



- (51) **International Patent Classification:**
A61F 2/34 (2006.01)
- (21) **International Application Number:**
PCT/GB2009/001396
- (22) **International Filing Date:**
3 June 2009 (03.06.2009)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
0810284.0 5 June 2008 (05.06.2008) GB
- (71) **Applicant (for all designated States except US):** CORIN LIMITED [GB/GB]; The Corinium Centre, Cirencester, Gloucestershire GL7 1YJ (GB).
- (72) **Inventor; and**
- (75) **Inventor/Applicant (for US only):** COLLINS, Simon Nicholas 18 Star Lane Avening, Tetbury Gloucestershire, GL8 8NT United Kingdom [GB/GB]; 18 Star Lane, Avening Tetbury, Gloucestershire GL8 8NT (GB).
- (74) **Agent:** ALBRIGHT PATENTS; Eagle Tower, Montpellier Drive, Cheltenham GL50 1TA (GB).
- (81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) **Designated States (unless otherwise indicated, for every kind of regional protection available):** ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:**
— without international search report and to be republished upon receipt of that report (Rule 48.2(g))

(54) **Title:** ACETABULAR CUP

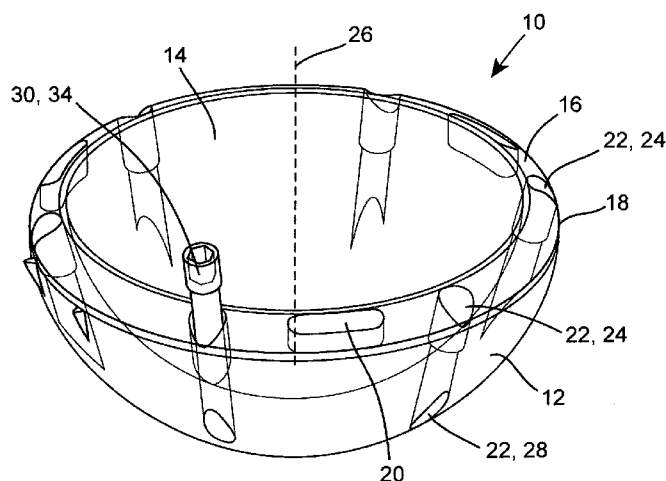


Fig. 1

(57) **Abstract:** An acetabular cup (10) comprises : i) an inner articulating surface (14) having a polar axis (26), an arcuate outer surface (12), an annular rim (16) therebetween, and at least one elongate passage (22) which extends from the rim (16) to the outer surface (12). A longitudinal extent of the said at least one passage (22) extends in a direction which is non-parallel with the polar axis (26). ii) an inner articulating surface (14), an arcuate outer surface (12), an annular rim (16) therebetween, and at least one elongate passage (22) which extends from the rim (16) to the outer surface (12). The said at least one passage (22) at least in part defines a slot (29) in the outer surface (12).

Acetabular Cup

The present invention relates to an acetabular cup.

An acetabular cup for a hip prosthesis is well known. However, attachment of an acetabular cup to a patient's acetabulum often requires additional fixation means, such as screw-threaded fasteners, whilst bone growth onto an outer fixation surface of the cup occurs. If a patient has or requires a metal-on-metal (MOM) or dysplasia acetabular device, these generally have limited cup wall thickness for securely fastening the cup in place. Fasteners cannot typically therefore extend through the cup wall and project perpendicularly from the cup as this affects the wear and lubrication performance of the prosthesis.

A further problem exists if fasteners are used, since, once bone growth onto and around the cup has occurred, if revision is required, it is often extremely problematic to extract or release the fasteners before the cup can be removed.

A final problem also becomes evident due to the orientation of the cup in the patient's acetabulum. The anteversion of the cup once inserted often results in an outer edge of the rim protruding from the reamed acetabular surface. This relatively sharp edge can then rub against, abrade and/or irritate the iliopsoas muscle.

The present invention seeks to provide solutions to these problems.

According to a first aspect of the invention, there is provided an acetabular cup comprising an inner articulating surface having a polar axis, an arcuate outer surface, an annular rim therebetween, and at least one elongate passage which extends from the rim to the outer surface, a longitudinal extent of the said at least one passage extending in a direction which is non-parallel with the polar axis.

Preferable and/or optional features of the first aspect of the invention are set forth in claims 2 to 27, inclusive.

According to a second aspect of the invention, there is provided an acetabular cup comprising an inner articulating surface, an arcuate outer surface, an annular rim

therebetween, and at least one elongate passage which extends from the rim to the outer surface, the said at least one passage at least in part defining a slot in the outer surface.

Preferable and/or optional features of the second aspect of the invention are set forth in claims 29 to 31, inclusive.

- 5 The invention will now be more particularly described, by way of example only, with reference to the accompanying drawings, in which :

Figure 1 is a perspective view of one embodiment of an acetabular cup, in accordance with the present invention;

Figure 2 is a side view of the acetabular cup; and

- 10 Figure 3 is an enlarged view of a passage of the cup showing a fastener received therein.

Referring to the drawings, there is shown an acetabular cup 10 which comprises a part-circular outer surface 12 suitably dimensioned to fit a reamed acetabular opening of a patient, a part-circular, typically hemispherical or substantially hemispherical, inner
15 articulating surface 14 adapted to receive a prosthetic femoral head, and an annular rim 16 which extends between the outer surface 12 and the articulating surface 14.

Although the outer surface 12 is part-circular, it may be shaped such that the equatorial diameter of the outer surface at the rim 16 is marginally greater than the polar diameter of the outer surface which extends perpendicularly to the equatorial diameter. This
20 shape is beneficial to aid press-fit and uncemented fixation of the cup 10 into a patient's acetabulum, which is generally reamed to the smaller polar diameter dimension.

A surface of the rim 16 preferably includes a radiused portion 18 which extends in a lateral direction of the rim 16 between the outer surface 12 and the articulating surface 14. The radiused portion 18 may extend across the entire lateral extent of the rim 16, or
25 only across part thereof. In the former case, the rim 16 is thus fully non-planar, whereas in the latter case, the rim 16 has a planar portion and a non-planar portion. Optionally, only a portion of the rim 16 in a circumferential direction may be radiused. A radius of the rim 16 is preferably in a range of 0.5 millimetre (mm) to 5 mm. The radiused

portion 18 prevents irritation of the iliopsoas muscle, should the rim 16 of the cup 10 project from the patient's acetabular surface.

The cup 10 is formed of, typically forged or cast, metal, and preferably high carbon cobalt chrome-alloy or titanium and may be subjected to a heat treatment process to improve its mechanical properties. However, it could be formed of a ceramic material, such as alumina, zirconia, or a combination thereof. The outer surface 12 of the cup 10 is also preferably coated with Titanium plasma and/or Hydroxyapatite, to aid fixation and bone growth.

The rim 16 is formed with three equi-angularly spaced introducer recesses 20 which have an elongate longitudinal extent extending in a circumferential direction of the rim 16, and a relatively shallow depth. The recesses 20 are bottomed and are spaced from both the articulating surface 14 and the outer surface 12. The introducer recesses 20 enable releasable engagement of the cup 10 with an introducer tool, and are optional dependent upon necessity.

A plurality of rectilinear elongate passages 22 is also provided in a wall of the cup 10, extending from the rim 16 to the outer surface 12. Openings 24 to the passages 22 are equi-angularly spaced around the rim 16 and are positioned either side of each introducer recess 20. Although in this embodiment six of the passages 22 are provided, any number of passages 22 is feasible, including only one.

Each passage 22 has an elongate longitudinal extent and a generally cylindrical bore. The longitudinal extent is non-parallel with a polar axis 26 of the articulating surface 14, so that the passage 22 passes through a reasonable amount of the wall of the cup 10. In this embodiment, the longitudinal extent of each passage 22 is provided in a converging direction relative to the polar axis 26. As a consequence, a plane of the polar axis 26 can be oriented to include a longitudinal axis of at least one of the passages 22. An included angle between the polar axis 26 and the longitudinal extent of each passage 22 is preferably in a range of 1 degree to 30 degrees, and is more preferably 15 degrees.

However, it may be beneficial to direct a longitudinal extent of one or more of the passages 22 so as to extend through the plane of the polar axis 26. In this case, the longitudinal axis may not be in a converging direction with the polar axis 26. This

orientation would simplify access to the passage(s) for a surgeon, once the cup 10 had been positioned in a patient's reamed acetabulum, due to the angles of offset of the cup 10 relative to the vertical and coronal planes.

Each passage 22 is spaced from the articulating surface 14 of the cup 10, and an opening 28 to the passage 22 on the outer surface 12 is spaced from the rim 16 and the corresponding opening 24 thereon. The passage opening 24 on the rim 16 may be formed on the radiused portion 18, in which case the opening 24 is non-circular. If the rim 16 is planar, then the opening 24 would be circular. The opening 24 on the outer surface 12 is substantially an ellipse, due to the curvature of the outer surface 12.

Each passage 22 of this embodiment is an enclosed passage with an opening 24, 28 at each end. However, especially in the case of a thin walled dysplastic acetabular cup 10, it may not be possible to have an enclosed passage. In this case, the passage may be open along its entire longitudinal extent or at least part of its longitudinal extent. In this embodiment and as shown in Figure 4, a slot 29 is thus defined by the passage in the outer surface. The slot 29 may extend from either the opening on the rim, the opening on the outer surface, or from both openings. Preferably, the slot 29 provides a restricted opening to the passage. As such, a lateral cross-section of the passage is or is substantially 'C' shaped.

The above described embodiments utilise a single shaft screw-threaded fastener 30, such as a surgical screw, and thus the passage 22 formed in the wall of the cup 10 is a single cylindrical or substantially cylindrical bore. Instead of a surgical screw, the fastener may be a surgical staple. In this case, the passage comprises a relatively shallow elongate rectangular or substantially rectangular recess formed in the rim, and a first narrow bore for receiving a prong of the staple. A secondary passage having a second narrow bore extends from the bottom of the recess to the outer surface. The first and second narrow bores are straight and, preferably, extend in parallel with each other.

As a further option, the acetabular cup 10 may comprise retaining means for preventing or inhibiting a fastener 30 from backing out of the passage 22. The passage 22 includes an enlarged bore portion 32 which extends from the rim 16 to receive a head 34 of the fastener 30. The retaining means includes a notch or ridge 36 formed partway down the

enlarged bore portion 32. Once an edge of the head 34 of the fastener 30 engages with the notch or passes over the ridge 36, backing out of the passage 22 is prevented or inhibited.

As a further option, a circlip device can be utilised which, once the fastener is fully received in the passage, is placed above the head of the fastener and expands into the notch to prevent the fastener backing out.

Additionally or alternatively, the enlarged bore portion of the passage may include a frusto-conical surface. The head of the fastener also includes a complementary surface. A taper-fit or Morse taper is thus formed by which a head of the fastener can be wedgingly engaged in the passage.

A blanking plug can be provided in the or each opening on the rim of the cup and above the respective fastener to seal the passage and prevent foreign objects and/or bodily fluid or other matter from passing therethrough.

In a modification to the embodiment described above, the opening on the rim to a passage may break out onto the outer surface of the cup. This would be advantageous in the event that a wall thickness of the cup, particularly at the rim, was insufficient to easily accommodate the entire diameter of the head of a fastener. This would result in the slot extending from the opening on the rim at least partway along the outer surface, and thus forming the above-described restricted opening to the passage. Again, the lateral cross-sectional shape of the passage at and adjacent to the opening on the rim is generally C-shaped.

In this modification, the head of the fastener, when accommodated in the passage, may have a part which is thus slightly proud of the outer surface.

The remainder of the passage may either be fully enclosed within the wall thickness of the cup, until it opens out at its end onto the outer surface, or may include the slot as described above which thus would extend to or substantially to the end of the passage on the outer surface. In this latter case, the shaft of the fastener, which may be for example screw-threaded, may have part of its lateral extent which projects through the slot and is thus proud of the outer surface.

In this embodiment, the passages may be parallel or non-parallel to the polar axis of the articulating surface of the cup.

In a further modification to the above embodiments, the passages need not necessarily be rectilinear or straight. One, more or all of the passages may be curved or arcuate
5 along their longitudinal extents. In this case, the fasteners would be formed of a flexible material, such as Nickel Titanium alloy (Nitinol). This would be advantageous to allow not only ease of access for a surgeon in inserting and securing the fasteners, but also being able to more accurately place the openings of the passages on the outer surface directly adjacent to good density bone of a patient, resulting in more reliable fixation.

10 The use of the term 'fastener' in all cases above is intended to include at least surgical screws, surgical staples, and surgical pins.

The problem associated with revision and the releasing of the fasteners can be addressed by the use of resorbable material for the fasteners. The resorbable material is typically a polymer, and may be for example PLLA, PCA, or PGA.

15 If the above described passage or passages are applied to an equatorially expanded cup having a non-uniform wall thickness, then it is advantageous to provide one or more passages in a thicker part of the wall.

Although the passages described above are equi-angularly spaced, this is only an option and the spacing may be at any relative angular distance, uniform or non-uniform,
20 dependent on necessity.

The present invention is particularly, but not exclusively, beneficial for use with thin walled acetabular components, such as monoblock large diameter metal-on-metal (MOM) articulations and dysplasia components where there is difficulty in achieving primary fixation with conventional bone screws in addition to cementless fixation.

25 However, the cup may be a multi-part component, for example utilising one or more liner options to accommodate wear couplings formed from materials, such as metal, polyethylene and ceramic.

There is thus provided an acetabular cup which enables fixation by a separate fastener through the rim of the cup. The passage of the fastener extends at an angle which is non-parallel with a polar axis of the cup. The passage may break out onto the outer surface, either for part or all of its longitudinal extent, and therefore may be parallel or
5 non-parallel with the polar axis of the cup. By providing the fastener entirely or substantially entirely within the thickness of the wall of the cup, without the need for flanges or specific outlying formations, a patient's acetabulum can be reamed in standard hemispherical fashion and the cup can be fixed directly to the reamed acetabulum surface.

10 The embodiments described above are provided by way of example only, and various other modifications will be apparent to persons skilled in the art without departing from the scope of the invention as defined by the appended claims.

Claims

1. An acetabular cup (10) comprising an inner articulating surface (14) having a polar axis (26), an arcuate outer surface (12), an annular rim (16) therebetween, and at least one elongate passage (22) which extends from the rim (16) to the outer surface (12), a longitudinal extent of the said at least one passage (22) extending in a direction which is non-parallel with the polar axis (26).
5
2. An acetabular cup (10) as claimed in claim 1, wherein the said at least one passage (22) extends in a converging direction towards the polar axis (26).
3. An acetabular cup as claimed in claim 2, wherein the said at least one passage
10 (22) forms an angle with the polar axis (26) in a range of 1 degrees to 30 degrees.
4. An acetabular cup (10) as claimed in claim 1, wherein a longitudinal extent of the said at least one passage (22) extends at an angle through a plane of the polar axis (26).
5. An acetabular cup (10) as claimed in any one of the preceding claims, wherein
15 the said at least one passage (22) is spaced from the inner articulating surface (14).
6. An acetabular cup (10) as claimed in any one of the preceding claims, wherein the said at least one passage (22) defines a slot (29) in the outer surface (12).
7. An acetabular cup (10) as claimed in claim 6, wherein the slot (29) extends from a first opening (24) on the rim (16) to a second opening (28) on the outer surface (12)
20 which is spaced from the first openings (24).
8. An acetabular cup (10) as claimed in claim 6 or claim 7, wherein the slot (29) defines a restricted opening to the passage (22).
9. An acetabular cup (10) as claimed in any one of the preceding claims, wherein the equatorial diameter of the outer surface (12) at the rim (16) is greater than the polar
25 diameter of the outer surface (12) which extends perpendicularly to the equatorial diameter.
10. An acetabular cup (10) as claimed in any one of the preceding claims, further comprising a secondary passage which extends from the said at least one passage (22).
11. An acetabular cup (10) as claimed in any one of the preceding claims, further
30 comprising retaining means for retaining a fastener (30) in the said at least one passage (22).

12. An acetabular cup (10) as claimed in claim 11, wherein the retaining means includes a notch or ridge (36) formed in or on a surface of the passage (22), the notch or ridge (36) being adapted to engage an edge of a head (34) of the fastener (30).
13. An acetabular cup (10) as claimed in claim 11 or claim 12, wherein the retaining
5 means includes a circlip device for preventing a fastener from backing out of the passage (22).
14. An acetabular cup (10) as claimed in any one of claims 11 to 13, wherein the retaining means includes a tapering surface within the said at least one passage (22), the tapering surface forming part of a taper-fit with a complementary screw-threaded
10 fastener (30).
15. An acetabular cup (10) as claimed in claim 14, wherein the tapering surface is spaced along the longitudinal extent of the passage (22) from a first opening (24) on the rim (16).
16. An acetabular cup (10) as claimed in any one of claims 11 to 15, wherein the
15 passage (22) includes an enlarged bore portion (32) which extends from the rim (16) to receive a head (34) of the fastener (30).
17. An acetabular cup (10) as claimed in any one of claims 11 to 16, further comprising a blanking plug for in use blocking the passage (22) between the rim (16) and a head of the fastener (30).
- 20 18. An acetabular cup (10) as claimed in any one of the preceding claims, wherein a longitudinal extent of the said at least one passage (22) is curved.
19. An acetabular cup (10) as claimed in any one of the preceding claims, wherein a wall between the inner articulating surface (14) and the outer surface (12) is of non-uniform thickness in a polar plane, the said at least one passage (22) being formed in a
25 thicker part of the wall.
20. An acetabular cup (10) as claimed in any one of the preceding claims, wherein a wall between the inner articulating surface (14) and the outer surface (12) is of non-uniform thickness in a plane perpendicular to the polar plane, the said at least one passage (22) being formed in a thicker part of the wall.
- 30 21. An acetabular cup (10) as claimed in any one of the preceding claims, wherein the rim (16) includes a radiused portion (18) which extends in a lateral direction of the rim (16) between the outer surface (12) and the articulating surface (14).

22. An acetabular cup (0) as claimed in claim 21, wherein the radius is in the range of 0.5 mm to 5 mm.
23. An acetabular cup (10) as claimed in any one of the preceding claims, further comprising equi-angularly spaced bottomed introducer recesses (20) for engagement
5 with an introducing tool.
24. An acetabular cup (10) as claimed in claim 23, wherein each introducer recess (20) has an elongate longitudinal extent extending in a circumferential direction of the rim (16).
25. An acetabular cup (10) as claimed in any one of the preceding claims, further
10 comprising a fastener (30) for the said at least one passage (22), the fastener (30) being resorbable.
26. An acetabular cup (10) as claimed in any one of the preceding claims, wherein the cup (10) is part of a metal-on-metal articulation.
27. An acetabular cup (10) as claimed in any one of the preceding claims, wherein
15 the cup (10) is part of a dysplasia component.
28. An acetabular cup (10) comprising an inner articulating surface (14) having a polar axis (26), an arcuate outer surface (12), an annular rim (16) therebetween, and at least one elongate passage (22) which extends from the rim (16) to the outer surface (12), the said at least one passage (22) at least in part defining a slot (29) in the outer
20 surface (12).
29. An acetabular cup (10) as claimed in claim 28, wherein the slot (29) extends from an opening (24) of the passage (22) on the rim (16) to an opening (28) on the outer surface (12).
30. An acetabular cup (10) as claimed in claim 29, wherein the slot (29) is adapted
25 so that a head of a fastener received in the passage (22) is proud of the outer surface (12) of the cup (10).
31. An acetabular cup (10) as claimed in any one of claims 28 to 30, wherein a longitudinal extent of the said at least one passage (22) extends in a direction which is parallel or non-parallel with the polar axis (26) of the cup (10).

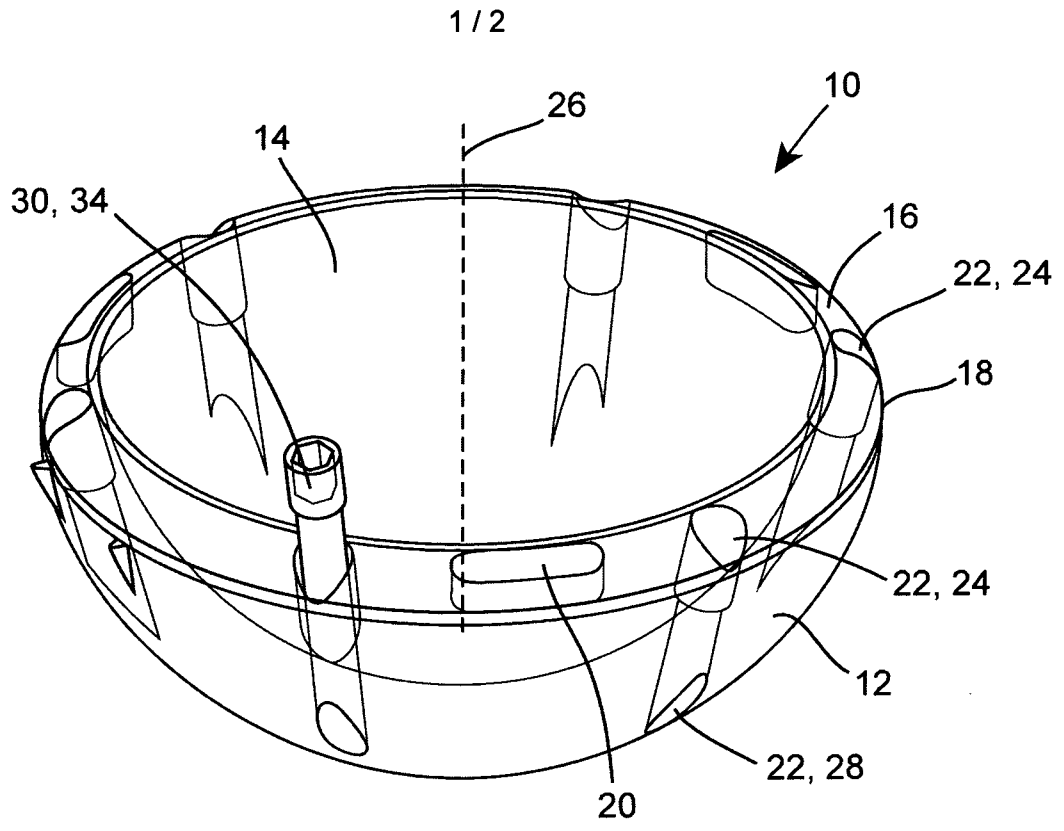


Fig. 1

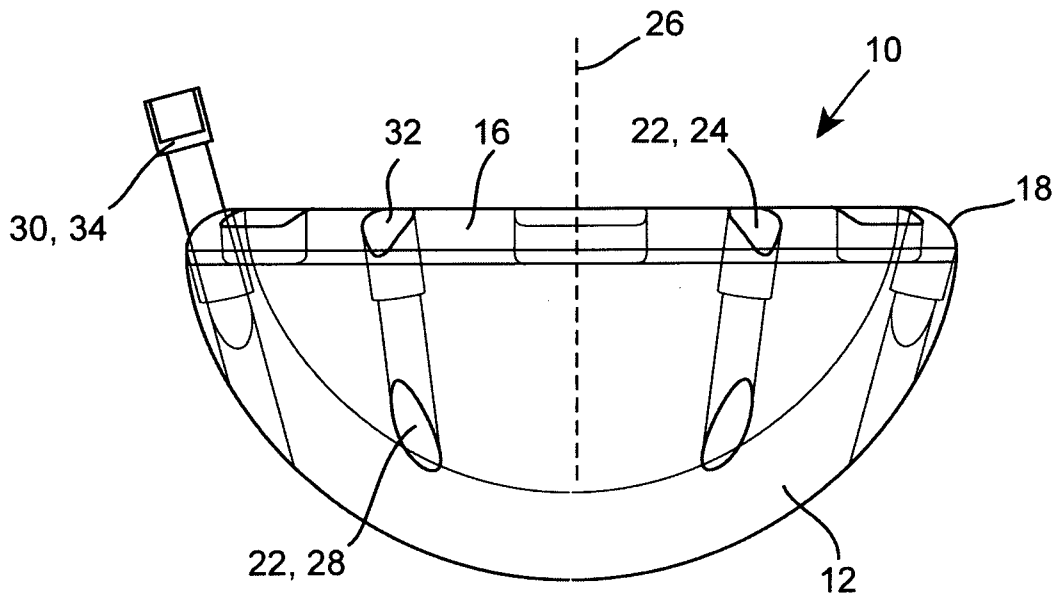


Fig. 2

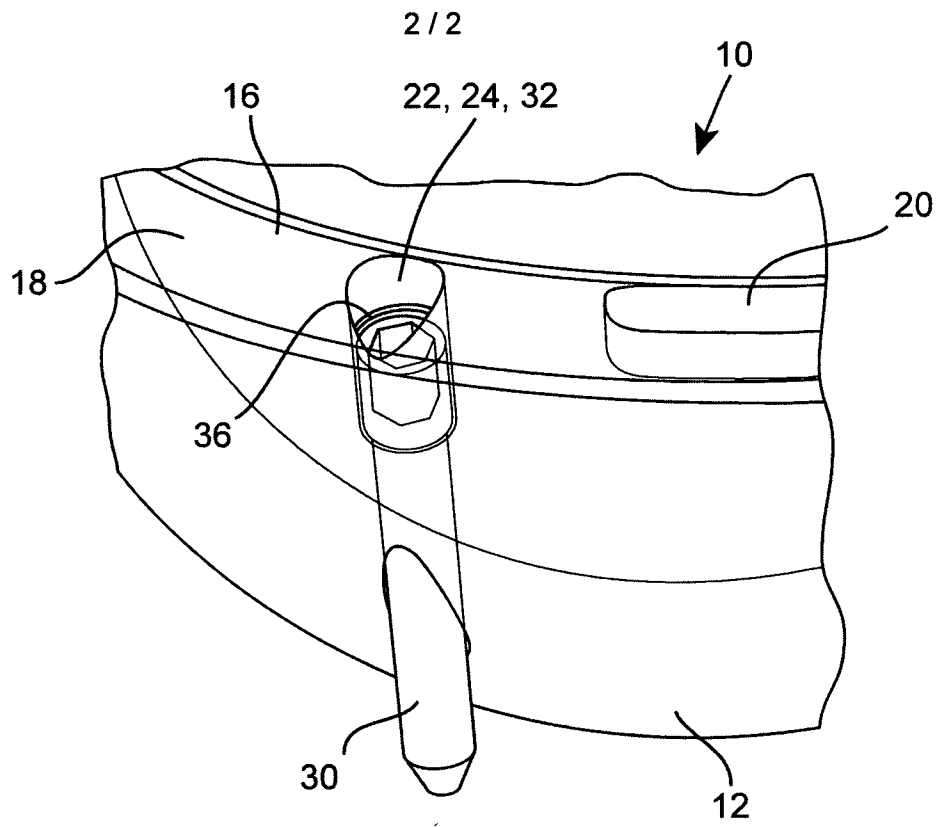


Fig. 3

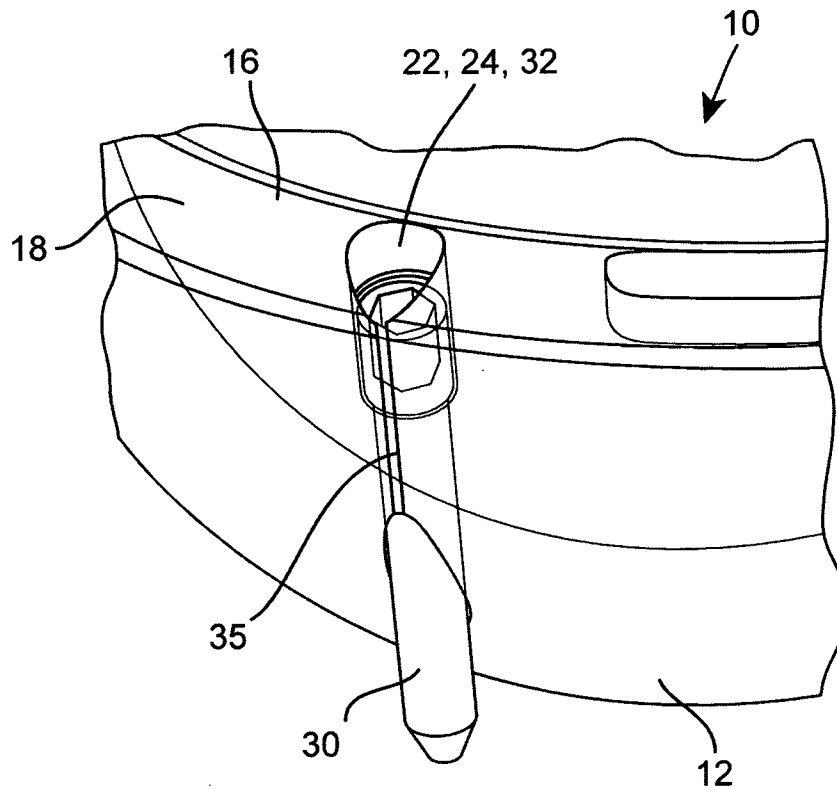


Fig. 4