



(51) International Patent Classification:
A61F 2/34 (2006.01)

(21) International Application Number:
PCT/US2010/041826

(22) International Filing Date:
13 July 2010 (13.07.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
12/502,848 14 July 2009 (14.07.2009) US

(71) Applicant (for all designated States except US):
BIOMET MANUFACTURING CORP. [US/US]; 56 E.
Bell Drive, Warsaw, Indiana 46582 (US).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **MERIDEW, Jason D.** [US/US]; 2211 Laurelwood Drive, Warsaw, Indiana 46580 (US).

(74) Agents: **WARNER, Richard, W.** et al.; Harness, Dickey & Pierce, P.L.C., P.O. Box 828, Bloomfield Hills, Michigan 48303 (US).

(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, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, 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, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, 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,

[Continued on next page]

(54) Title: MULTIPLE BEARING ACETABULAR PROSTHESIS

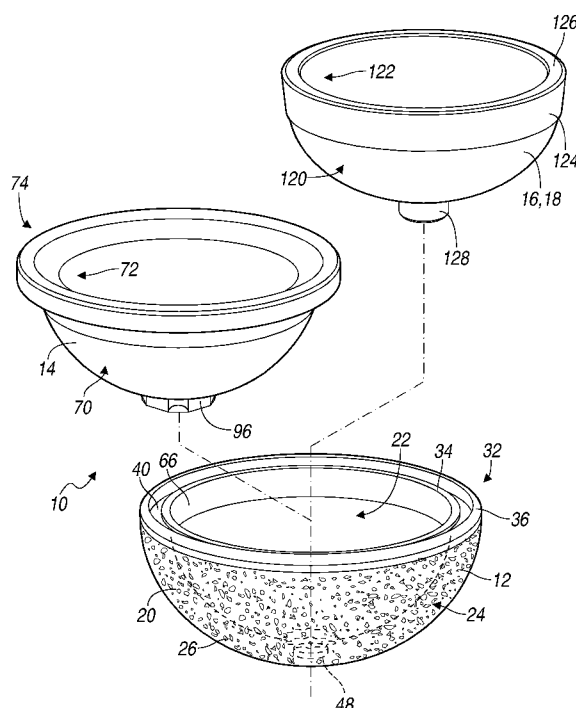


FIG. 1

(57) Abstract: An acetabular prosthesis assembly (10) can include an acetabular cup (12) and a first liner (14). The acetabular cup can have an outer surface (24), an inner surface (22) and an upper rim extending between the outer surface and the inner surface. The acetabular cup can have a cup connection portion (32) including a groove (40) formed on an upper face of the upper rim. The first liner can have an outer cup engaging surface (70) and a liner connection portion (74) that extends from a flange of the first liner. The liner connection portion can have a finger (82) that is received by the groove formed on the upper face of the acetabular cup that selectively couples the liner connection portion with the cup connection portion in an assembled position.



SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

— *with international search report (Art. 21(3))*

MULTIPLE BEARING ACETABULAR PROSTHESIS FIELD

[0001] The present disclosure relates to a modular prosthesis, particularly to an acetabular prosthesis including a plurality of liners operable to
5 interconnect with a single acetabular cup.

BACKGROUND

[0002] This section provides background information related to the present disclosure which is not necessarily prior art.

10 **[0003]** Articulating regions of the anatomy can include areas where two bone sections move relative to one another. For example, an acetabulum can provide a region for articulation with a femoral head. The articulating region, however, can become injured or worn, but it can be replaced with various prostheses. Such prostheses can replace the acetabulum, the femoral head,
15 and various other portions of the femur, or other combinations thereof. The replacement of both the acetabulum and the femoral head is generally referred to as a total joint replacement.

[0004] The total joint replacement of the acetabulum and the femoral head can require a bearing or articulating surface for both the femoral head and
20 the acetabulum. The articulating surfaces are generally positioned relative to the various portions of the remaining natural anatomy in a substantially fixed manner. Materials must be selected for the bearing surfaces for various purposes.

SUMMARY

25 **[0005]** This section provides a general summary of the disclosure, and is not a comprehensive disclosure of its full scope or all of its features.

[0006] An acetabular prosthesis assembly can include an acetabular cup and a first liner. The acetabular cup can have an outer surface, an inner surface and an upper rim extending between the outer surface and the inner
30 surface. The acetabular cup can have a cup connection portion including a groove formed on an upper face of the upper rim. The first liner can have an outer cup engaging surface and a liner connection portion that extends from a

flange of the first liner. The liner connection portion can have a finger that is received by the groove formed on the upper face of the acetabular cup that selectively couples the liner connection portion with the cup connection portion in an assembled position.

5 **[0007]** According to additional features, the cup connection portion can be collectively formed by an inner wall and an outer wall that are offset by the groove. The groove can extend annularly around the upper rim. One of the inner and outer walls can include an undercut formed in the groove. The first liner can include a protrusion extending from the finger that nests in the undercut
10 of the acetabular cup in the assembled position.

[0008] According to still other features, the acetabular cup can further include an anti-rotation counterbore defined by the inner liner engaging surface. The first liner can include an anti-rotation projection extending from the outer cup engaging surface that cooperatively locates at the anti-rotation counterbore of
15 the acetabular cup in the assembled position.

[0009] According to additional features, the cup connection portion can further comprise a plurality of grooves formed radially on the upper face of the upper rim. The liner connection portion can further comprise a plurality of radial flanges each having a finger that selectively mates with selected grooves of the
20 cup connection portion in an assembled position. Each of the fingers can have oppositely extending protrusion portions that selectively locate within opposing cut-out portions formed on the upper rim at the plurality of grooves.

[0010] According to yet other features, the first liner can be formed of polyethylene. The acetabular prosthesis assembly can additionally comprise a
25 second liner and a third liner. The second liner can be formed of cobalt-chromium. The second liner can have a male taper portion that selectively engages a complementary female taper portion formed on the inner liner engaging surface of the acetabular cup in an assembled position. The third liner can be formed of ceramic. The third liner can have a male tapered portion that
30 selectively engages the female tapered portion on the inner liner engaging surface of the acetabular cup in an assembled position. The acetabular cup can selectively and alternatively mate with any of the first, second or third liners.

[0011] Further areas of applicability will become apparent from the description provided herein. The description and specific examples in this summary are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

5

DRAWINGS

[0012] The drawings described herein are for illustrative purposes only of selected embodiments and not all possible implementations, and are not intended to limit the scope of the present disclosure.

[0013] Fig. 1 is a perspective exploded view of an acetabular prosthesis assembly constructed in accordance to one example of the present teachings;

[0014] Fig. 1A is a perspective exploded view of an acetabular prosthesis assembly according to additional features;

[0015] Fig. 2 is a perspective exploded view of an acetabular cup and first liner of the acetabular prosthesis assembly of Fig. 1;

[0016] Fig. 3 is a cross-sectional exploded view of the acetabular cup and first liner of Fig. 1;

[0017] Figs. 4-6 are partial cross-sectional views of the acetabular cup and first liner of Fig. 1 shown during an exemplary assembly sequence;

[0018] Fig. 6A is a partial cross-sectional view of an acetabular cup and liner according to additional features;

[0019] Fig. 7 is a cross-sectional view of the acetabular cup and first liner of Fig. 1 shown in an assembled position;

[0020] Fig. 8 is a plan view of the assembled acetabular cup and first liner of Fig. 7;

[0021] Fig. 9 is a cross-sectional assembled view of the acetabular cup and second liner of Fig. 1;

[0022] Fig. 10 is a perspective exploded view of an acetabular prosthesis assembly according to another example of the present teachings;

[0023] Fig. 11 is a plan view of the acetabular cup and first liner of Fig. 10 shown in an assembled position;

[0024] Fig. 12 is a cross-sectional view of the acetabular cup and first liner taken along line 12-12 of Fig. 11;

[0025] Figs. 13 and 14 are partial detail views of the acetabular cup and first liner of Fig. 10 shown during an exemplary assembly sequence;

5 [0026] Fig. 15 is a cross-sectional view of the acetabular cup and second liner of Fig. 10 shown in an assembled position;

[0027] Fig. 16 is a perspective exploded view of an acetabular prosthesis assembly according to another example of the present teachings;

10 [0028] Fig. 17 is a perspective exploded view of the acetabular cup and second liner shown with a connecting member partially cooperating with the acetabular cup and partially cooperating with the second liner for illustrative purposes during an assembly step;

15 [0029] Fig. 18 is a perspective partial exploded view of the acetabular cup and connecting member shown during receipt of the second liner during an exemplary assembly sequence;

[0030] Fig. 19 is a perspective view of the acetabular cup, connecting member and second liner shown in an assembled position;

[0031] Fig. 20 is a cross-sectional view of the assembled acetabular cup, connecting member and second liner taken along line 20-20 of Fig. 19;

20 [0032] Fig. 21 is a perspective view of the acetabular cup, connecting member and first liner of Fig. 16 and shown in an assembled position;

[0033] Fig. 22 is a cross-sectional view of the assembled acetabular cup, connecting member and first liner taken along line 22-22 of Fig. 21; and

25 [0034] Fig. 23 is an environmental view of an acetabular prosthesis assembly positioned relative to an acetabulum of a patient.

[0035] Corresponding reference numerals indicate corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION

30 [0036] With initial reference to Fig. 1, an acetabular prosthesis assembly constructed in accordance to one example of the present teachings is shown and generally identified at reference numeral 10. The acetabular

prosthesis assembly 10 can generally include a single acetabular cup 12 that can be selectively and alternatively interconnected with a first bearing or liner 14, a second bearing or liner 16 or a third bearing or liner 18. According to one example, the first liner 14 can be formed of any appropriate materials, such as
5 polymers including ultra-high molecular weight polyethylene (UHMWPE) or polyetheretherketone (PEEK). The second liner 16 can be formed of a substantially or relatively hard or rigid material, such as metals (e.g., titanium, titanium alloys, stainless steel alloys, cobalt chromium alloys). The third liner 18 can be formed of a substantially or relatively hard or rigid material, such as a
10 ceramic material. In one example, the second and third liners 16 and 18 can have an equivalent geometry. As such, the second and third liners 16 and 18 have been denoted in the drawings simply as a single liner.

[0037] Briefly, the provision of the first, second and third liners 14, 16 and 18 allow for a pre-operative or intra-operative selection of liners for
15 positioning within the acetabular cup 12. In addition or alternatively, the provision of the first, second and third liners 14, 16 and 18 that can each engage a common acetabular cup 12 can minimize the number of parts for a procedure. For example, rather than requiring a first acetabular cup to engage the first liner 14 and a second acetabular cup to engage the second liner 16 and/or a third
20 acetabular cup to engage the third liner 18, only the single acetabular cup 12 is needed to engage all of the first, second and third liners 14, 16 and 18. As will be described, the first liner 14 can include different connection portions relative to the second and third liners 16 and 18 for interconnecting with the single acetabular cup 12.

[0038] With continued reference to Fig. 1 and additional reference now to Figs. 2 and 3, the acetabular cup 12 will be described in greater detail. According to one example, the acetabular cup 12 can be formed of biocompatible metallic material, such as, but not limited to titanium, titanium alloy, stainless steel alloy and cobalt-chromium alloy. The acetabular cup 12
25 can generally include a hemispherical body 20 having an inner liner engaging surface 22 and an outer bone engaging surface 24. The outer bone engaging surface 24 can have a porous metal coating 26. The acetabular cup 12 can
30

include an upper rim 30 that extends between the inner liner engaging surface 22 and the outer bone engaging surface 24. The upper rim 30 can include an upper face 31 having a cup connection portion 32. The cup connection portion 32 can collectively be formed by an inner wall 34 and an outer wall 36 offset by an annular groove 40 formed around the upper rim 30 where the cup connection portion 32 is outside of the inner liner engaging surface 22. A portion of the inner wall 34 can be common with the inner liner engaging surface 22. A portion of the outer wall 36 can be common to the outer bone engaging surface 24. The inner liner engaging surface 22 of the acetabular cup 12 can define a cup cavity 42. As best illustrated in Fig. 2, the cup connection portion 32 is outside of the cup cavity 42. The inner end outer walls 34 and 36 can be parallel to an axis through an apex of the acetabular cup 12.

[0039] The acetabular cup 12 can include an apical portion 44 that includes an anti-rotation counterbore 46 formed thereat. The anti-rotation counterbore 46 is defined in the inner liner engaging surface 22. The anti-rotation counterbore 46 can include a bore or apical hole 48 that passes entirely through the acetabular cup 12. The anti-rotation counterbore 46 includes a series of inset and outset portions 50 and 52 formed therearound.

[0040] The cup connection portion 32 will now be described in greater detail. The cup connection portion 32 can include an undercut 56 (Fig. 3) formed from the annular groove 40 into the inner wall 34. In one example, the undercut 56 can extend radially into the inner wall 34 in a direction opposite of the outer wall 36. The inner wall 34 can include a lip surface 58. In one example, an upper surface of the inner wall 34 can define a first plane 60 and an upper surface of the outer wall 36 can define a second plane 62. The first and second planes 60 and 62 can be offset relative to each other. A portion of the inner liner engaging surface 22 proximate to the upper rim 30 can include a female taper 66.

[0041] According to additional features shown in Fig. 1A, an acetabular cup 12' can include an upper rim 30' that extends between the inner liner engaging surface 22' and the outer bone engaging surface 24'. The upper rim 30' can include an upper face 31' having a cup connection portion 32'. The cup

connection portion 32' can collectively be formed by an inner wall 34' and an outer wall 36' offset by an annular groove 40' formed around the upper rim 30' where the cup connection portion 32' is outside of the inner liner engaging surface 22'. A portion of the inner wall 34' can be common with the inner liner engaging surface 22'. A portion of the outer wall 36' can be common to the outer bone engaging surface 24'. The inner liner engaging surface 22' of the acetabular cup 12' can define a cup cavity 42'. A series of inset portions 45a can be provided around the rim 30' configured to cooperatively receive a complementary series of outset portions 45b provided on liner 14'. Unless otherwise described, the acetabular cup 12' and liner 14' can be configured similar to the acetabular cup 12 and liner 14. Like features have been identified with a common reference numeral having a "prime" suffix.

[0042] With reference now to Figs. 2 and 3, the first liner 14 according to one example will be described in greater detail. The first liner 14 can include an outer cup engaging surface 70 and an articulation or internal surface 72 for articulation relative to a femoral implant 73a, 73b (Fig. 22) or a natural femoral head 73c (Fig. 22). The outer cup engaging surface 70 of the first liner 14 can also engage the inner liner engaging surface 22 of the acetabular cup 12 in an appropriate manner, such as a substantially fixed or non-moving manner. The first liner 14 can include a liner connection portion 74 around an upper rim 76. The liner connection portion 74 can include a flange 80 formed around the upper rim 76. The flange 80 can include an annular finger 82 including an annular protrusion 84 that extends in a direction generally toward the outer cup engaging surface 70 of the first liner 14. An annular channel 88 is formed on the first liner 14 generally between the flange 80, finger 82, annular protrusion 84 and the outer cup engaging surface 70. A ridge surface 90 can be provided around the annular protrusion 84. A plurality of relief notches 94 can be formed around the liner connection portion 74 of the first liner 14.

[0043] Returning to Fig. 1A, the liner 14' can have an outer cup engaging surface 70', an internal surface 72' and a liner connection portion 74'. As described above, the inset portions 45a of the acetabular cup 12', can cooperatively receive the outset portions 45b of the liner 14'. The alternating

inset and outset configuration can act as an anti-rotation feature. Unless otherwise described, the cup connection portion 32' can cooperate with the liner connection portion 74' similar to the cup connection portion 32 and liner connection portion 74.

5 **[0044]** The first liner 14 can also include an anti-rotation projection 96 extending from an apex of the first liner 14 at the outer cup engaging surface 70. The anti-rotation projection 96 can include an alternating plurality of inset and outset portions 100 and 102, respectively.

10 **[0045]** Briefly, the acetabular cup 12 can be implanted into an acetabulum 106 (Fig. 22). In one example, the apical hole 48 can be used with an implantation tool to assist in positioning the acetabular cup 12 in a selected location. Also, an apical plug or other member can be positioned in the apical hole 48, if selected. The acetabular cup 12, according to various embodiments, can also include other bores, external projections, etc., to assist in positioning
15 and fixing the acetabular cup 12 to the anatomy. Exemplary implantation tool systems include apical hole inserters, sold by Biomet Manufacturing Corp. of Warsaw, Indiana, USA. As can be appreciated, the acetabular cup 12 can also be provided in different sizes or configurations. For example, a diameter or height of the acetabular cup 12 can be altered based upon different portions that
20 articulate with the first liner 14, the size of the patient, or other appropriate considerations.

[0046] With reference now to Figs. 3-8, assembly of the first liner 14 to the acetabular cup 12 according to one example will now be described. At the outset, a surgeon can align the anti-rotation projection 96 of the first liner 14 with
25 the anti-rotation counterbore 46 of the acetabular cup 12. The inset and outset portions 100 and 102 of the anti-rotation projection 96 can cooperatively nest within complementary inset and outset portions 50 and 52 provided by the anti-rotation counterbore 46. As can be appreciated, the anti-rotation projection 96 does not necessarily need to be confined to one orientation relative to its axis.
30 Rather, the anti-rotation projection 96 can index between a plurality of available rotational positions within the anti-rotation counterbore 46.

[0047] As the surgeon advances the first liner 14 into the cup cavity 42 of the acetabular cup 12, the liner connection portion 74 is directed into engagement with the cup connection portion 32. More specifically, the finger 82 and annular protrusion 84 extending from the flange 80 of the first liner 14 is inserted into the annular groove 40 formed around the upper rim 30 of the acetabular cup 12. During advancement into the annular groove 40, the finger 82 and annular protrusion 84 of the first liner 14 flexes radially outwardly (Fig. 5) away from the inner wall 34 of the acetabular cup 12 until the annular protrusion 84 can retract (Fig. 6) into the undercut 56 of the acetabular cup 12. In one example, the relief notches 94 (Fig. 2) can facilitate outward flexing of the finger 82 and the annular protrusion 84. In the assembled position (Fig. 6), the annular protrusion 84 of the first liner 14 is nestingly received into the undercut 56 of the acetabular cup 12, such that the ridge surface 90 of the first liner 14 opposes the lip surface 58 (as best shown in Fig. 5) of the acetabular cup 12. The attachment is achieved outside of the cavity 42 with the annular protrusion 84 and annular groove 40.

[0048] In another example shown in Fig. 6A, a finger 82' has an outwardly facing annular protrusion 84' that flexes inwardly until retracting into an outwardly directed undercut 56'. A ridge surface 90' opposes lip surface 58' when assembled. Like features with the configuration shown in Fig. 6 have been identified with a common reference numeral having a "prime" suffix.

[0049] With reference to Figs. 1 and 9, the second liner 16 will now be described in greater detail. For discussion purposes, only description of the second (metal) liner 16 will be described. However, it is appreciated that the third (ceramic) liner 18 can be similarly constructed. The second liner 16 can generally include an outer cup engaging surface 120 and an internal articulating surface 122. A male taper 124 can be formed around the outer cup engaging surface 120 near an upper rim 126 of the second liner 16. A projection 128 can extend proud from an apex of the second liner 16 on the outer cup engaging surface 120. The male taper 124 can include any appropriate angle relative to a central or concentric axis of the second liner 16. The angle of the male taper 124 can be substantially identical or similar to an angle provided by the female

taper 66 of the acetabular cup 12. The tapers 124 and 66 can include selected angles, such as about 1° to about 45°. The angles can allow the male taper 124 to engage the female taper 66 in a substantially locked or connected manner, such as with a Morse taper. The interconnection of the tapers 124 and 66 can allow a fixation of the second liner 16 into the cup cavity 42 of the acetabular cup 12 at a selected time. The female taper 66 can also assist in aligning the second liner 16 during implantation of the second liner 16 into the acetabular cup 12. As shown in Figs. 3 and 9, the interconnection of the tapers 124 and 66 occurs below the plane 60 and inward of the female taper 66.

[0050] During assembly of the second liner 16 with the acetabular cup 12, a surgeon can generally align the projection 128 of the second liner 16 into the apical hole 48 of the acetabular cup 12. As can be appreciated, an outer wall surface formed by the projection 128 can be offset radially inwardly relative to the inset and outset portions 50 and 52 of the anti-rotation counterbore 46 provided in the acetabular cup 12 (see Fig. 9).

[0051] Turning now to Figs. 10-15, an acetabular prosthesis assembly constructed in accordance to another example of the present teachings is shown and generally identified at reference numeral 210. The acetabular prosthesis assembly 210 can generally include a single acetabular cup 212 that can be selectively and alternatively interconnected with a first bearing or liner 214, a second bearing or liner 216 or a third bearing or liner 218. In one example, the first liner 214 can be formed of any appropriate material, such as polymers including UHMWPE or PEEK. The second liner 216 can be formed of a substantially or relatively hard or rigid material, such as a metal material described above with respect to the second liner 16. The third liner 218 can be formed of a substantially or relative hard or rigid material, such as a ceramic material. In one example, the second and third liners 216 and 218 can have an equivalent geometry. As such, the second and third liners 216 and 218 have been denoted in the drawings simply as a single liner. As with the acetabular prosthesis assembly 10 described above, the acetabular prosthesis assembly 210 allows for pre-operative or intraoperative selection of various liners for alternatively positioning within the acetabular cup 212. In this way, the first,

second and third liners 214, 216 and 218 can each engage a common acetabular cup 212 therefore minimizing the number of required components for a procedure.

[0052] With continued reference to Figs. 10-14, the acetabular cup 212 will be described in greater detail. The acetabular cup 212 can be formed of biocompatible metallic material, such as described above with respect to the acetabular cup 12. The acetabular cup 212 can generally include a hemispherical body 220 having an inner liner engaging surface 222 and an outer bone engaging surface 224. The outer bone engaging surface 224 can have a porous metal coating 226. The acetabular cup 212 can include an upper rim 230 that extends between the inner liner engaging surface 222 and the outer bone engaging surface 224. The upper rim 230 can have an upper face 231 including a cup connection portion 232. The cup connection portion 232 can include a plurality of grooves 238 formed in a radial direction into the upper face 231 of the upper rim 230. The upper rim 230 can also include a corresponding series of converging ramp surfaces 239 (Fig. 13) and cut-out portions 240 that collectively make up each of the grooves 238. The inner liner engaging surface 222 of the acetabular cup 212 can define a cup cavity 242 (Fig. 10) that extends below a plane 243 (Fig. 15) that is below the cup connection portion 232. The acetabular cup 212 can include an apical portion 244 having an apical hole 248 that passes entirely through the acetabular cup 212.

[0053] The first liner 214 according to one example will be described in greater detail. The first liner 214 can include an outer cup engaging surface 270 and an articulation or internal surface 272 for articulation relative to a femoral implant or a natural femoral head. The outer cup engaging surface 270 of the first liner 214 can also engage the inner liner engaging surface 222 of the acetabular cup 212 in an appropriate manner, such as a substantially fixed or non-moving manner. The first liner 214 can include a liner connection portion 274 around an upper rim 276. The liner connection portion 274 can include a plurality of radial flanges 280 each having a finger 282. A distal end of each finger 282 can include oppositely extending protrusion portions 284.

[0054] The acetabular cup 212 can be implanted into an acetabulum, such as described above with respect to the acetabular cup 12. Assembly of the first liner 214 to the acetabular cup 212 according to one example will now be described. At the outset, a surgeon can align flanges 280 of the liner connection portion 274 with complementary grooves 238 of the cup connection portion 232 at an area generally outside of the cup cavity 242 and provided on the upper face 231 of the acetabular cup 212. As can be appreciated, the first liner 214 can assume a number of radial locations around its longitudinal axis whereupon the flanges 280 are aligned for receipt into any complementary series of grooves 238. While the exemplary first liner 214 illustrates four flanges 280 and the acetabular cup 12 provides twelve grooves 238, the actual number of the flanges 280 and the grooves 238 is merely exemplary and other combinations may be implemented. Once the respective flanges 280 are aligned for receipt into identified grooves 238 (Fig. 13), the first liner 214 can be further advanced into the cup cavity 242. In one example, the protrusion portions 284 of the flanges 280 can ride along respective ramp surfaces 239 to further guide the respective fingers 282 into the grooves 238. During advancement into the respective grooves 238, the protrusion portions 284 can flex radially inwardly toward each other until the protrusion portions 284 can retract (Fig. 14) into the cutout portions 240 of the grooves 238. In the assembled position, the fingers 282 are confined for rotational movement around the upper rim 230 of the acetabular cup 212 by the respective grooves 238. Therefore, the interaction between the fingers 282 and the grooves 238 can provide an anti-rotation feature 290 (Fig. 11).

[0055] With reference to Figs. 10 and 15, the second liner 216 and third liner 218 can be constructed similarly to the second and third liners 16 and 18 described above. The second liner 216 can generally include an outer cup engaging surface 294 and an internal articulating surface 296. A male taper 297 can be formed near an upper rim 298 of the second liner 216. A projection 299 can extend proud from an apex of the second liner 216 on the outer cup engaging surface 294. The male taper 297 can include any appropriate angle relative to a central or concentric axis of the second liner 216. The angle of the

male taper 297 can be substantially identical or similar to an angle provided by a female taper 266 of the acetabular cup 212. The tapers 297 and 266 can include selected angles, such as about 1° to about 45°. The angles can allow the male taper 297 to engage the female taper 266 in a substantially locked or connected manner, such as with a Morse taper. The interconnection of the tapers 297 and 266 can allow a fixation of the second liner 216 into the cup cavity 242 of the acetabular cup 212 at a selected time.

[0056] During assembly of the second liner 216 with the acetabular cup 212, a surgeon can generally align the projection 299 of the second liner 216 into the apical hole 248 of the acetabular cup 212.

[0057] Turning now to Figs. 16-22, an acetabular prosthesis assembly constructed in accordance to another example of the present teachings is shown and generally identified at reference numeral 310. The acetabular prosthesis assembly 310 can generally include a single acetabular cup 312 that can be selectively and alternatively interconnected with a first bearing or liner 314, a second bearing or liner 316 or a third bearing or liner 318. In one example, the first liner 314 can be formed of any appropriate material, such as polymers, including UHMWPE or PEEK. The second liner 316 can be formed of a substantially or relatively hard or rigid material, such as a metal material described above with respect to the second liner 16. The third liner 318 can be formed of a substantially or relatively hard or rigid material, such as a ceramic material. In one example, the second and third liners 316 and 318 can have an equivalent geometry. As such, the second and third liners 316 and 318 have been denoted in the drawings simply as a single liner. As with the acetabular prosthesis assembly 10 described above, the acetabular prosthesis assembly 10 allows for preoperative or intraoperative selection of various liners for alternatively positioning within the acetabular cup 312. In this way, the first, second and third liners 314, 316 and 318 can each engage a common acetabular cup 312 therefore minimizing the number of required components for a procedure.

[0058] With specific reference to Figs. 16-19, the acetabular cup 312 will be described in greater detail. The acetabular cup 312 can be formed of

biocompatible metallic material, such as described above with respect to the acetabular cup 12. The acetabular cup 312 can generally include a hemispherical body 320 having an inner liner engaging surface 322 and an outer bone engaging surface 324. The outer bone engaging surface 324 can have a porous metal coating 326. The acetabular cup 312 can include an upper rim 330 that extends between the inner liner engaging surface 322 and the outer bone engaging surface 324. Positioned near the upper rim 330 and above a plane 331 (Fig. 22) can be a connection area 332 including a groove 334. The groove 334 can receive or interconnect with a locking or connecting member 336. The connecting member 336 can cooperate with a locking groove 338 formed around the first liner 314 to assist in interconnecting the first liner 314 with the acetabular cup 312. The respective grooves 334 and 338 can be sized in any appropriate manner to receive or cooperate with the connecting member 336, such as in the Ringloc® Acetabular Implant sold by Biomet Manufacturing Corp. of Warsaw, Indiana, USA.

[0059] The acetabular cup 312 can further include anti-rotation projections 340 and associated depressions 342 to assist in minimizing or eliminating rotation of the first liner 314 relative to the acetabular cup 312 after implantation. Also formed around the upper rim 330 can be a first and a second notch 343a and 343b (Fig. 19) configured to accept portions of the connecting member 336 as will be described herein. The inner liner engaging surface 322 of the acetabular cup 312 can define a cup cavity 344 that starts below the connection area 332 and below the plane 331. The acetabular cup 312 can include an apical portion 346 having an apical hole 348 that passes entirely through the acetabular cup 312.

[0060] With reference now to Figs. 16, 21 and 22, the first liner 314 according to one example will be described in greater detail. The first liner 314 can include an outer cup engaging surface 370 and an articulation or internal surface 372 for articulation relative to a femoral implant or a natural femoral head. The outer cup engaging surface 370 of the first liner 314 can also engage the inner liner engaging surface 322 of the acetabular cup 312 in an appropriate manner (Fig. 22), such as a substantially fixed or non-moving manner. The first

liner 314 can include a liner connection portion 374 formed around an upper rim 376. The liner connection portion 374 can include a series of alternating anti-rotation tabs 378 and associated depressions 380 formed around the upper rim 376. A male taper 382 can be formed near the upper rim 376, such as at an area below the groove 338.

[0061] The connecting member 336 can generally include a ring-like body 390 having a pair of fingers 392 extending upright from a plane of the body 390. The fingers 392 can be located at a slot 394 formed in the body 390. Diametrically opposing the fingers 392 can be an outset tab 396. In one example, the connecting member 336 can be formed of PEEK or similar material. In one example, the connecting member 336 can be injection molded allowing for improved customization during a manufacturing process. By providing an injection molded connecting member 336, such as formed of PEEK, a cost savings can be realized over a traditional locking member that may be manufactured from metallic materials. One benefit of using a connecting member 336 formed of PEEK is that it will not allow any fretting corrosion when in contact with a liner made of metallic material (such as the second liner 316 as will be later described). In addition, a connecting member 336 being formed of PEEK can be easily cut or ruptured with a surgical instrument allowing for easy liner removal, such as during a revision procedure. For example, as shown in Fig. 21, a surgeon can gain access to the connecting member 336, such as at the first notch 343a and break or separate the connecting member 336 with a tool.

[0062] The second liner 316 and third liner 318 can be constructed similarly to the second and third liners 16 and 18 described above. The second liner 316 can generally include an outer cup engaging surface 404 and an internal articulating surface 406. A male taper 407 can be formed near an upper rim 408 of the second liner 316. A groove 410 can be formed proximate to the upper rim 408. The male taper 407 can include any appropriate angle relative to a central or concentric axis of the second liner 316. As with the other male tapers described herein, the male taper 407 can be substantially identical or similar to an angle provided by a female taper 366 of the acetabular cup 312. A

projection 418 can be formed at an apex of the second liner 316 that extends proud from the outer cup engaging surface 404. The projection 418 can generally be received within the apical hole 348 provided on the acetabular cup 312 in an assembled position for alignment purposes.

5 **[0063]** The acetabular cup 312 can be implanted into an acetabulum, such as described above with respect to the acetabular cup 12. Assembly of the first liner 314 to the acetabular cup 312 according to one example will now be described. At the outset, a surgeon can align the connecting member 336 for receipt into the groove 334 of the acetabular cup 312. In one example of
10 installing the connecting member 336 into the groove 334 of the acetabular cup 312, the outset tab 396 can be positioned into the notch 343a while the body 390 of the connecting member 336 is compressed and manipulated into the groove 334.

[0064] In another method of assembly, the connecting member 336
15 can be first installed onto the groove 338 of the first liner 314 or the groove 410 of the second liner 316. In either scenario, a surgeon can press the respective liners 314, 316 or 318 into the acetabular cup 312 and the connecting member 336 can compress or expand to allow it to pass over a portion of the acetabular cup 312 or the respective liners 314, 316 or 318 and expand into the respective
20 grooves 334 and 338. The connecting member 336 is shown in two pieces in Fig. 17 to illustrate how it can either first be engaged to the acetabular cup 312 or to the respective liner (the second liner 316 shown). It is appreciated however that the connecting member 336 is one-piece. The connecting member 336 includes a width that is great enough to engage both of the groove 334 in the
25 acetabular cup 12 and the groove 338 in the first liner 314 (and the groove 410 in the second and third liners 316, 318). Therefore, the connecting member 336 can fixedly hold the respective liners 314, 316 and 318 relative to the acetabular cup 312, at least in an axial position. When assembling the first liner 314, the anti-rotation projections 340 of the acetabular cup 312 can locate within selected
30 depressions 380 formed around the upper rim 376 of the first liner 314. It is appreciated that while six anti-rotation projections 340 are illustrated around the rim 330 of the acetabular cup 312 and twelve depressions 380 are illustrated

around the upper rim 376 of the first liner 314, the quantity of these features is merely exemplary and other configurations may be used.

[0065] The foregoing description of the embodiments has been provided for purposes of illustration and description. It is not intended to be
5 exhaustive or to limit the disclosure. Individual elements or features of a particular embodiment are generally not limited to that particular embodiment, but, where applicable, are interchangeable and can be used in a selected embodiment, even if not specifically shown or described. The same may also be
varied in many ways. Such variations are not to be regarded as a departure from
10 the disclosure, and all such modifications are intended to be included within the scope of the disclosure.

CLAIMS

What is claimed is:

5

1. An acetabular prosthesis assembly comprising:

an acetabular cup having an outer surface, an inner surface and an upper rim extending between the outer surface and the inner surface, the acetabular cup having a cup connection portion including a groove formed on an upper face of the upper rim; and

10

a first liner having an outer cup engaging surface and a liner connection portion that extends from a flange of the first liner, the liner connection portion having a finger that is received by the groove that selectively couples the liner connection portion with the cup connection portion in an assembled position.

15

2. The acetabular prosthesis assembly of claim 1 wherein the cup connection portion is collectively formed by an inner wall and an outer wall offset by the groove, the groove extending annularly around the upper rim.

20

3. The acetabular prosthesis of claim 2 wherein the inner and outer walls are generally parallel to an axis through an apex of the acetabular cup.

4. The acetabular prosthesis assembly of claim 2 wherein an undercut is formed in the groove on one of the inner and outer walls.

25

5. The acetabular prosthesis assembly of claim 4 wherein the first liner includes a protrusion extending from the finger that nests in the undercut of the acetabular cup in the assembled position.

30

6. The acetabular prosthesis assembly of claim 5 wherein the cup connection portion and liner connection portion include a plurality of alternating inset and outset portions that cooperatively mate in the assembled position.

5 7. The acetabular prosthesis assembly of claim 2 wherein the acetabular cup further comprises an anti-rotation counterbore defined by the inner liner engaging surface and wherein the first liner includes an anti-rotation projection extending from the outer cup engaging surface that cooperatively locates at the anti-rotation counterbore of the acetabular cup in the assembled
10 position.

8. The acetabular prosthesis assembly of claim 1 wherein the cup connection portion further comprises a plurality of grooves formed radially on the upper face of the upper rim.

15 9. The acetabular prosthesis assembly of claim 8 wherein the liner connection portion further comprises a plurality of radial flanges each having a finger that selectively mates with selected grooves of the cup connection portion in an assembled position.

20 10. The acetabular prosthesis assembly of claim 9 wherein each of the fingers have extending protrusion portions that selectively locate within cutout portions formed on the upper rim at the plurality of grooves.

25 11. The acetabular prosthesis assembly of claim 1, wherein the first liner is formed of polyethylene.

12. The acetabular prosthesis assembly of claim 1, further comprising:
a second liner formed of metal, the second liner having a male tapered portion that selectively engages a complementary female tapered
30 portion formed on the inner liner engaging surface of the acetabular cup in an assembled position; and

a third liner formed of ceramic and having a male tapered portion that selectively engages the female tapered portion on the inner liner engaging surface of the acetabular cup in an assembled position;

5 wherein the acetabular cup selectively and alternatively mates with any of the first, second or third liners.

13. An acetabular prosthesis assembly comprising:

an acetabular cup having an outer bone engaging surface, an inner liner engaging surface and a cup connection portion formed at an upper rim, the
10 cup connection portion collectively formed by an inner wall and an outer wall offset by an annular groove on the upper rim, wherein a portion of the inner liner engaging surface is common to the inner wall and a portion of the outer bone engaging surface is common to the outer wall; and

a first liner having an outer cup engaging surface and a liner
15 connection portion that extends from a flange of the first liner, the liner connection portion having an annular finger that is received by the annular groove of the acetabular cup that selectively couples the liner connection portion with the cup connection portion in an assembled position.

20 14. The acetabular prosthesis assembly of claim 13 wherein the acetabular cup further comprises an anti-rotation counterbore defined by the inner liner engaging surface.

25 15. The acetabular prosthesis assembly of claim 14 wherein the acetabular cup further comprises a threaded bore located within the anti-rotation counterbore that passes entirely through the acetabular cup.

30 16. The acetabular prosthesis assembly of claim 14 wherein the anti-rotation counterbore includes a series of alternating inset and outset portions.

17. The acetabular prosthesis assembly of claim 14 wherein the first liner includes an anti-rotation projection extending from the outer cup engaging

surface that cooperatively locates at the anti-rotation counterbore of the acetabular cup in the assembled position.

18. The acetabular prosthesis assembly of claim 17 wherein the anti-rotation projection defines a series of inset and outset portions that cooperatively mate with corresponding inset and outset portions of the acetabular cup in the assembled position.

19. The acetabular prosthesis assembly of claim 13 wherein the inner liner engaging surface defines a cup cavity and wherein the cup connection portion is formed outside of the cup cavity.

20. The acetabular prosthesis assembly of claim 13 wherein the inner wall includes an undercut formed from the annular groove.

21. The acetabular prosthesis assembly of claim 20 wherein the undercut is formed into one of the inner wall or the outer wall.

22. The acetabular prosthesis assembly of claim 20 wherein the first liner includes a protrusion extending from the annular finger that nests in the undercut of the acetabular cup in the assembled position.

23. The acetabular prosthesis assembly of claim 22 wherein the annular finger is flexible such that the annular finger flexes radially outwardly during advancement of the liner around the inner wall until the protrusion reaches the undercut of the acetabular cup in the assembled position.

24. The acetabular prosthesis assembly of claim 22 wherein the annular finger includes at least one relief notch formed therein.

25. The acetabular prosthesis assembly of claim 13, wherein the first liner is formed of polyethylene.

26. The acetabular prosthesis assembly of claim 13, further comprising:

a second liner formed of cobalt-chromium, the second liner having a male tapered portion that selectively engages a complementary female tapered portion formed on the inner liner engaging surface of the acetabular cup in an assembled position; and

a third liner formed of ceramic and having a male tapered portion that selectively engages the female tapered portion on the inner liner engaging surface of the acetabular cup in an assembled position;

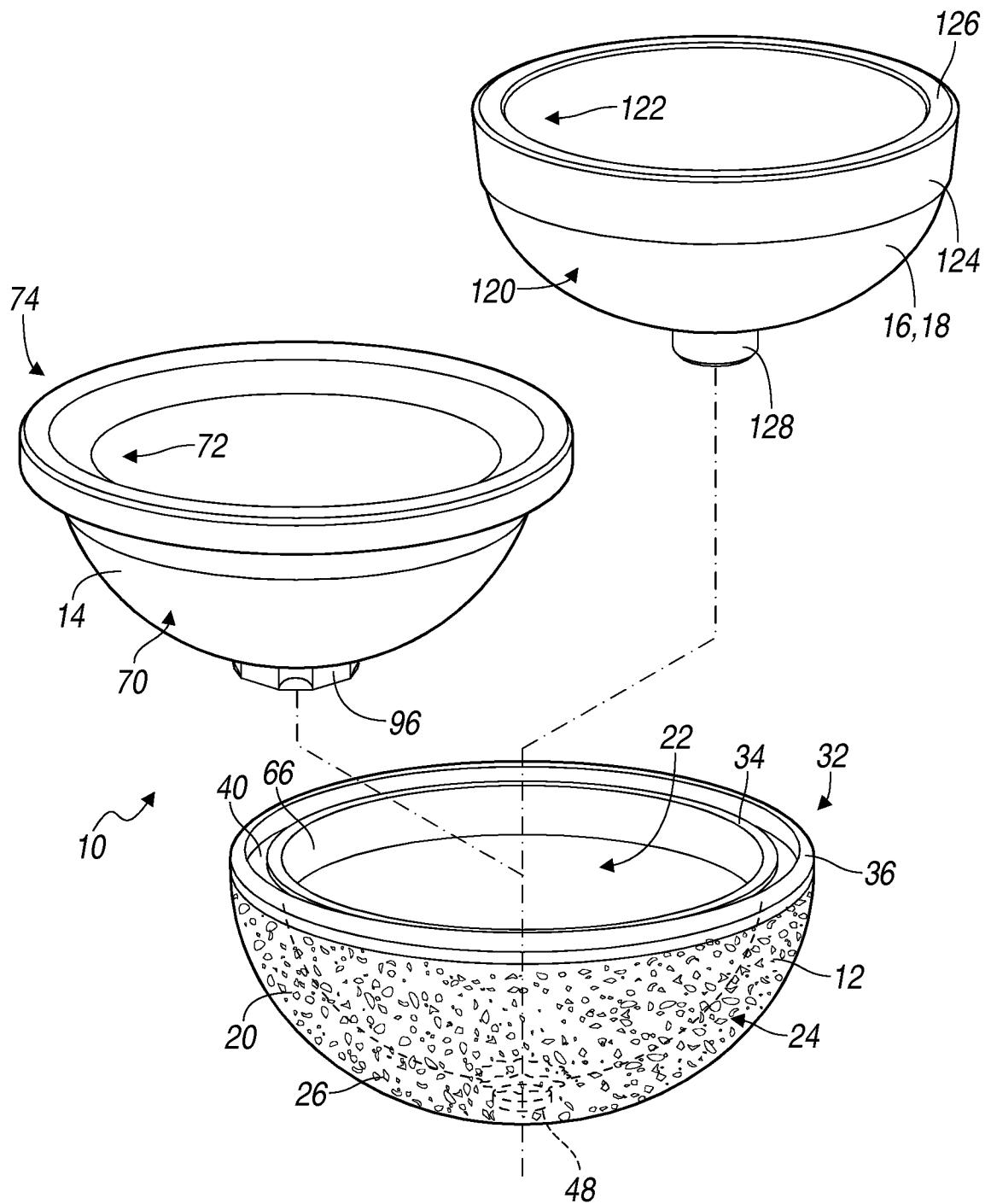
wherein the acetabular cup selectively and alternatively mates with any of the first, second or third liners.

27. An acetabular prosthesis assembly comprising:

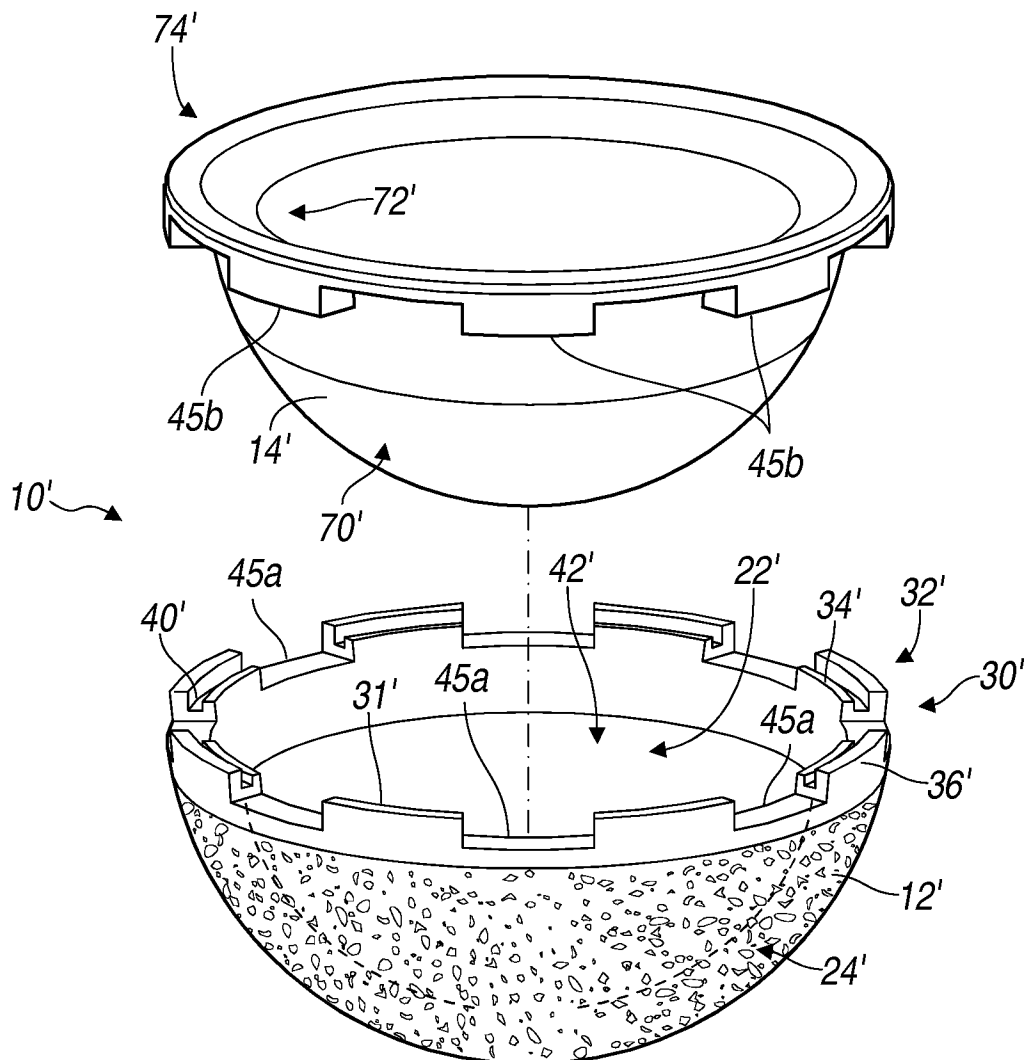
an acetabular cup having an outer bone engaging surface, an inner liner engaging surface and an upper rim extending between the outer bone engaging surface and the inner liner engaging surface, the acetabular cup having a cup connection portion including an annular groove formed between inner and outer walls on an upper face of the upper rim, one of the inner and outer walls having an undercut formed from the groove; and

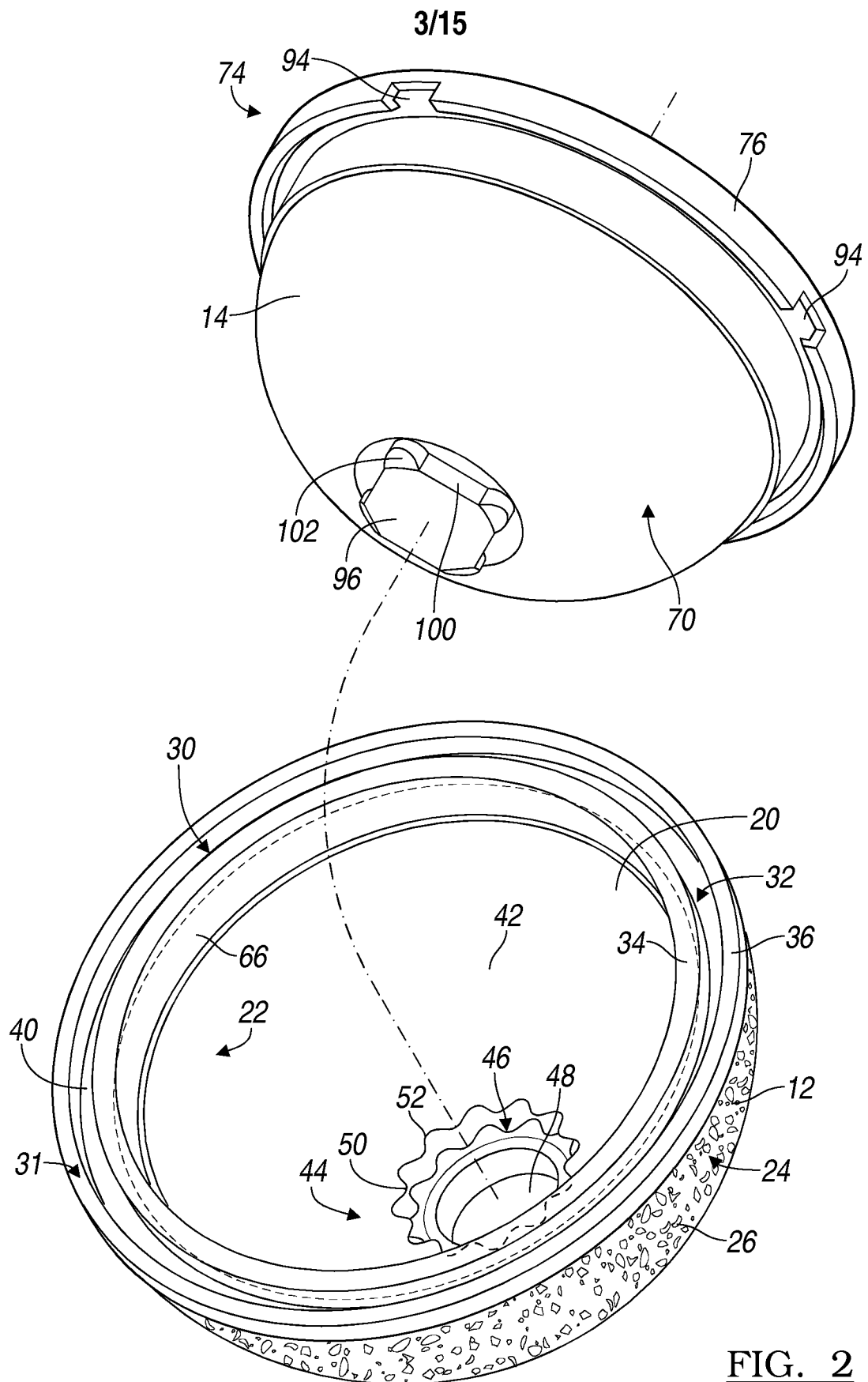
a liner having an outer cup engaging surface and a liner connection portion including a protrusion extending from a finger that extends from a flange of the first liner, the finger being received by the groove formed on the upper face of the acetabular cup whereby the protrusion locates beneath the undercut and selectively couples the liner connection portion with the cup connection portion in an assembled position.

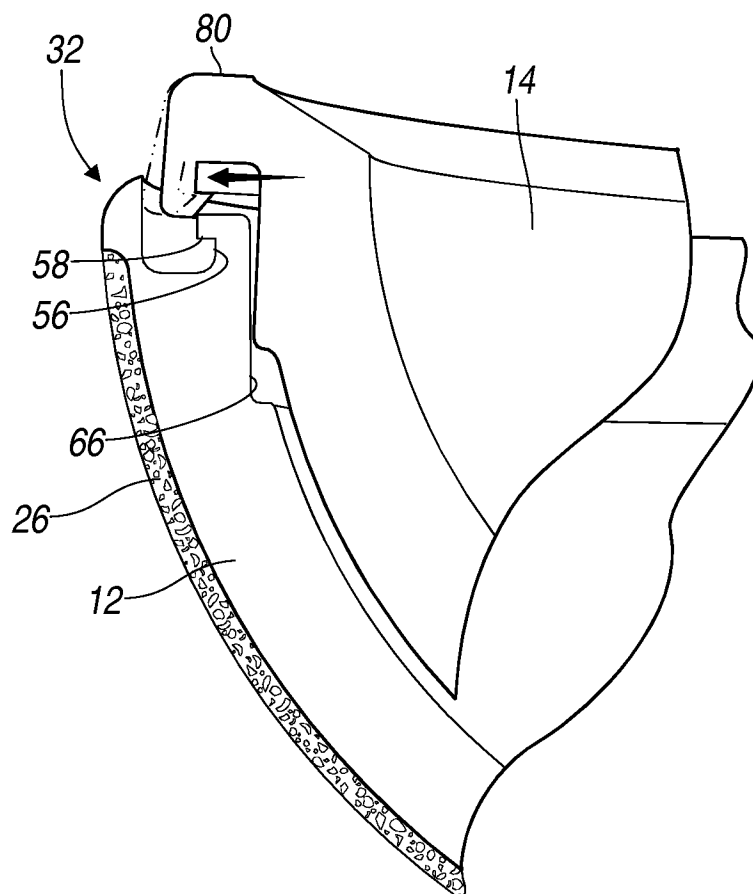
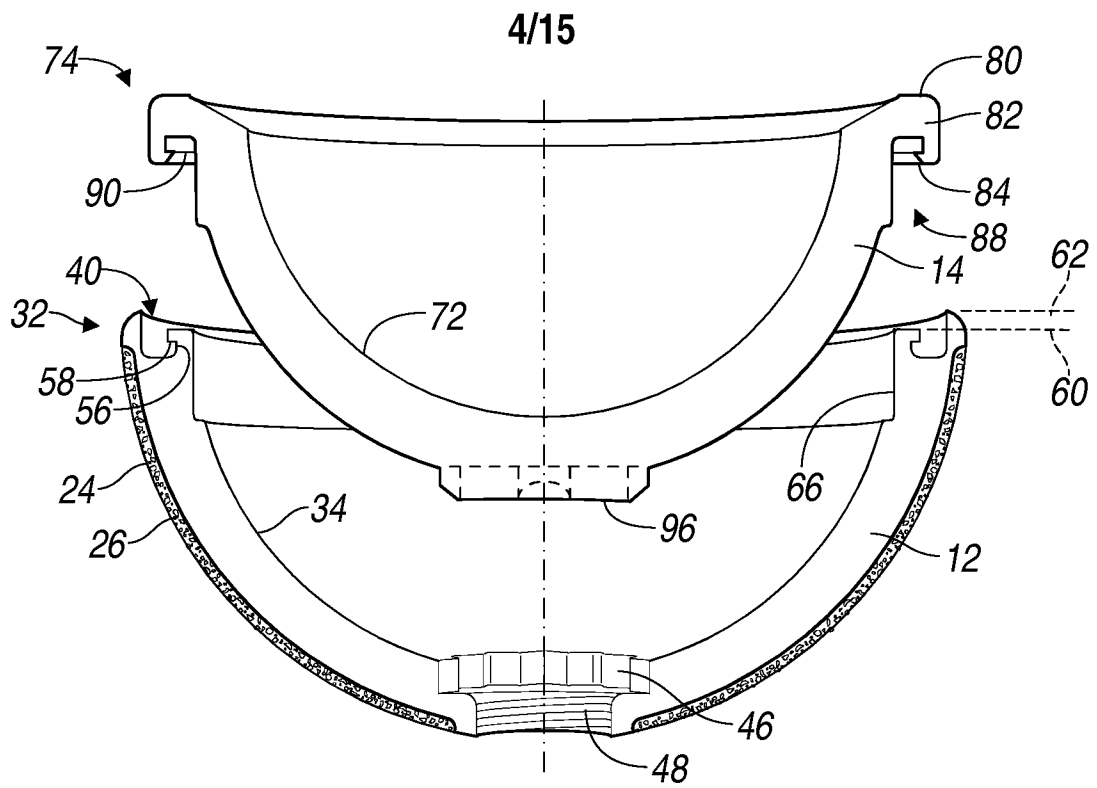
1/15

FIG. 1

2/15

FIG. 1A





5/15

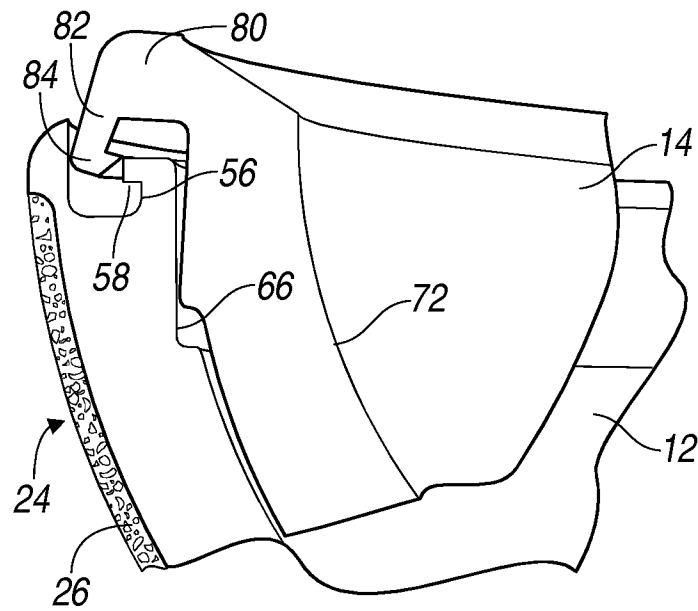


FIG. 5

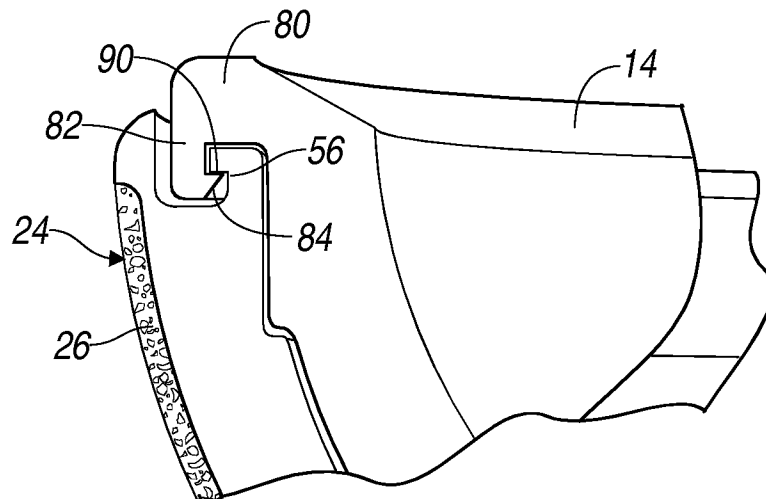


FIG. 6

6/15

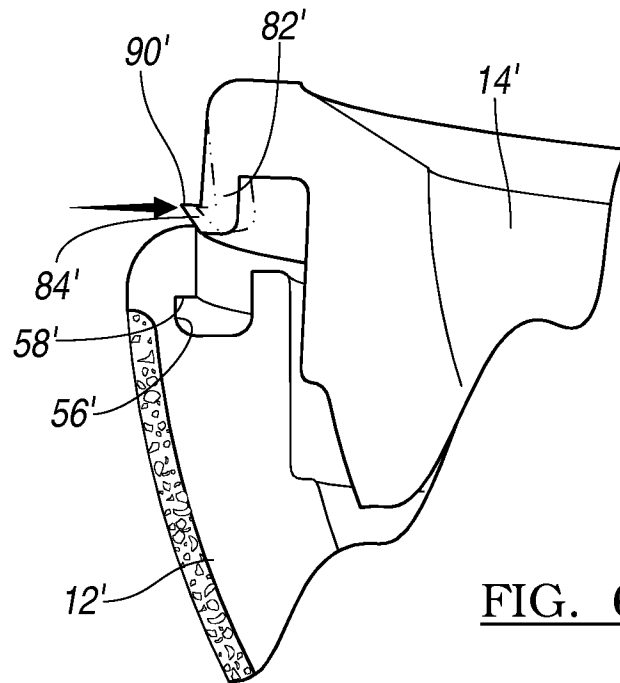


FIG. 6A

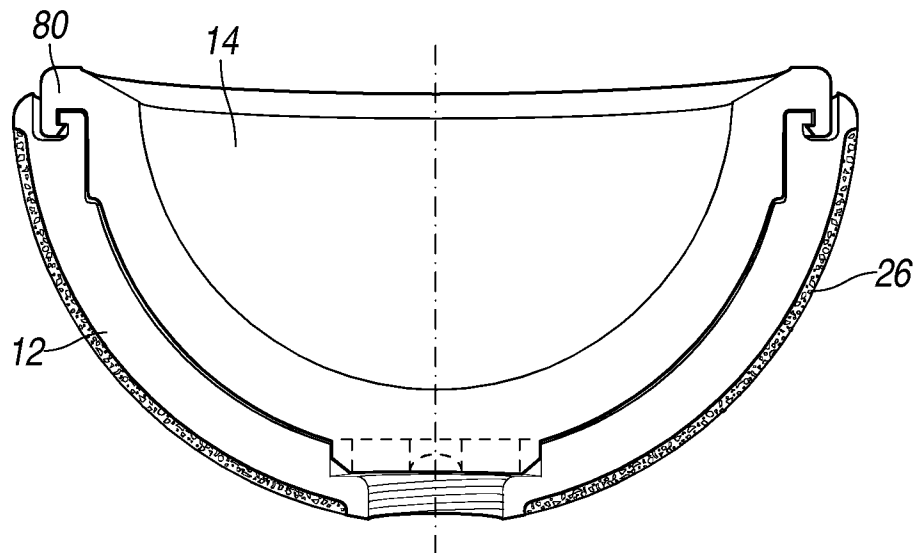


FIG. 7

7/15

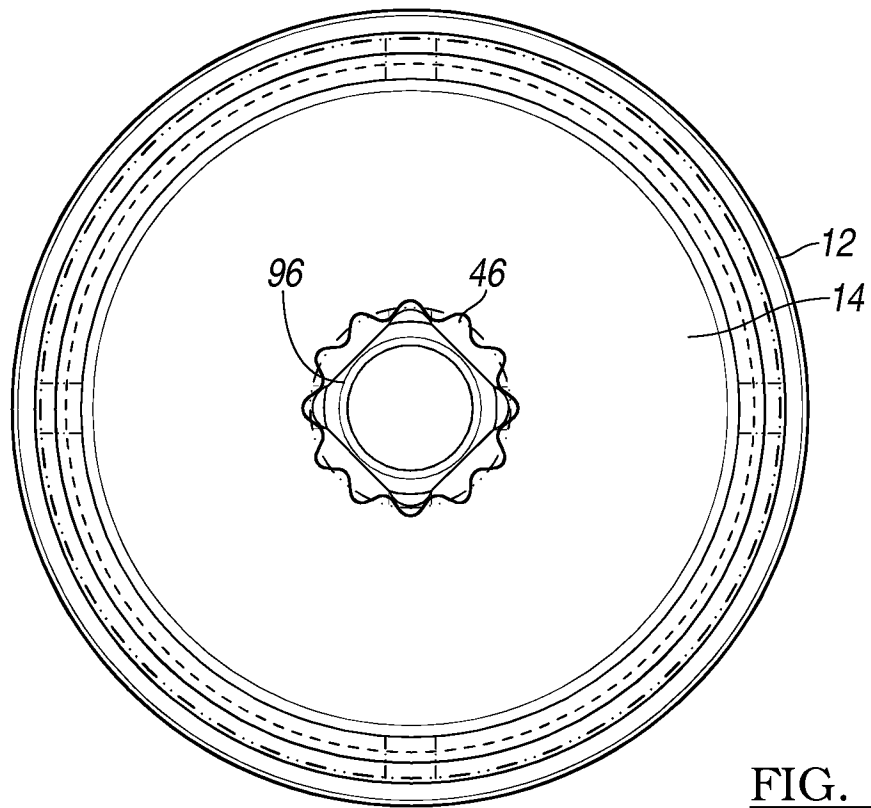


FIG. 8

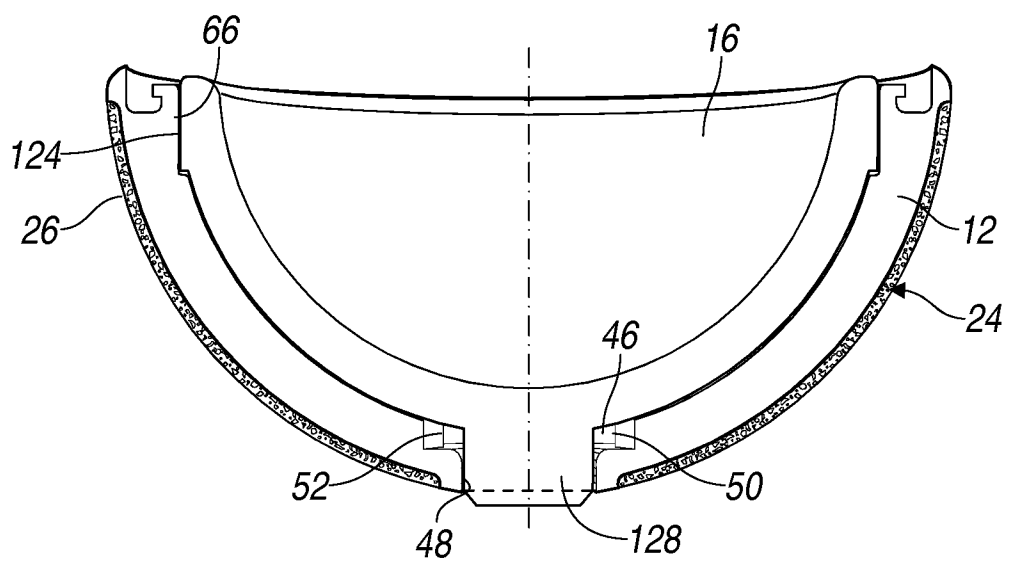
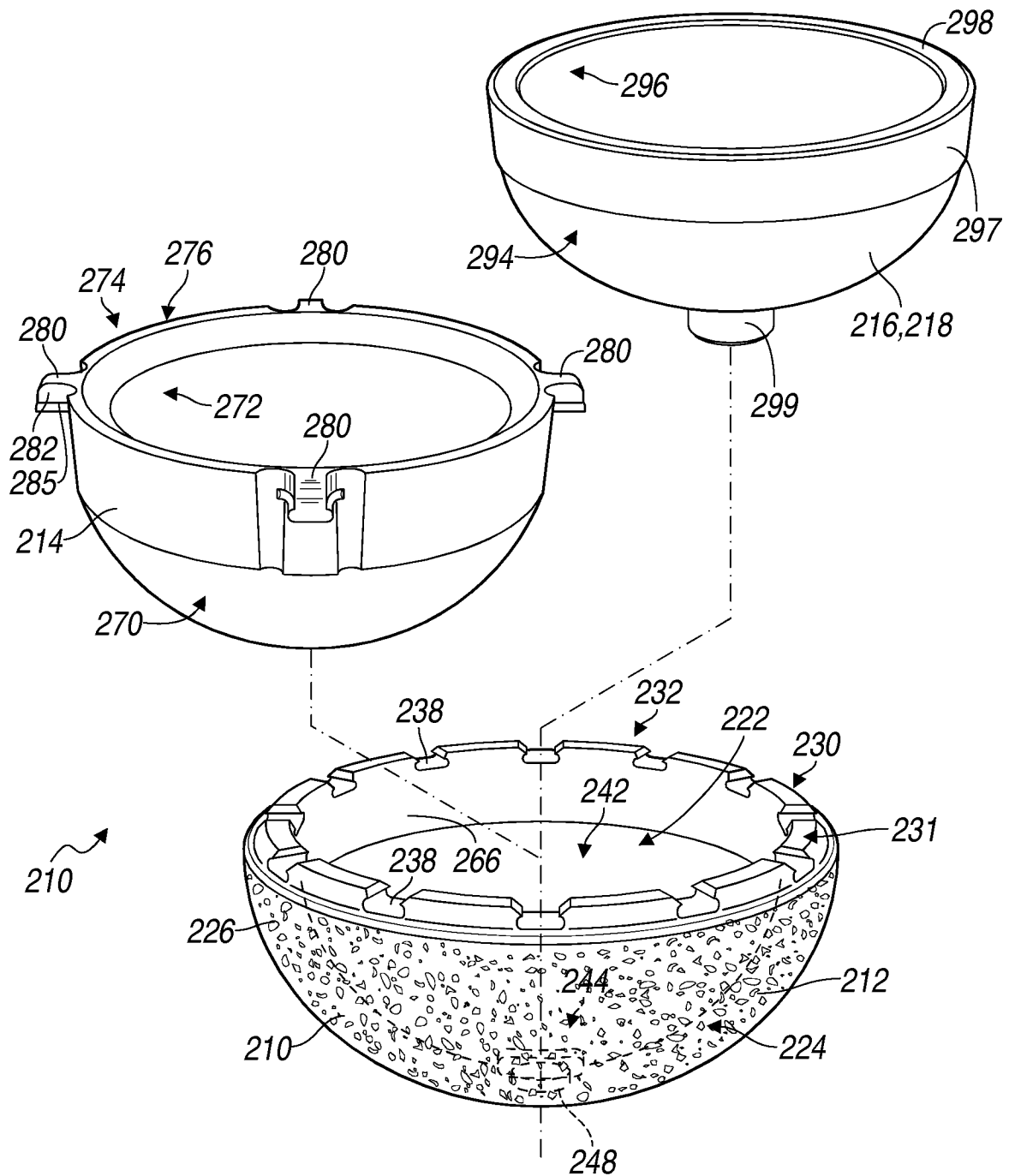
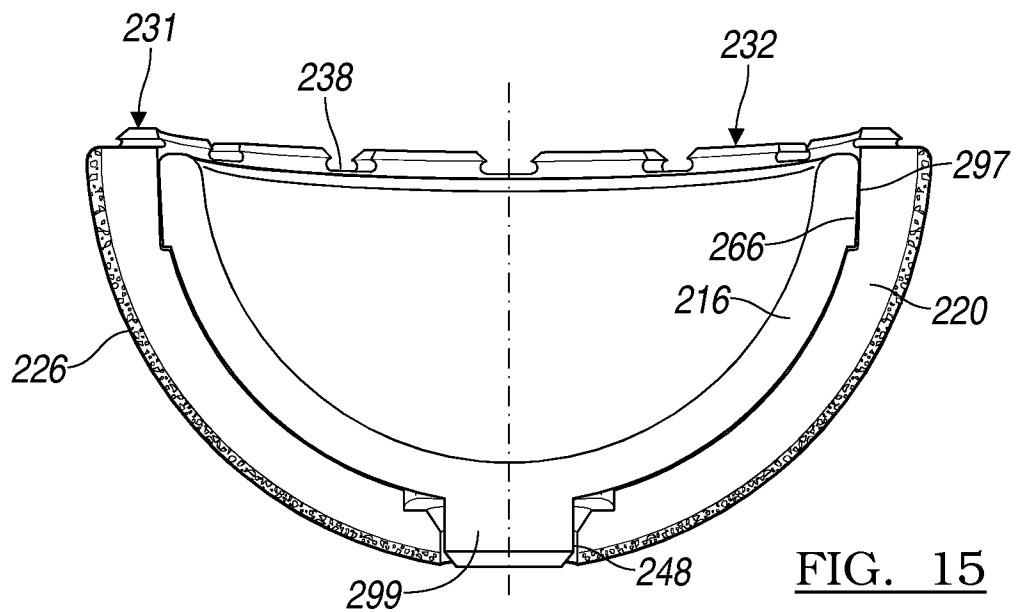
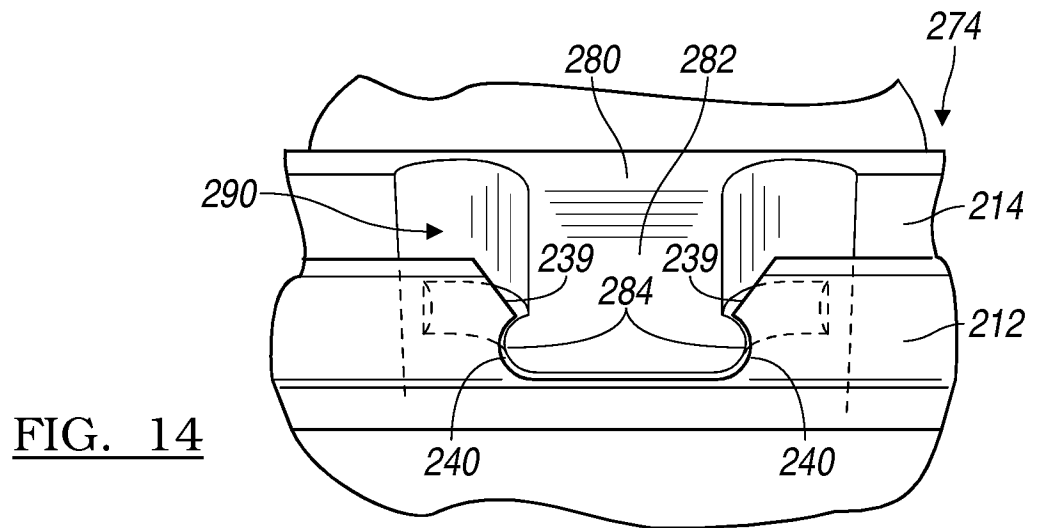
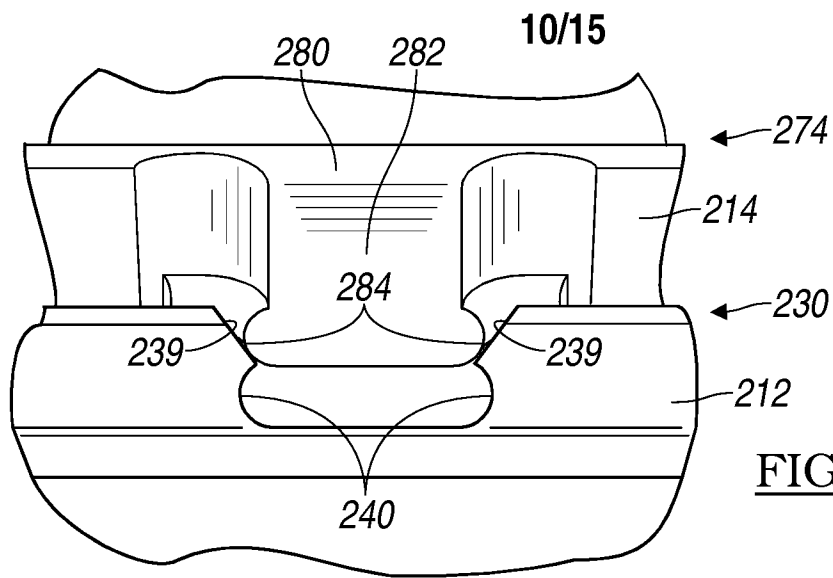
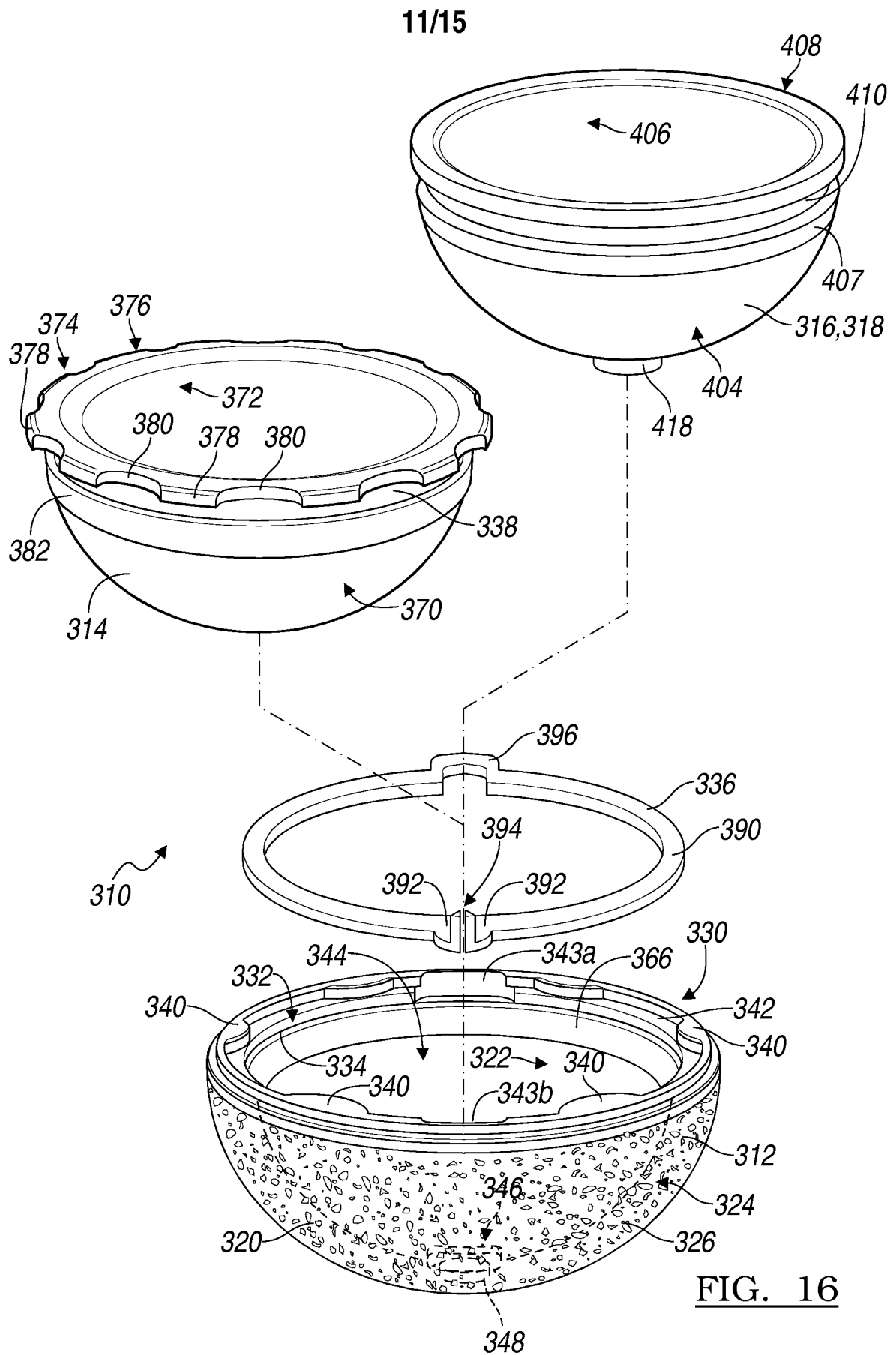


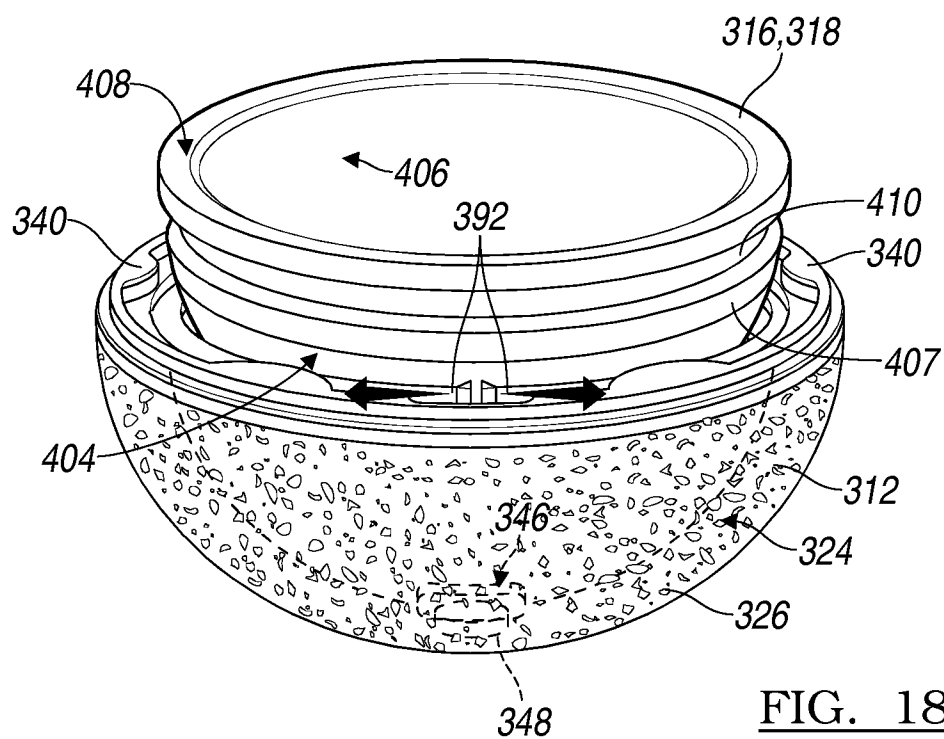
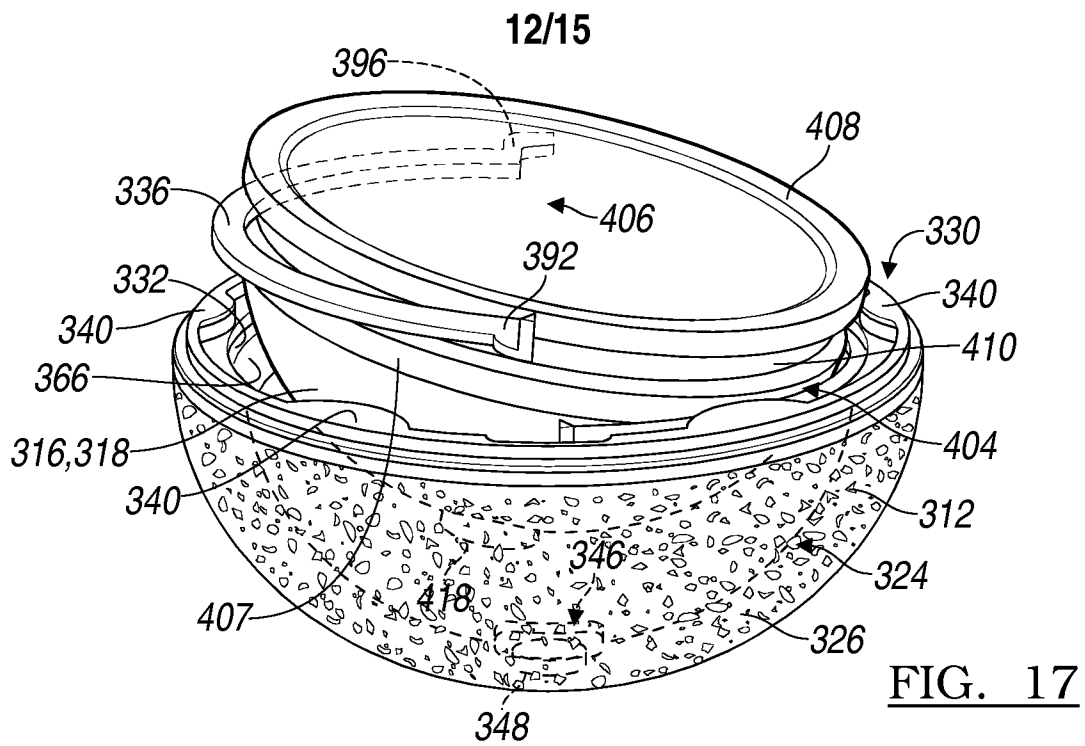
FIG. 9

8/15

FIG. 10







13/15

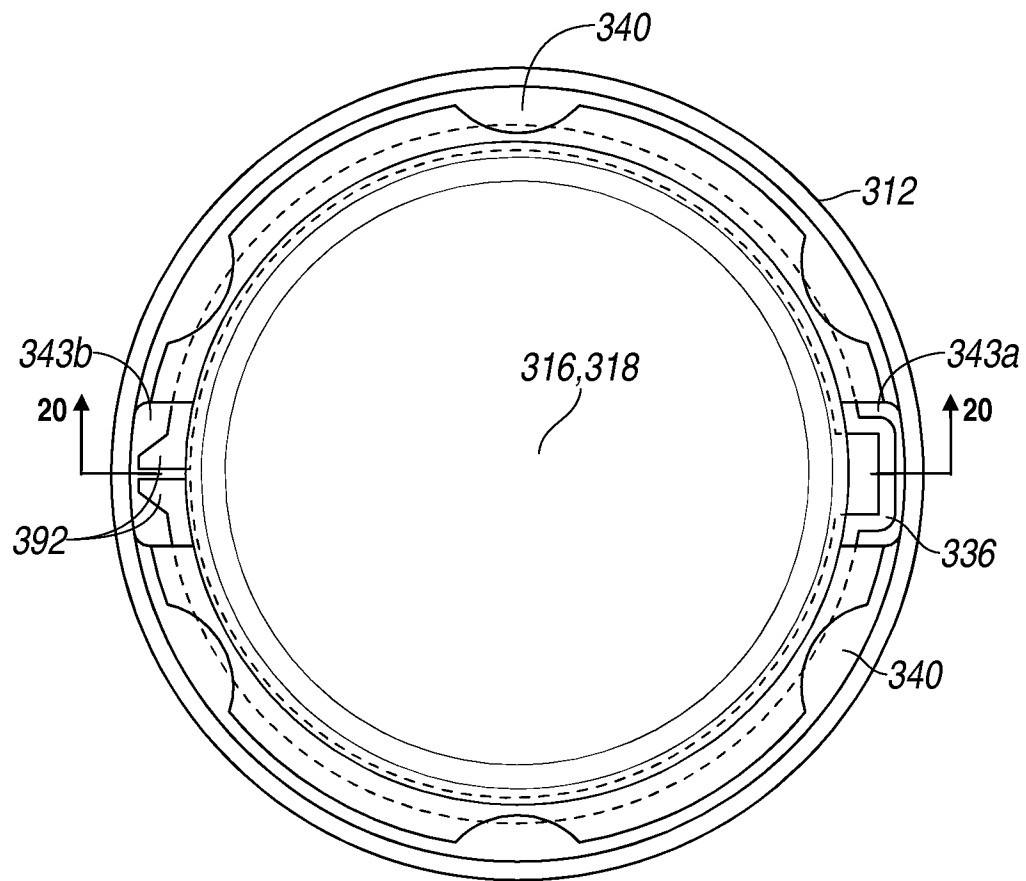


FIG. 19

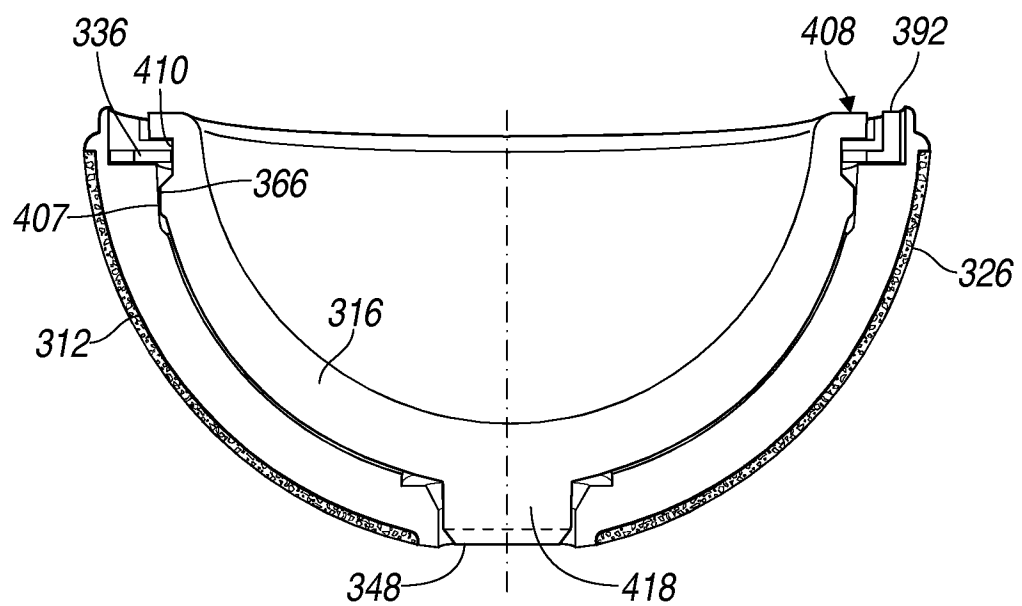


FIG. 20

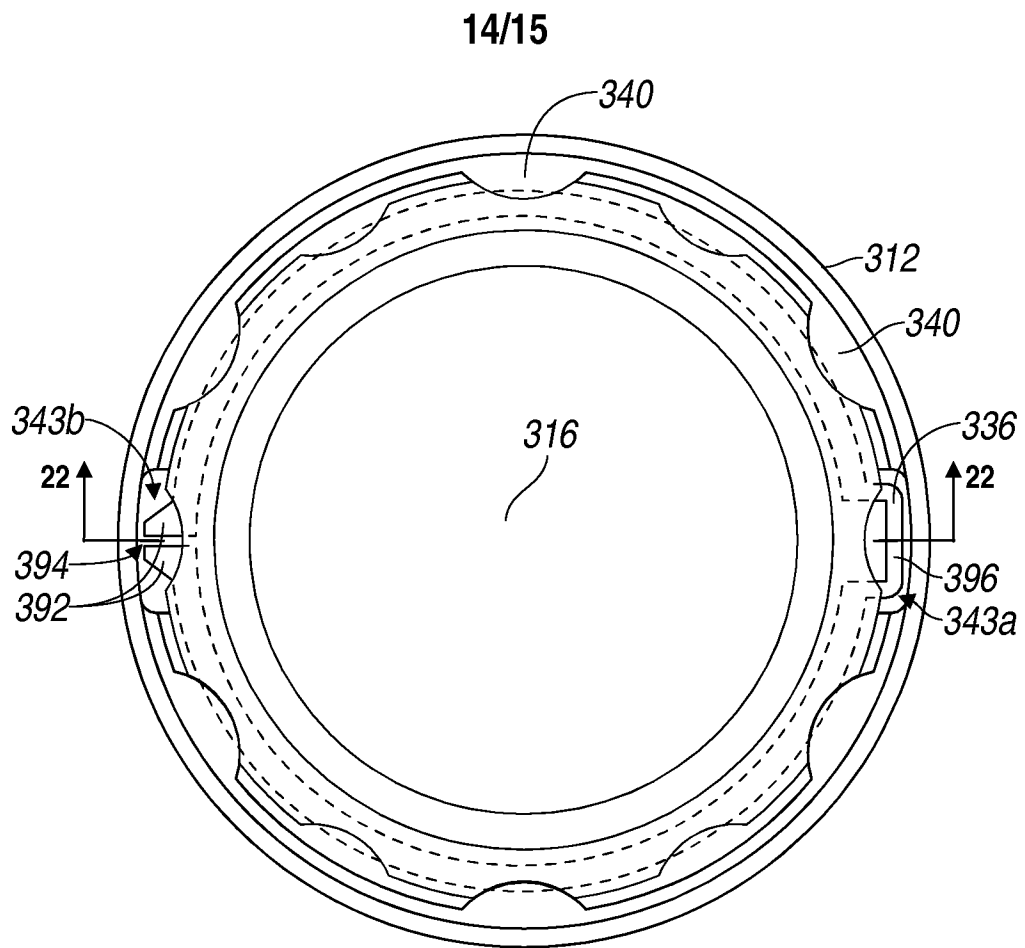


FIG. 21

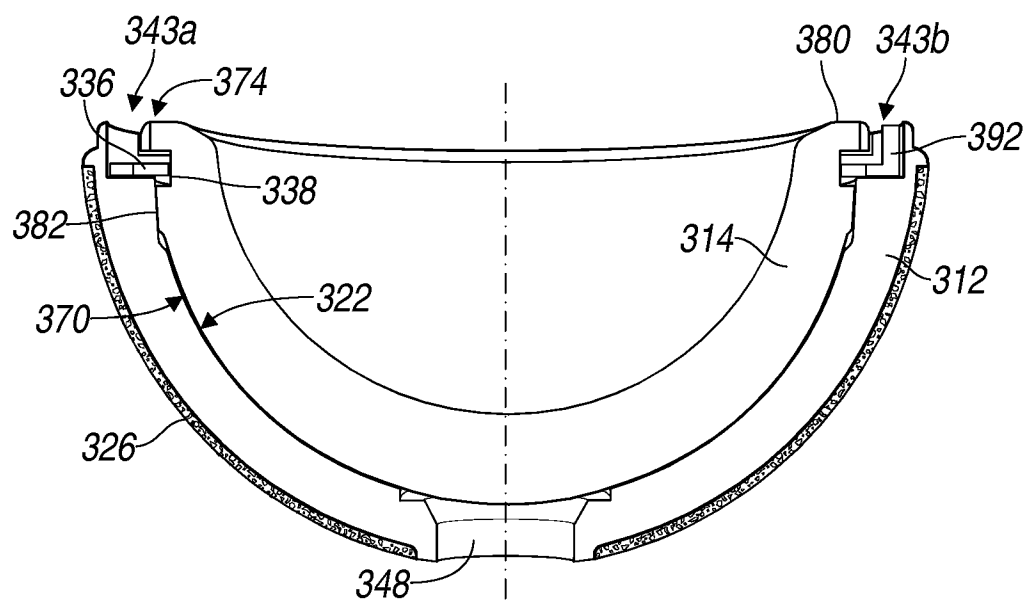


FIG. 22

15/15

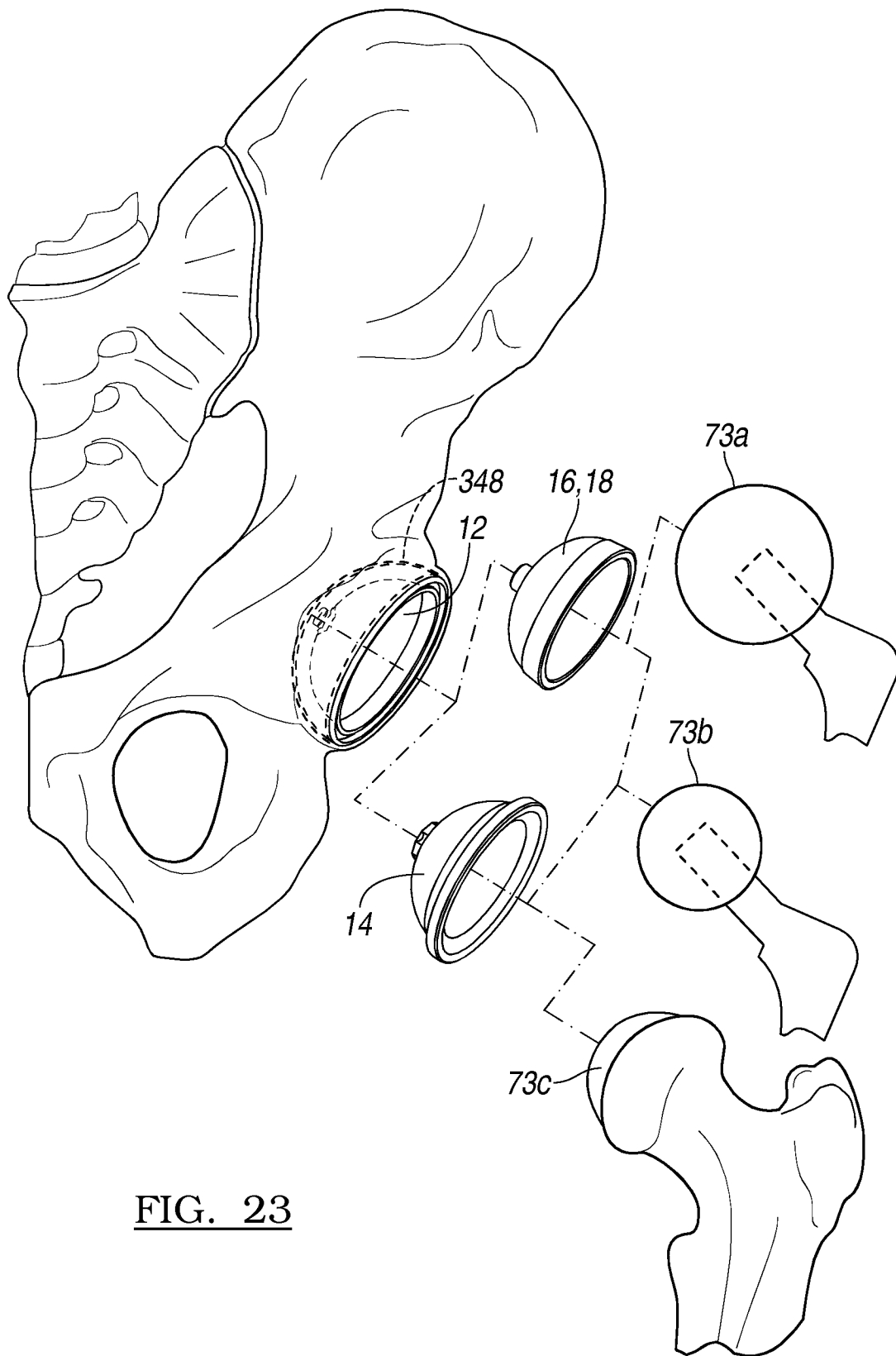


FIG. 23

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2010/041826

A. CLASSIFICATION OF SUBJECT MATTER

INV. A61F2/34

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61F

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 668 923 A1 (TECH AVANCEES SARL [FR]) 15 May 1992 (1992-05-15)	1,6,8-11
A	figures 1-9 page 3, line 25 - page 4, line 33	2,3, 13-27
X	DE 196 20 750 C1 (CHIROPRO GMBH [DE]) 15 January 1998 (1998-01-15)	1,11
A	figures 1,2,3e,4,6,8 column 3, line 50 - line 57 column 5, line 54 - line 56 claim 7	2,4, 13-27
A	US 5 766 260 A (WHITESIDE LEO A [US]) 16 June 1998 (1998-06-16) figures 1,3,4 column 5, line 35 - line 42 column 5, line 57 - line 63	1-27
	----- -/--	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

7 October 2010

Date of mailing of the international search report

14/10/2010

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Josten, Stefan

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2010/041826

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1 336 394 A1 (LIMA LTO SPA [IT]) 20 August 2003 (2003-08-20) figures 16,17 paragraph [0036] - paragraph [0037] -----	7,17
A	US 2007/239283 A1 (BERGER RICHARD A [US] ET AL) 11 October 2007 (2007-10-11) figure 1 paragraph [0020] - paragraph [0021] -----	11,12, 25,26

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2010/041826

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2668923	A1	15-05-1992	NONE
DE 19620750	C1	15-01-1998	NONE
US 5766260	A	16-06-1998	NONE
EP 1336394	A1	20-08-2003	AT 340544 T 15-10-2006 DE 60308569 T2 09-08-2007 IT UD20020037 A1 14-08-2003 US 2003153982 A1 14-08-2003
US 2007239283	A1	11-10-2007	CA 2646109 A1 25-10-2007 EP 2010108 A1 07-01-2009 JP 2009533178 T 17-09-2009 US 2009287312 A1 19-11-2009 WO 2007121167 A1 25-10-2007