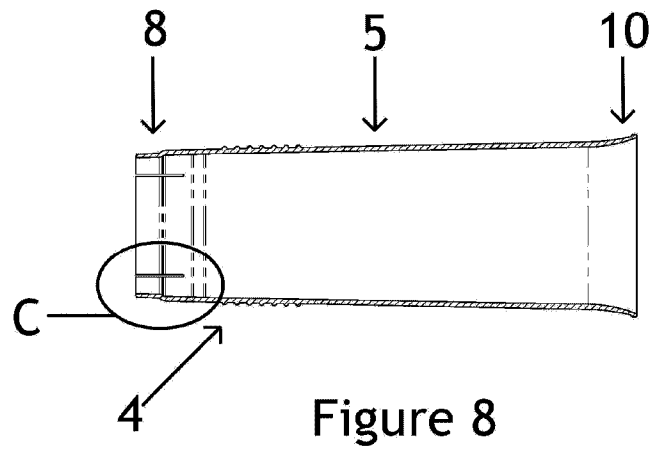
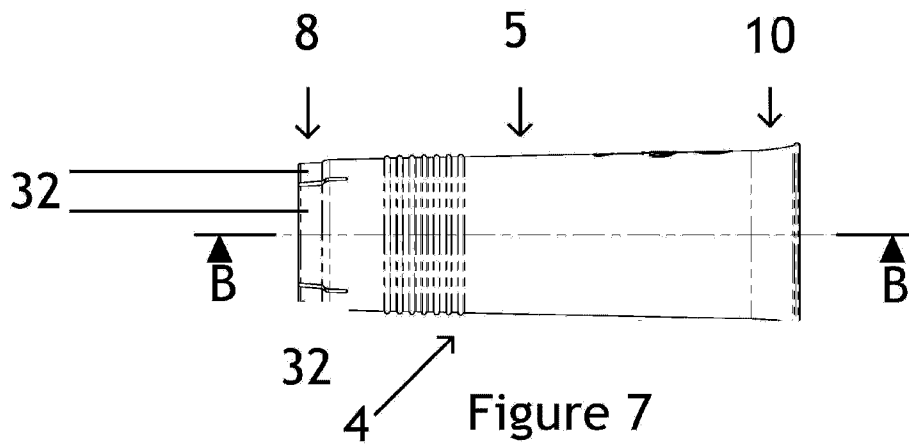
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A medical collapsible quiver comprising
at least two elongate tubular members, comprising a first elongate
tubular member and a second elongate tubular member;
5 the first member having a first member inner surface and a free end
portion with a first open end;
the second member having a second member inner surface and a second
member outer surface;
10 at least a part of the second member received within the first member
for reciprocal motion in the elongate direction relative to the first
member from a retracted position to an extended position in which at
least a first end portion of the second member extends out of the first
open end;
15 the second member having a second end portion at a second end
thereof with a first inner surface portion and an outer surface portion
and, in the extended position, the outer surface portion engages the
first member inner surface, with the second end forming a junction
with the first member, and
20 the first inner surface portion and the outer surface portion converge
toward the second end so that, in the extended position, at the
junction there is substantially no discontinuity between the first
member inner surface and the first inner surface portion.
2. The medical collapsible quiver of claim 1 wherein the outer surface
portion extends alongside the first member inner surface and the first inner
25 surface portion extends toward the outer surface portion.
3. The medical collapsible quiver of claim 1 or claim 2 wherein, in
longitudinal section, the first inner surface portion is curved.
4. The medical collapsible quiver of any one of claims 1 to 3 wherein the
first inner surface portion extends from a second inner surface portion of the
30 second member inner surface.
5. The medical collapsible quiver of any one of claims 1 to 4 wherein, in
longitudinal section, the first inner surface portion extends tangent to the
second inner surface portion.
6. The medical collapsible quiver of any one of claims 1 to 5 wherein the
35 first member inner surface and the second member outer surface are shaped
so that movement of the second member from the retracted position to the
extended position brings at least part of the outer surface portion of the
second end portion and at least part of the first member inner surface into
engagement or into closer engagement with each other.
- 40 7. The medical collapsible quiver of any one of claims 1 to 6 wherein the
outer surface portion engages the first member inner surface when in the
extended position to provide a seal that resists passage of fluid between the
first and second members.

8. The medical collapsible quiver of any one of claims 1 to 7 wherein the outer surface portion is sized so that the first member applies a compressive force to the second member when in the extended position.
- 5 9. The medical collapsible quiver of any one of claims 1 to 8 wherein the second member has a first retaining portion and, when in the extended position, the first retaining portion is outside the first member adjacent the free end of the first member.
- 10 10. The medical collapsible quiver of claim 9 wherein, when in the extended position, the first retaining portion resists movement of the second member toward the retracted position.
11. The medical collapsible quiver of claim 9 or claim 10 wherein the first retaining portion and the free end portion are sized so that passage of the first retaining portion through the free end portion requires deflection of at least a part of the free end portion.
- 15 12. The medical collapsible quiver of any one of claims 1 to 11 wherein the second member has a second retaining portion and, when in the extended position, the second retaining portion engages with the first member and resists movement of the second member toward further extension.
- 20 13. The medical collapsible quiver of claim 12 wherein, when in the extended position, the second retaining portion is located in the first member adjacent the free end portion.
- 25 14. The medical collapsible quiver of any one of claims 1 to 13 wherein the first member inner surface and the second member outer surface are shaped so that movement of the second member from the extended position to the retracted position brings at least part of the second member outer surface of the first end portion and at least part of the first member inner surface into engagement with each other.
- 30 15. The medical collapsible quiver of any one of claims 1 to 14 wherein the first member has an intermediate portion between its first and second ends and the free end portion is connected to the intermediate portion by a transition portion.
- 35 16. The medical collapsible quiver of claim 15 wherein the free end portion has a cross sectional area normal to the elongate direction that is less than the cross sectional area normal to the elongate direction of the intermediate portion adjacent the free end portion.
17. The medical collapsible quiver of claim 15 or claim 16, when dependent on claim 12, wherein, when in the extended position, the second retaining portion is located in the first member adjacent the transition portion.

Figure 3





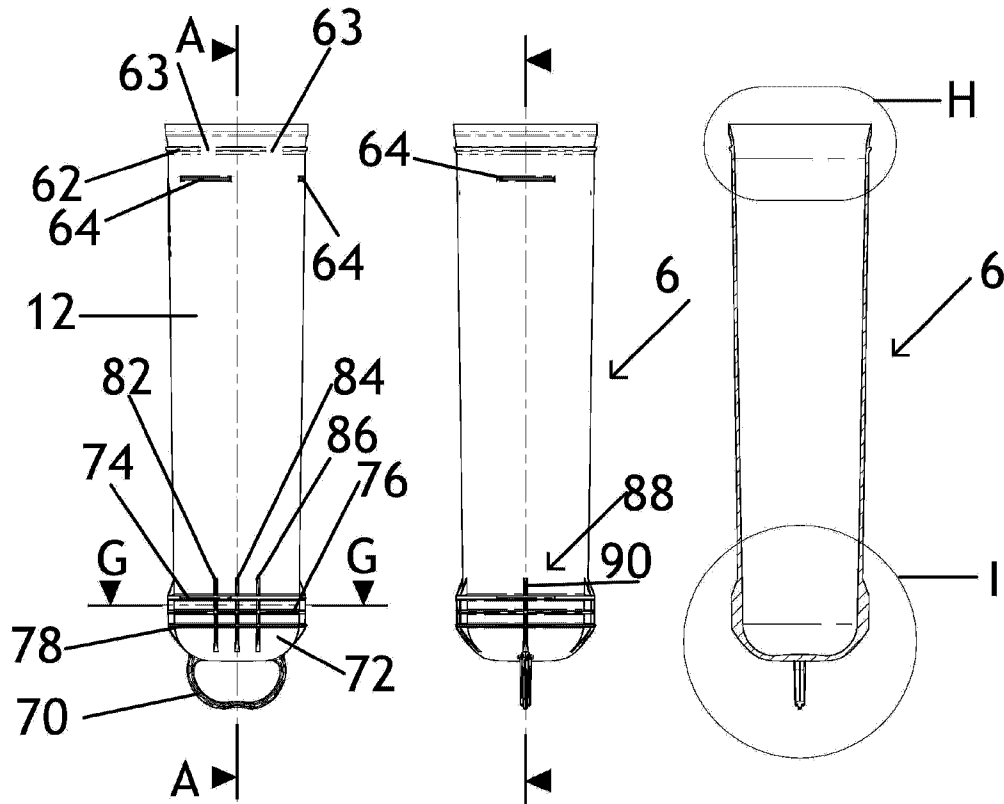


Figure 10

Figure 11

Figure 12

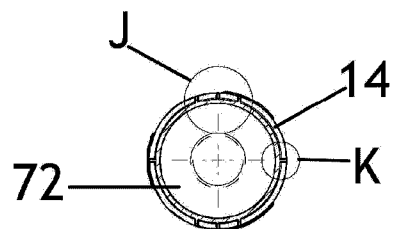


Figure 12 A

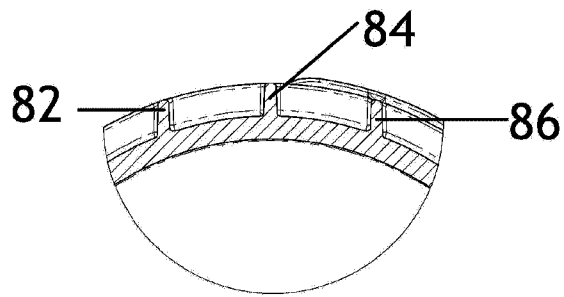


Figure 13

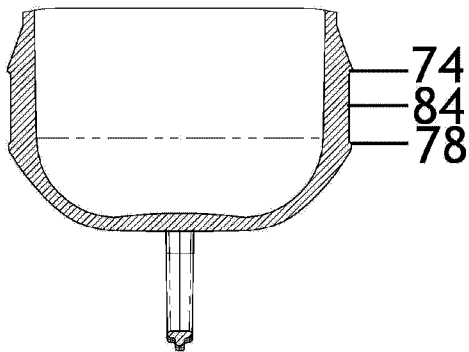


Figure 15

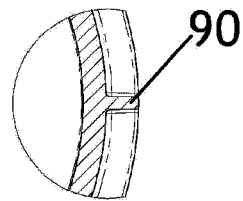


Figure 14

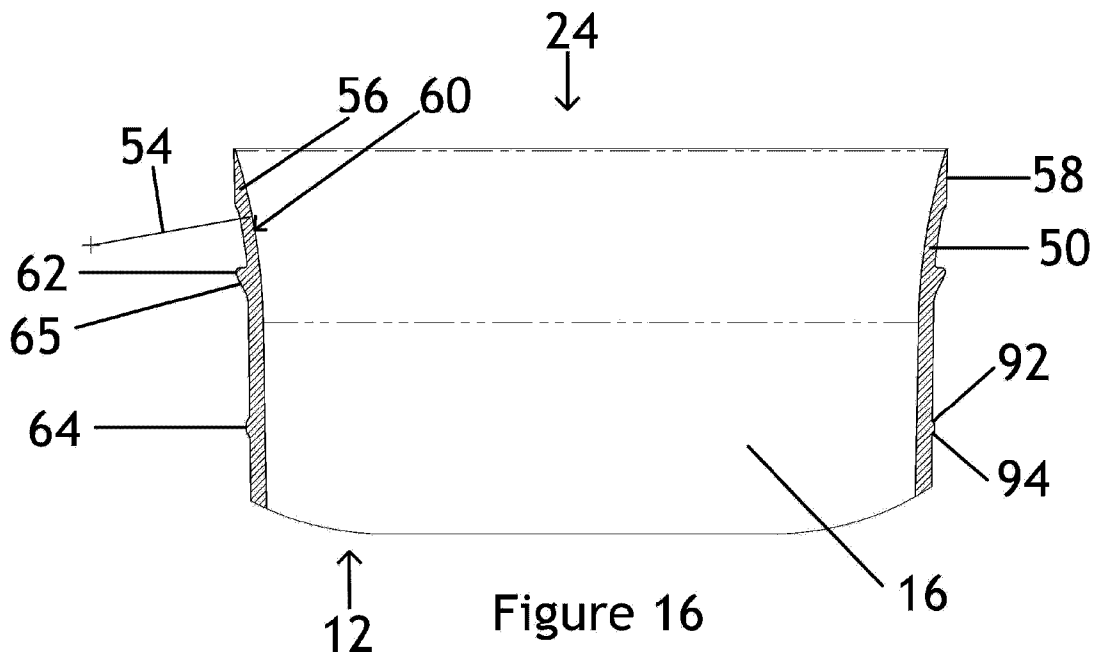


Figure 16

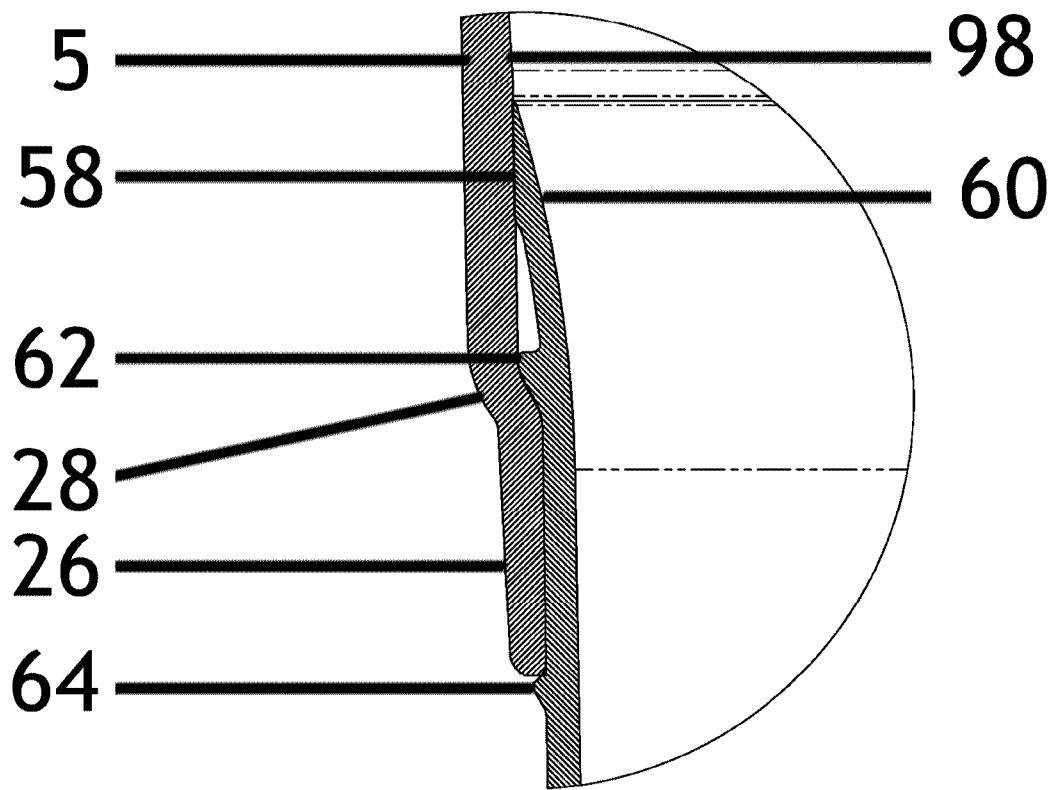


Figure 17

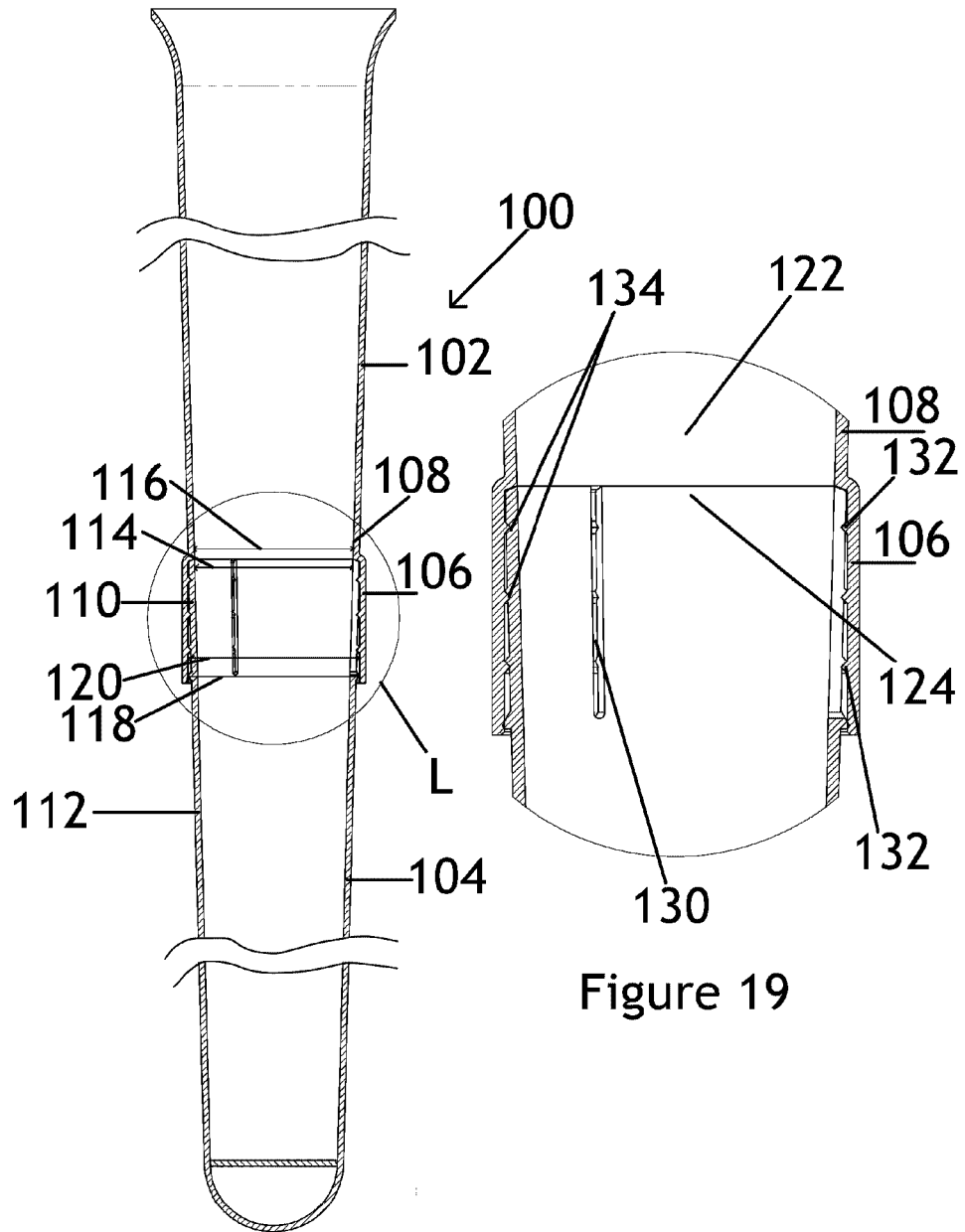


Figure 18

Figure 19

