AUSTRALIA 661293

PATENTS ACT 1990

PATENT REQUEST : STANDARD PATENT

I/We being the person(s) identified below as the Applicant(s), request the grant of a patent to the person(s) identified below as the Nominated Person(s), for an invention described in the accompanying standard complete specification.

Full application details follow:

[71/70] Applicant(s)/Nominated Person(s):

Smith & Nephew Richards Inc

of

1450 Brooks Road, Memphis, Tennessee, 38116, United States of America

[54] Invention Title:

Acetabular prosthesis with anchoring pegs

[72] Name(s) of actual inventor(s):

Jeff SCHRYVER
Jeff SHEA
Dawn Michelle RYAN

[74] Address for service in Australia:

DAVIES COLLISON CAVE, Patent Attorneys, 1 Little Collins Street, Melbourne, Victoria, Australia. Attorney Code: DM

Basic Convention Application(s) Details:

[31] Application Number	[33] Country	Code	[32] Date of Application
656247	United States of America	US	14 February 1991
830243	United States of America	US	10 February 1992

DATED this THIRTEENTH day of FEBRUARY 1992

.....
a member of the firm of DAVIES COLLISON CAVE for and on behalf of the applicant(s)

M 033816 130292

AUSTRALIA

Patents Act 1990

NOTICE OF ENTITLEMENT

We Smith & Nephew Richards, Inc. the applicant/nominated person in respect of Application No. 10909/92, state the following:-

The Nominated person is entitled to the grant of the patent because the Nominated person derives title to the invention from the inventors by assignment.

The Nominated person is entitled to claim priority from the basic applications listed on the patent request because the nominated person is the assignee of the applicants in respect of the basic applications.

DATED this 23rd day of May, 1995.

(A member of the firm of Davies Collison Cave for and on behalf of the applicant)

AU9210909

(12) PATENT ABRIDGMENT (11) Document No. AU-B-10909/92
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 661293

(54) Title
ACETABULAR PROSTHESIS WITH ANCHORING PEGS

International Patent Classification(s)
(51)[5] A61F 002/34

(21) Application No. : 10909/92 (22) Application Date : 13.02.92

(30) Priority Data

(31) Number	(32) Date	(33) Country
656247	14.02.91	US UNITED STATES OF AMERICA
830243	10.02.92	US UNITED STATES OF AMERICA

(43) Publication Date : 20.08.92

(44) Publication Date of Accepted Application : 20.07.95

(71) Applicant(s)
SMITH & NEPHEW RICHARDS INC

(72) Inventor(s)
JEFF SCHRYVER; JEFF SHEA; DAWN MICHELLE RYAN

(74) Attorney or Agent
DAVIES COLLISON CAVE , 1 Little Collins Street, MELBOURNE VIC 3000

(56) Prior Art Documents
DE 3310944
FR 2210909
FR 2638963

(57) Claim

1. An acetabular cup prosthesis, comprising:

a) an acetabular cup body having an inner concave surface and an outer convex surface;

b) a plurality of openings that extend between the inner and outer surfaces along lines that converge at or near the centre of curvature of the inner concave surface, the openings forming elongated bores surrounded by a bore wall portion of the acetabular cup body;

c) the openings being positioned to define one or more drill guides so that the surgeon can drill into the underlying tissue and form surgical openings therein via one or more of the openings;

d) at least one peg member being insertable into and registering respectively with one of the openings, having a first proximate end portion which is engageable with the bore wall portion in said one of the openings and which has a centrally longitudinally extending opening in a proximate end

.../2

face thereof, and a second distal end portion adapted to extend into bone tissue; and

e) means which is engageable with the opening in the peg member to radially enlarge the proximate end portion and thereby force the proximate end portion into engagement with said bore wall portion.

661293

AUSTRALIA

PATENTS ACT 1990

COMPLETE SPECIFICATION

NAME OF APPLICANT(S):

Smith & Nephew Richards Inc

ADDRESS FOR SERVICE:

DAVIES COLLISON CAVE
Patent Attorneys
1 Little Collins Street, Melbourne, 3000.

INVENTION TITLE:

Acetabular prosthesis with anchoring pegs

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

The present invention relates to acetabular prosthetic devices and more particularly to an improved acetabular prosthesis wherein the prosthesis has a cup or shell that includes radially extending bores therethrough that can be used as drill guides by a surgeon after the acetabular cup or shell has been placed in the patient's acetabululum. Holes can be drilled surgically into the underlying bone tissue using the drill guide openings so that one or more pegs for improved anchoring can be placed into the bores and anchored into the underlying surgical openings.

There are a number of commercially available acetabular prosthetic devices that include a cup shaped body, some of which have projections extending from the outer surface of the cup-shaped body. For example, US Patent No. 3939497 describes a socket for a hip joint prosthesis which is secured to a cavity in the bone tissue by a series of radially arranged pegs which can be projected outwardly from the wall of the socket into the surrounding tissue by a central screw which also has a self-tapping thread that enters the tissue.

US Patent no. 4685923 provides a hip joint socket made from a plastics material that can be installed

without the use of bone cement or adhesive. The socket comprises a hemisphere of polyethylene. The socket may have four bores extending skewed to the equatorial plane to permit the surgeon to fix the socket in the acetabulum by means of screws or dowels temporarily or permanently. The primary anchoring is provided by two plugs or pins arranged on the outer surface of a socket. The pins may be substantially parallel to each other. The pins are inserted in bore holes drilled into the bone. The bore holes are drilled so that the pins are inserted under stress. A secondary anchor in the form of flaps are present near the actuarial plane of the socket. These flaps supplement the anchoring affect of the pins.

In US Patent No. 4792337 an acetabular cup is provided which has a metallic anchoring shell. The cup is form cement-less fixation in the acetabulum. The shell has several holes through which screws are driven into the bone. The screws have rounded heads and the holes are countersunk so that the orientation of the screws may be varied with respect to the cup and each other.

In US Patent No. 4828565 there is provided a cotyliodal component for a non-cemented hip prosthesis. The component has two parts, a titanium hemispherical

shell and a cup of polymer which is engaged into it. The shell has two zones, the first zone is covered with porous titanium capable of being invaded by a spongy bone and also has two projecting pieces. The other zone has a smooth metal surface. Two screws pass through the projecting pieces and are used to anchor the component in the acetabulum.

Another acetabular cup for cement-less fixation in the acetabulum is described in European Patent Application No. 13863 published June 8, 1990. The cup is anchored to the bone by a central pin and a number of other pins distributed over the surface of the cup. The pins have several sawtooth notches along their length. The bone may be pre-drilled to take the pins.

European Patent Application No. 169978 published May 2, 1986, describes an acetabular cup which has an outer shell embedded into the patient's pelvis. The outer shell has a frustro-conical skirt and a spherical central cap. The shell has a number of small tufts with rounded ends projecting from its surface. The tufts are embedded in the bone tissue to provide improved anchorage.

In European Patent Application No. 211169 published February 25, 1987, an acetabular cup is

described in which an external boss protrudes from the outer surface of the acetabulum body to fit into a pre-drilled hole in the acetabulum. The cup also has two anchoring lugs in the meridian plane. The lugs take screws to aid in anchoring the cup.

Other references in the patent literature which describe acetabular cups include European Patent Application No. 212087 published April 3, 1987, wherein metallic pins project from the surface of the cup and contain holes in which tissue may grow. In European Patent No. 341198 published November 8, 1989, an acetabular cup has a metal outer shell and a plastics body for retaining the hip joint head. The shell is frustro-conical in cross-section with an opening at an apex and circular teeth around the outside. Three or more anchoring dowels parallel to the convexes protrude from the outer surface of the shells. The dowels are slotted and provide with circular teeth of a sawtooth central bolt may be fitted into the dowel to provide a rounded end.

The use of cement for fixation of acetabular process, and in some cases the use of spacers, is found in US Patent Nos. 4563778 and 4566138. This concept of the use of bone cement and spacers is also seen in United Kingdom Patent Nos. 1170295 and 2080118.

US Patent No. 4923473, issued to Peter Griss et al, entitled "Hemispherical Acetabulum", relates to a hemispherical acetabulum having a fixing pin which projects from the outside surface of the acetabulum.

In prior art acetabular cup prosthetic devices, the projections or spacers are often for the sole purpose of providing a space from the bone tissue that can be occupied by bone cement. Further, many acetabular cup prosthetic devices carry projections on their outer surface which are a part of the prosthesis as constructed and which cannot be added thereafter.

Still other prosthetic devices in the form of acetabular cups provide pegs which must be affixed to the tissue before the acetabular cup is placed in the position. Pegs which are preattached to the cup may require predrilling or other preparation which includes impaction for the purpose of forcing the projections into the bone. The bone bed may require advance preparation in some devices to accept the protrusions.

The present invention seeks to provide an improved acetabular cup prosthesis wherein the prosthesis body (ie. the cup or shell) is provided with pegs which are attachable to the shell.

In accordance with the present invention there is provided an acetabular cup prosthesis, comprising:

a) an acetabular cup body having an inner concave surface and an outer convex surface;

b) a plurality of openings that extend between the inner and outer surfaces along lines that converge at or near the centre of curvature of the inner concave surface, the openings forming elongated bores surrounded by a bore wall portion of the acetabular cup body;

c) the openings being positioned to define one or more drill guides so that the surgeon can drill into the underlying tissue and form surgical openings therein via one or more of the openings;

d) at least one peg member being insertable into and registering respectively with one of the openings, having a first proximate end portion which is engageable with the bore wall portion in said one of the openings and which has a centrally longitudinally extending opening in a proximate end face thereof, and a second distal end portion adapted to extend into bone tissue; and

e) means which is engageable with the opening in the peg member to radially enlarge the proximate end portion and thereby force the proximate end portion into engagement with said bore wall portion.

The present invention affords improved fixation and stability of the component because pegs or spikes can be placed and secured in the acetabular

AUSTRALIAN PATENT OFFICE LS

cap body after it has been placed in position by the surgeon. The pegs or spikes can be easily removed and easily installed from the concave side of the acetabular cup body component notwithstanding the fact that the acetabular cup body component has already been placed in operative position in the patient.

With the present invention, a multiplicity of pegs or spikes can be rigidly attached to an acetabular cup prosthesis body for the purpose of securing it in place in the acetabular bone. This can be done through an opening or bore which is interchangeably used for a desired peg or spike. A bone screw can be used through one of the openings if desired.

With the present invention, the acetabular cup can be placed in its desired position in the pelvis by the surgeon. The pegs are then added to the cup body and attached to the prosthesis in a rigid fashion. The peg or spike protrudes through the acetabular cup body and into the underlying bone tissue of the acetabulum to provide a mechanical locking of the acetabular cup (including pegs) into the pelvis. The surgeon can use a pre-drill before placing the peg or spike wherein the opening or bore in the acetabular cup body functions as a drill guide. Pegs can be selectively placed so that they are not aligned with each other but are at angles

AUSTRALIAN PATENT OFFICE

to each other which aids in the mechanical stability of the acetabular cup body.

The apparatus preferably uses a plurality of pegs or spikes that can of different shapes and which can use a taper lock, barb lock, knurl lock, or screw lock in addition to a compression friction lock for forming a rigid connection with the acetabular cup at the bores or drill guide openings. The interference fit assures a rigid connection between peg and cup body so that each peg and the cup body move together, rather than relative to one another. Relative motion causes possible contact between a peg and any polymer liner, creating the problem of liner debris generation. The pegs are preferably smooth along the distal portion thereof so that movement of the peg and cup as a unit will not disrupt adjacent bone tissue.

The plurality of openings in the shell or cup extend between the inner and outer surfaces along radial lines that can merge at or near the centre of curvature of the inner concave surface of the cup body, the openings forming elongated bores surrounded by a bore wall of the acetabular cup body. The cup body or shell can be spherical in form, or non spherical in form eg. an egg-shaped or ovoid.

AUSTRALIAN PATENT OFFICE

The relationship between the or each peg member and the bore wall portion enables load transfer to occur between the cup body and peg member without there being substantial rotational or translational movement, for example migration of the peg in a direction along the axis of the opening, between the cup body and each peg member.

The apparatus of the present invention may be surgically implanted by the following procedure which comprises

a) placing a hermispherically shaped cup in the

AUSTRALIAN PATENT OFFICE

patient's acetabulum, the cup having an inner concave surface and an outer convex surface, the concave and convex surfaces being spaced apart a distance that defines the thickness of the cup, and the cup having a plurality of radially extending openings that each communicate with the cup concave and convex surfaces;

b) drilling a bore into the patient's acetabulum via the selected opening;

c) optionally using a selected radially extending opening as a drill guide to align a drill bit after placement of the cup into the patient's acetabulum;

d) inserting a peg having proximate and distal end portions into the opening and the bore wherein the distal portion registers in the bore and the proximate portion registers with the opening in the cup; and

e) forming a rigid connectin between the proximate end of the peg and the cup at the opening.

The invention will be further described and by way of example only, illustrated with reference to the accompanying drawings in which:

Figure 1 is a side sectional view of the preferred embodiment of the apparatus of the present invention;

Figure 2 is a perspective view of the preferred embodiment of the apparatus of the present invention;

AUSTRALIAN PATENT OFFICE LS

Figure 3 is an exploded perspective view of the preferred embodiment of the apparatus of the present invention;

Figures 4-4A are side elevational and fragmentary views, respectively of the apparatus of the present invention using the peg member of Figure 10;

Figures 5A-5C are bottom, side, and top views of another embodiment of the peg member;

Figures 6A-6C are bottom, side, and top views of another embodiment of the peg member;

Figures 7A-7C are bottom, side and top views of another embodiment of the peg member, in the form of a spike;

Figures 8, 9, 10 and 11 illustrate other peg members which may be used with the apparatus of the present invention including respectively thread lock, barb lock, taper lock and knurl lock embodiments thereof;

Figures 12A-12D illustrate alternate head constructions of a peg locking screw;

Figure 13 is a perspective view of the preferred embodiment of the peg locking screw;

AUSTRALIAN PATENT OFFICE LS

Figure 14 is a perspective fragmentary view of one embodiment of the apparatus of the present invention illustrating an interface of the peg locking screw with one of the pegs of Figures 5A-5C; and

Figure 15 is a partial sectional view illustrating the peg of Figure 10.

Figure 16 is a perspective view of a second and preferred embodiment of the apparatus of the present invention;

Figure 17 is a fragmentary view illustrating a peg member used with the second embodiment of the apparatus of the present invention;

Figure 18 is a fragmentary view illustrating the closure member portion of the second embodiment of the apparatus of the present invention; and

Figure 19 is a fragmentary sectional view illustrating the second embodiment of the apparatus of the present invention;

Figure 20 is a another fragmentary sectional view illustrating the second embodiment of the apparatus of the present invention;

Figure 21 is a another fragmentary sectional view illustrating the cup portion of the second embodiment of the apparatus of the present invention; and

Figure 22 is a fragmentary sectional view of the second embodiment of the apparatus of the present invention illustrating the cup and cup liner

connection.

In Figure 1 there can be seen a sectional view of the preferred embodiment of the apparatus of the present invention designated generally by the numeral 10. In Figure 1, there can be seen a hip prosthesis member 11 mounted in a femur 12. The hip prosthesis 11 includes an upper ball portion 13 that registers with the acetabular prosthetic apparatus 10 of the present invention. The acetabular prosthesis 10 includes a cup body 14, preferably of a metallic material with a plastic liner 15 portion. The metallic cup body 14 includes an inner concave surface 16 and an outer convex surface 17.

Referring to Figures 2 and 3 plurality of openings 18 in the form of ~~preferably~~ elongated bores extend between the inner concave surface 16 and the outer convex surface 17. These openings are in the form of bores having a bore wall 19. The openings 18 can function as drill guides for the surgeon. Therefore, once the metallic cup body 14 portion of the acetabular cup prosthesis 10 is placed in position as shown in Figure 1, the surgeon can simply drill through any one of the plurality of bores forming an opening in the underlying bone tissue 20.

AUSTRALIAN PATENT OFFICE LS

When the surgeon places the cup body 14 in position as shown in Figure 1, the plurality of bores 18 can act as a drill guide for the surgeon, as the bore 19 walls of each opening 18 define a guide for a corresponding sized drill so that the surgeon can penetrate and form surgical openings in the bone tissue 20. A selected surgically formed opening is then occupied by a peg 25-29, which may extend into the bone tissue at a different angular position with respect to the other pegs to provide a rigid anchor for the cup 14. Pegs 25-29 can be polymer, metal, or other resorbable polymer. It should be noted that it is not necessary that surgical openings be formed behind all openings 18.

Once the pegs 25-28 are placed into operative position, a strong connection is formed between the outer surface of each peg 25-28 and the walls 19 of each opening or bore 18.

The cup body 14 and plastic liner 15 are identical to the cup body 71 and liner 72 described in detail with reference to Figures 16 to 22 except for the shape of the bore wall 19 in each opening 18. The openings 18 are adapted to receive a respective one of the pegs 25-29 so that the proximate end face is flush with the inner concave surface 16 of the cup body 14, as shown in Figure 2.

One of the peg members 25 is shown in Figure 3 about to be inserted into one of the openings 18. The peg member 25 has a proximate end portion 49 which is received within the opening 18 and a distal end portion 50 which projects therefrom into the bone tissue as shown in Figures 1 and 2. The distal end 51 is rounded and generally of hemispherically shape. An annular shoulder 53 extends around the peg member

AUSTRALIAN PATENT OFFICE LS

between the proximate and distal end portions 49 and 50. A pair of elongate slots 52 extend from the proximate end face 55 at right angles to each other through the proximate end portion 49 and partway through the distal end portion 50.

An enlarged set screw 30 is engageable with the proximate end portion 49 at the intersection of the slots 52 to radially expand the proximate end portion in the opening 18 so as to force the proximate end portion into locking engagement with the bore wall 19 and thereby secure the peg member relative to the cup body 14. The radial expansion of the proximate end portion 49 is illustrated schematically in Figure 14. As shown in Figure 2, the set screw 30 is flush with the proximate end face 55 when the screw is fully engaged. The screw 30 is described in further detail with reference to Figures 12A to D and 13.

In Figures 4A-C, 5A-5C, 6A-6C, 7A-7C and 8-11, various alternative embodiments of the pegs and some of their attachments to the cup body 14 are illustrated.

In Figure 8, peg 25A includes a proximate end face 31 and a rounded distal end face 38 and a central longitudinal axis 34. A distal smaller diameter section 33 connects with a proximate larger diameter section 35 at a rounded sealing portion 32. The proximate section 35 is covered with an external spiralling thread 39. The thread 39 bites into and interfaces with the cup body 14 at the wall 19 of each opening 18. The opening or bore 18 wall 19 can also be internally threaded to engage the thread 39.

In Figure 9, peg 25B is similar to peg 25A except that,

AUSTRALIAN PATENT OFFICE LS

instead of the thread 39, the proximate larger diameter section 35 carries a plurality of annular barb rings 40. When the peg 25B is forced into the opening 18, the barbs 40 form a tight fit with the cup body 14 at the wall 19 of each opening 18.

Similarly, in peg 25D the thread 39 is replaced by a knurled outer surface. In all of pegs 25A, B and D the proximate end portion 35 may be radially expanded by an enlarged set screw 30 as described hereinafter with reference to the peg 25C.

In the embodiment of Figures 10 and 15, peg 25C provides a proximate, larger diameter 41 end portion, a smaller generally cylindrical distal end portion 44, a transitional frustro-conical section 42, and a rounded distal end 43.

The large diameter section 41 and the frustro-conical portion 42 can also be seen in Figure 15 in a partial sectional view. The larger diameter and frusto-conical sections 41, 42 surround an internally threaded bore 68 which accepts set screw 30 having thread 67, shown by of example in Figure 13. The screw 30 is sized to expand the enlarged 41 and frustro-conical 42 sections slightly when the peg 25C is placed in position within one of the bores 18 which would be similar in shape to the outside surface of frustro-conical portion 42 and enlarged portion 41, as shown in Figures 4 and 4A. When the set screw 30 is fully threaded into the threaded opening 68, so that the external thread 67 of the set screw 30 engages the internal thread 68 of the bore, a taper lock connection or interference fit is formed between the peg 25C and the wall 19 of opening 18. Internal threads

AUSTRALIAN PATENT OFFICE

68 in Figure 15 can also be used to receive an extraction or holding tool for placing and removing the peg 25C, respectively before the set screw 30 is engaged with and after the set screw is removed from the threaded bore 68.

The set screw 30 can have different tooled sockets, as shown in Figures 12A-12D. In Figure 12A, a set screw 30A includes a square tooled socket 63. In Figure 12B, the set screw 30B has a X-shaped slot 64 for receiving a Phillips-type screwdriver, for example. In Figure 12C, the set screw 30C has a single transverse slot 65 and in the embodiment of Figure 12D, shown also in Figure 13, the set screw 30D has an hexagonal tool socket 66. Other tooled sockets could be employed.

In Figures 4-4A the pegs 25C can be seen extending from the convex 17 surface of cup body 14 and into a surgically formed opening 70 in the bone tissue 20 which is formed by the drill that penetrates the opening 18. In such a situation, the surgeon simply uses the opening 18 as a drill guide for a similarly shaped drill when forming surgical opening 63.

In Figures 5A-5C, an alternative construction of the peg 25 is illustrated, designated generally by the numeral 50A. Peg 50A differs from peg 25 only by having annular waist 54 in the proximate end portion 49 adjacent the annular shoulder 53.

In the embodiments of Figures 6A-6C, the peg 50B differs from peg 50A only by having a single longitudinally extending transverse slot 52.

AUSTRALIAN PATENT OFFICE

In the embodiment of the Figures 7A-7C, a spike-shaped peg 56 is provided having a pointed tip portion 57, and a plurality of beveled surfaces 58 that connect with a cylindrical proximate end portion 49 that includes an enlarged annular shoulder 60 and an annular waist 59. The proximate end portion 49 of the peg includes a longitudinally extending Y-shaped slot 62 extending from the proximate end face 61, as seen in Figures 7B and 7C.

In all of pegs 50A, 50B and 56, the enlarged set screw 30 would be used to radially expand the proximate end portion 49 to lock the peg and the opening 18.

Figures 16-22 illustrate another embodiment of the apparatus of the present invention designated generally by the numeral 70. Acetabular cup apparatus 70 includes a cup body 71 to which can be removably affixed a plastic cup liner 72 made of polyethylene for example. Liner 72 has an inner concave surface 73 and an external convex surface 74. Liner 72 is in the form of a hemispherical member having an annular base 75 with a plurality of curved members extending around the periphery of liner 72 at base 75 and which interface with a similarly shaped circumferentially recess formed on cup body 71 to prevent rotation of liner 72 with respect to body 71.

The cup body 71 is preferably metallic having an annular base 76 that defines a plane. The cup body 71 has an inner concave surface 77 and an external convex surface 78. The cup body 71 concave surface 77 is a shiny polished surface that faces the convex surface 74 of polymeric liner 72. The polished concave surface 77 has a roughness of less than 40μ

AUSTRALIAN PATENT OFFICE

(16 microinches), and preferably about 20μ (8 microinches). Such a highly polished surface 77 appears mirror-like. The polished concave surface 77 inhibits polymer liner debris generation.

External surface 78 can be covered with a plurality of small metallic beads or the like forming a bone ingrowth surface 79. The apex 80 of cup body 71 has a through opening 81 that has an internal thread 82 for attachment thereto of a tool for inserting and/or removing the cup body 71 from its position in the acetabular bone tissue of a patient.

A plurality of openings, for example four openings 84, 85, 86 and 87 are provided preferably in one quadrant 88 of cup body 71. Each opening 84-87 has an internal opening configuration that includes a larger diameter generally cylindrically shaped opening portion 91 and a smaller diameter opening portion 92 (Figure 21). The larger and smaller diameter sections 91, 92 are interfaced by an annular shoulder 93. The smaller diameter section 92 can be tapered from a point of maximum diameter adjacent annular shoulder 93 to a point of minimal diameter adjacent an outer annular shoulder 89. A second larger diameter cylindrical section 90 meets outer edge 94 of each opening 84-87.

Pegs 95 can be selectively fitted into any one of the openings 84-87 during use. Each peg 95 has a tapered section 96 that includes a larger diameter circular base 97 defining a proximate end portion of peg 95. Distal end portion 98 of peg 95 is generally cylindrical and smooth, and includes a curved or hemispherical smooth tip 99.

AUSTRALIAN PATENT OFFICE LS

In Figure 20 force arrows are used to demonstrate that the above-described connection between each peg 95 and the cup body 71 is a substantially rigid connection that produces load transfer between each peg member and the cup body of tension loads, compression loads, axial torsion loads, and bend moment loading. Thus, the peg 95 does not rotate or back out with respect to the opening 85-87. However, the peg 95 may be modified to include the threaded bore 68 shown in Figure 15 to receive an enlarged screw 30 and ensure the locking of the peg relative to the cup body 71.

The force arrow 117 is an angled force having both a bending force component (Fb) designated as 118 and a compression force component (Fc) designated as 119. The force arrows 120 and 124 show shear forces at the interface between peg 95 and cup body 71 at a selected opening 84-87. The force arrows 121A,B are force arrows that are resisting the shear forces and the force arrows 122A,B are resisting bending forces.

A closure member 100 is shown in Figure 18-19 and includes a larger section 101 and a smaller diameter section 102. Annular shoulder 103 forms an interface

AUSTRALIAN PATENT OFFICE LS

between the larger 101 and smaller 102 diameter sections. Closure member 101 has an enlarged circular base 104 defining its proximate end portion during use and a smaller circular flat distal end 105.

The larger diameter section 101 of closure member 100 can have a bevelled annular wall 106 for forming a wedge type fit with the larger diameter section 91 of a particular selected opening 84-87. In this manner, the closure member 100 can be placed in any one of the selected openings 84-87 and pressed into the selected opening 84-87 by the user even after the cup body 71 has been placed into operative position. The user simply presses the closure member 100 into one of the selected openings 84-87 by accessing the cup body 71 from the concave 77 side.

The surgeon can close any one of the selected openings 84-87 using the closure member 100 after the cup body 71 has been placed in the desired operative position and anchored into position using on or more of the pegs 95. The closure member 100 may be placed in the shell 71 before implantation, such as during manufacturing, and then selectively removed by the surgeon before use of the shell 71. Each closure member 100 occupies a position in its selected opening 84-87 and between the convex 78 and concave 77 surfaces

of shell or cup body 71.

Each of the openings 84-87 has a generally cylindrical smaller diameter section 92 that can act as a drill guide for the surgeon so that drilled openings can be made into the underlying bone tissue after the acetabular cup body 71 has been placed into position. This allows one or more pegs to be placed into one or more of the selected openings 84-87. Any of the selected openings 84-87 that are not selected can be plugged using the closure member 100. This prevents the flow of the polyethylene liner into any of the openings 84-87 that are not occupied by a peg 95. The closure member 100 friction fits into the above-mentioned larger diameter portion 91 of the openings 84-87.

In figure 22, the connection between cup 71 and liner 72 is illustrated with greater detail. Liner 72 can be rotated as shown by arrows 107 in figure 16 until the raised portion 75A of base 75 is in a selected position. The liner 70 is then fitted to the cup 71 by engaging the the annular recess 116 of the cup 71 with the annular corrugated shoulder 108 of the liner 72. Shoulder 108 has an inclined annular shoulder that forms an acute angel of between abut eighty and eighty five degrees with the flat upper

surface 111 of annular base 75 of liner 72.

The surface 111 is flat so as to register with the surface of base 76 of cup 71. The numeral 112 in figure 22 designates the angle between surface 111 and inclined annular wall 109. A recess 116 has a corresponding shape and size to the annular corrugated shoulder 108. The angle 113 formed between inner inclined annular surface 114 and annular surface 115 is the same angular measure as angle 112.

This configuration of annular shoulder 108 and recess 116 provides a snap or interference fit between the liner shoulder 108 and the cup 71 at recess 116 which helps secure the liner 72 to the cup 71 during use.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

AUSTRALIAN PATENT OFFICE LS

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An acetabular cup prosthesis, comprising:

a) an acetabular cup body having an inner concave surface and an outer convex surface;

b) a plurality of openings that extend between the inner and outer surfaces along lines that converge at or near the centre of curvature of the inner concave surface, the openings forming elongated bores surrounded by a bore wall portion of the acetabular cup body;

c) the openings being positioned to define one or more drill guides so that the surgeon can drill into the underlying tissue and form surgical openings therein via one or more of the openings;

d) at least one peg member being insertable into and registering respectively with one of the openings, having a first proximate end portion which is engageable with the bore wall portion in said one of the openings and which has a centrally longitudinally extending opening in a proximate end face thereof, and a second distal end portion adapted to extend into bone tissue; and

e) means which is engageable with the opening in the peg member to radially enlarge the proximate end portion and thereby force the proximate end portion into engagement with said bore wall portion.

2. Apparatus according to claim 1 wherein the inner concave and outer convex surfaces are of parallel curvature.

3. Apparatus according to claim 1 or claim 2 wherein each of the openings is a generally cylindrically shaped bore.

AUSTRALIAN PATENT OFFICE LS

4. Apparatus according to any one of claims 1 to 3 wherein the elongated bores include a generally cylindrical portion and a generally frusto-conical portion.

5. Apparatus according to any one of claims 1 to 4 wherein each peg member is generally cylindrical in configuration.

6. Apparatus according to any one of claims 1 to 5 wherein each peg member includes a section of larger diameter and a section of smaller diameter.

7. Apparatus according to claim 6 wherein the section of larger diameter is the proximate end portion which is at least partly frusto-conical.

8. Apparatus according to claim 6 or 7 wherein said larger diameter section is the proximate end portion and said smaller diameter section is the distal end portion.

9. Apparatus according to any one of claims 1 to 8 wherein the bore engaging means is a screw.

10. Apparatus according to claim 9 wherein said peg member bore is screw threaded.

11. Apparatus according to any one of claims 1 to 10 wherein the bore wall portion of the acetabular cup body is comprised of a metallic material.

12. Apparatus according to any one of claims 1 to 10 wherein the proximate end portion of the at least one peg member has a surface formation defined by external grooves which is

AUSTRALIAN PATENT OFFICE LS

engageable with the bore wall portion in said one of the openings.

13. Apparatus according to any one of claims 1 to 12 wherein each peg member has a longitudinally extending slot in the proximate end portion which facilitates the radial enlargement of said portion.

14. Apparatus according to any one of claims 1 to 13 wherein at least one peg member has a rounded distal end face.

15. Apparatus according to any one of claims 1 to 13 wherein the at least one peg member has a pointed, beveled distal end portion.

16. Apparatus according to any one of claims 1 to 15 comprising a cup liner that registers with and affixes to the cup body at the cup body concave surface, with an annular shoulder on the liner having an inclined annular sidewall that forms an acute angle with a base plane of the cup during use, wherein the annular sidewall is corrugated and an annular rebate in the cup body has a corresponding corrugated surface.

17. Apparatus according to claim 16 wherein the cup liner has a flat annular surface extending between the inclined annular sidewall and a radially outer most surface of the liner.

18. Apparatus according to either of claims 16 and 17 wherein the cup body concave surface includes a polished surface having a roughness of less than 40.6μ (16

microinches).

19. An acetabular cup prosthesis according to claim 1 and substantially as hereinbefore described with reference to the drawings.

Dated this 22nd day of May, 1995

SMITH & NEPHEW RICHARDS INC
By its Patent Attorneys
DAVIES COLLISON CAVE

AUSTRALIAN PATENT OFFICE

ABSTRACT

An improved acetabular cup prosthesis has a cup body with a plurality of bores extending between an inner concave surface and an outer convex surface, wherein the bores can function as drill guides for providing alignment in the drilling of surgical openings after the acetabular cup body is placed in a patient. A plurality of pegs or spikes have proximate end portions that have connection members for forming connections with the bores, and distal end portions that can register into the drilled surgical openings.

FIG. 1.

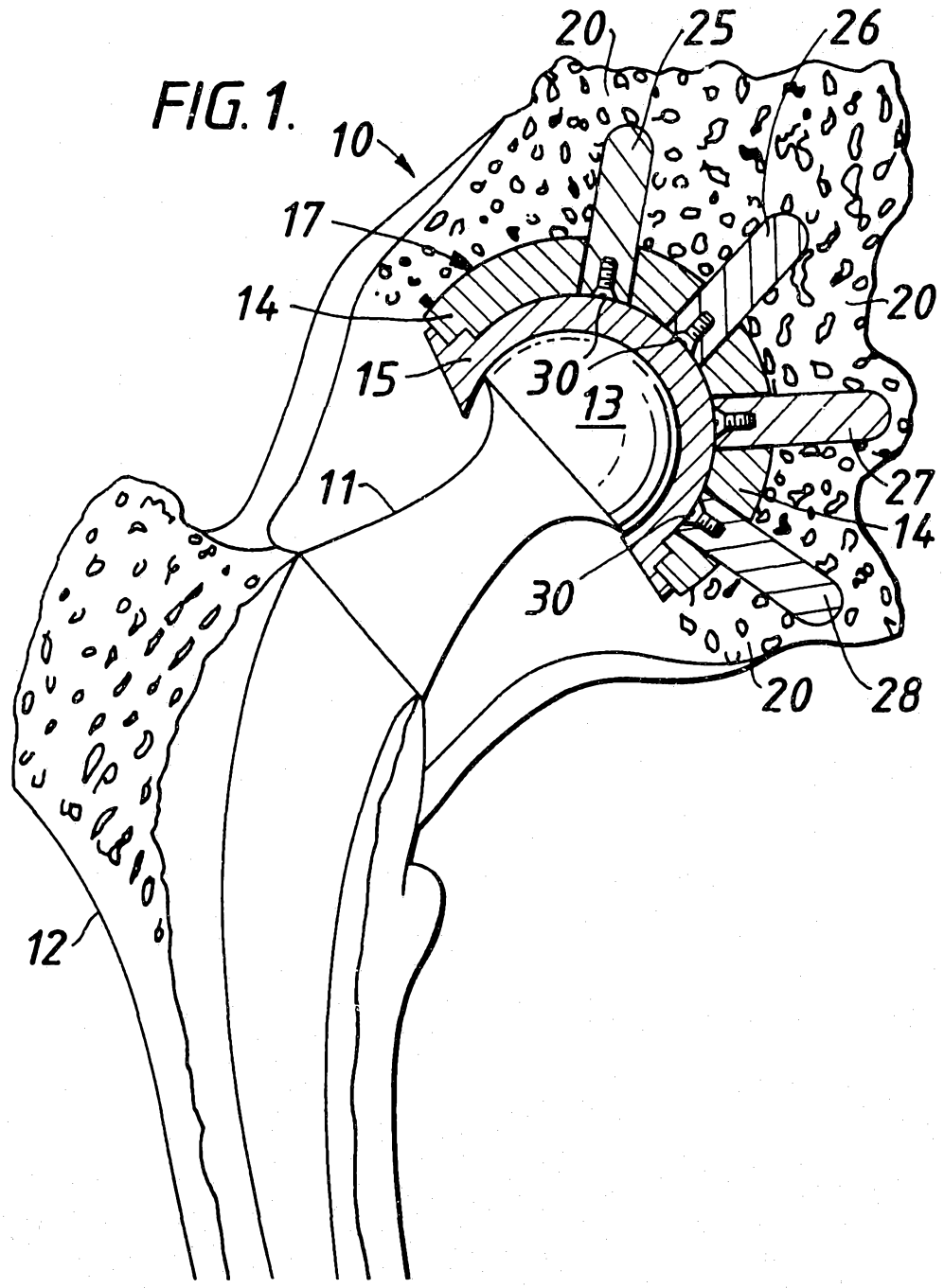
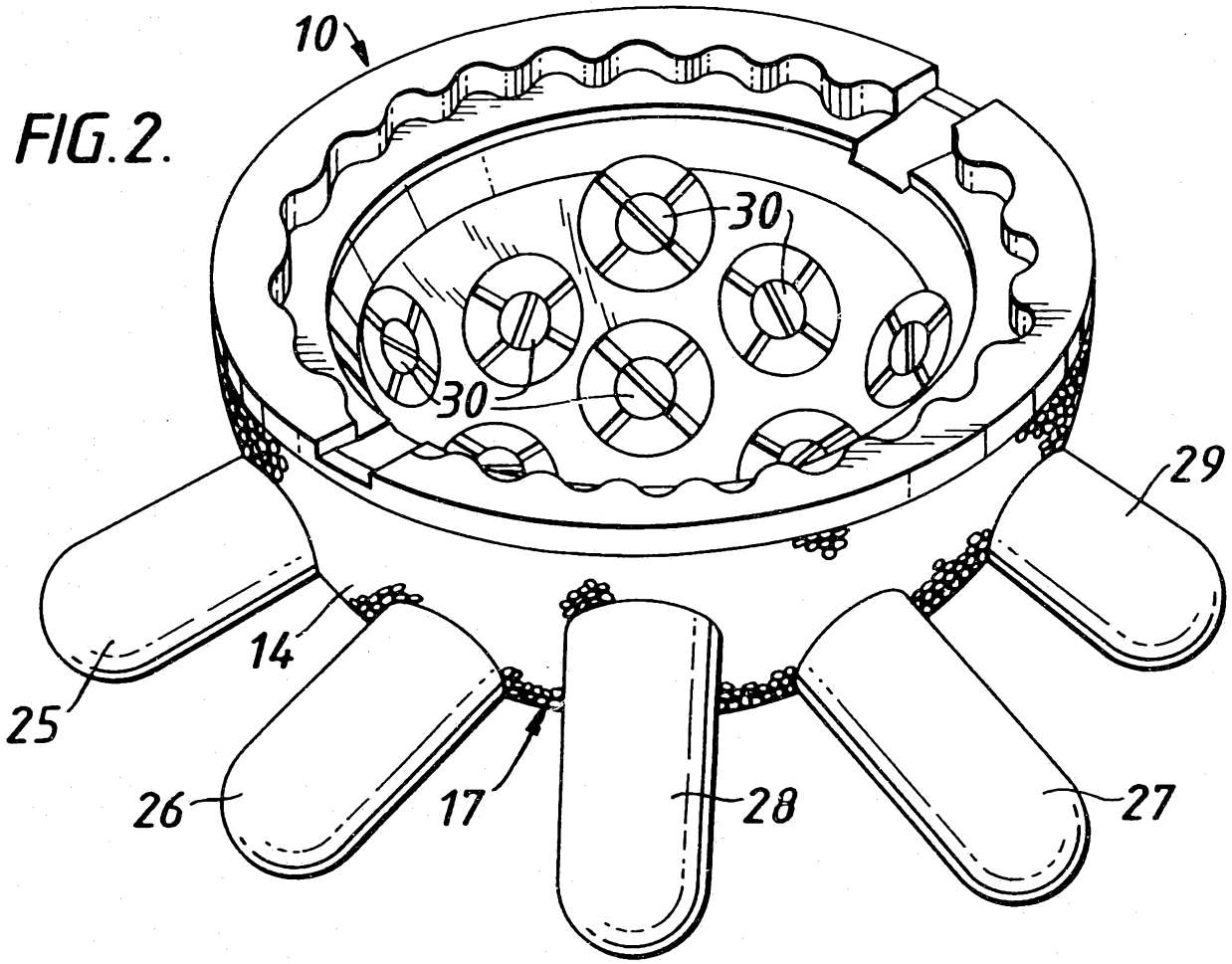


FIG.2.



10909/92

FIG.3.

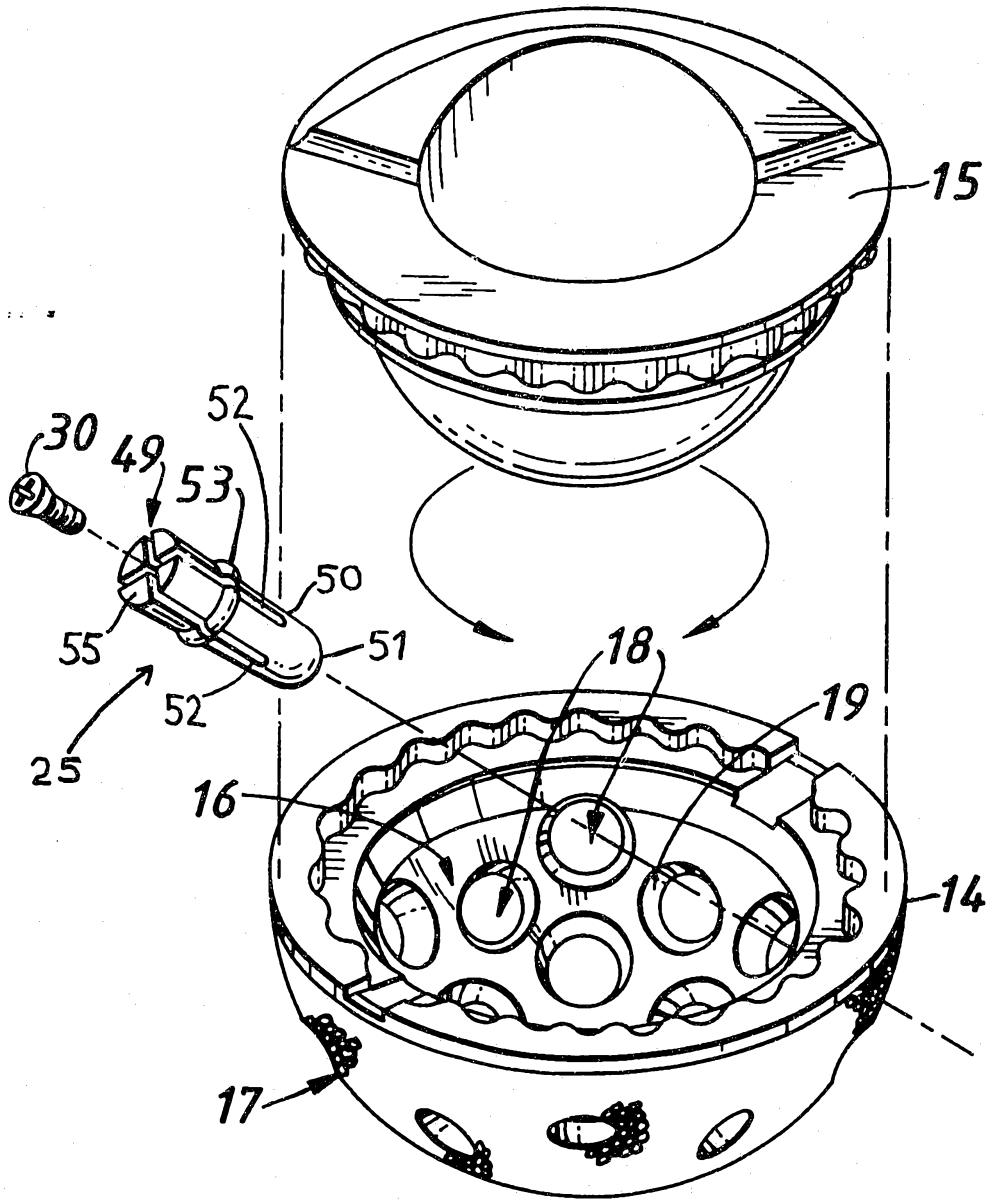


FIG. 4.

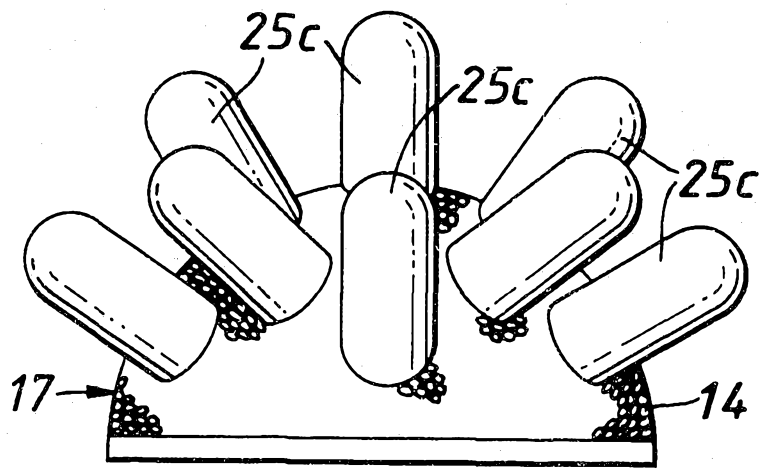


FIG. 4A.

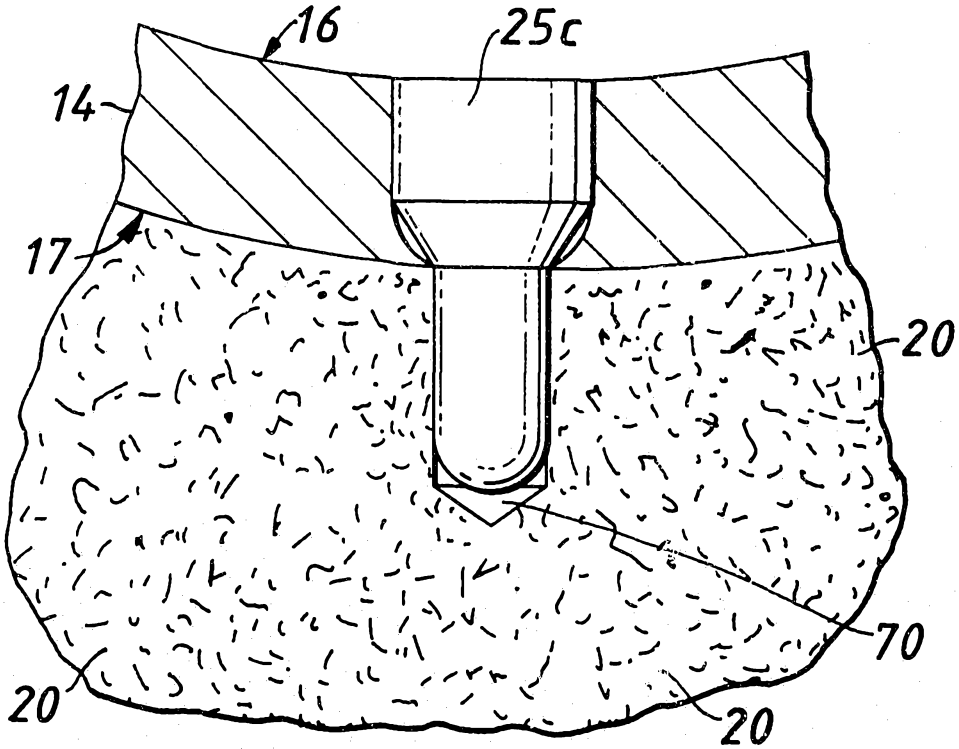


FIG.5A.



FIG.5B.

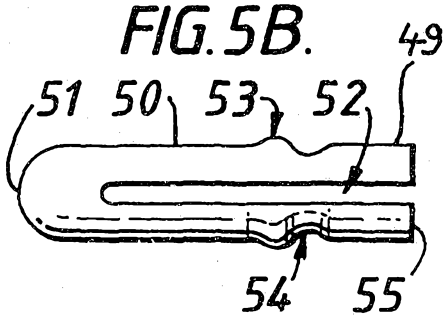


FIG.5C.

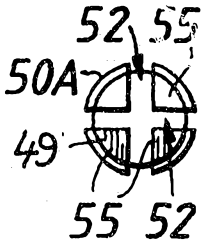


FIG.6A.



FIG.6B.

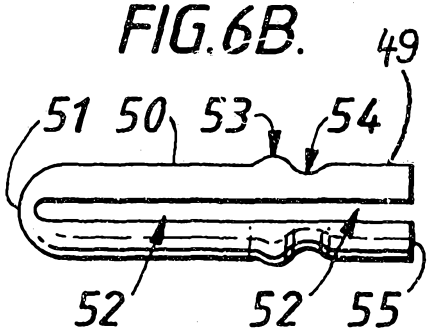


FIG.6C.

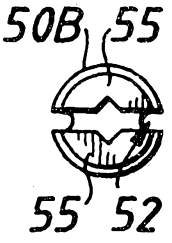


FIG.7A.



FIG.7B.

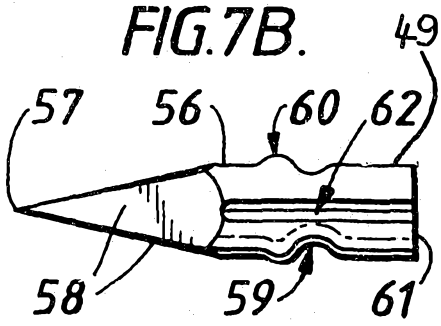


FIG.7C.



FIG.8.

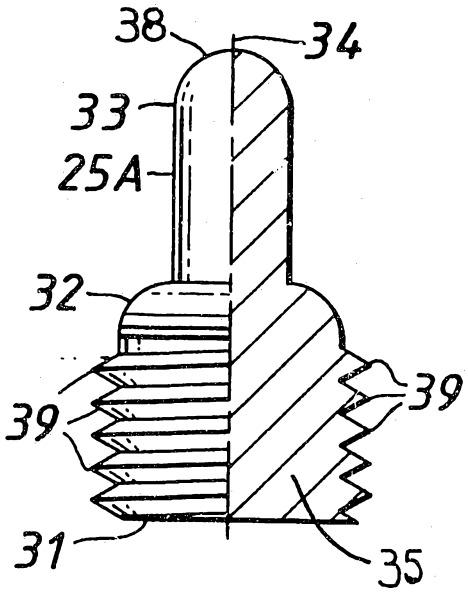


FIG.10.

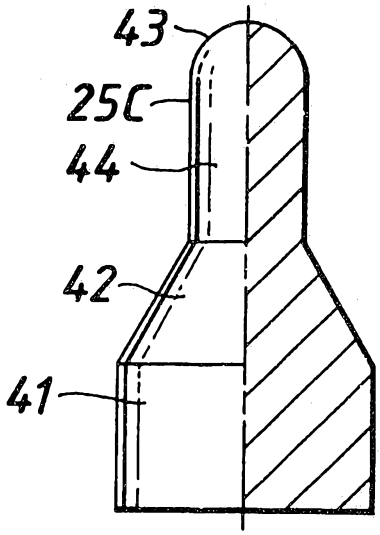


FIG.9.

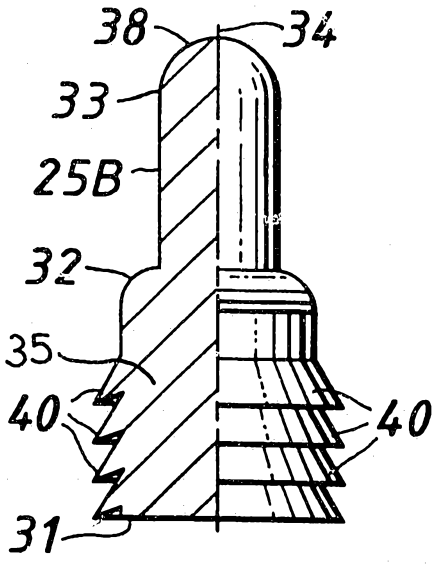


FIG.11.

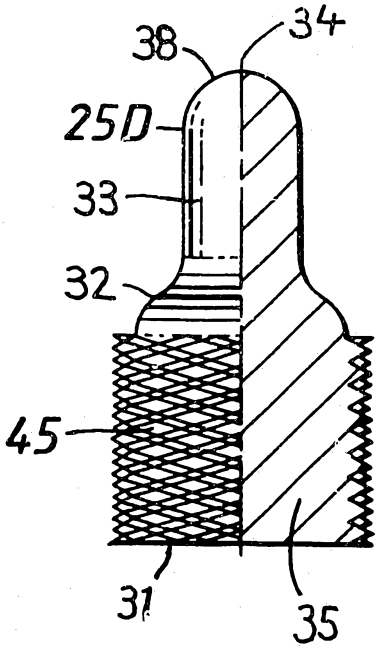


FIG.12A.

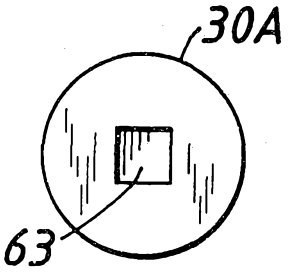


FIG.12B.

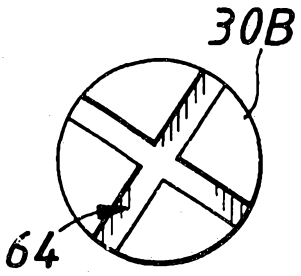


FIG.12C.

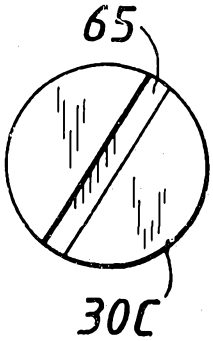


FIG.12D.

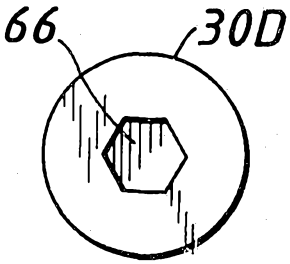


FIG.13.

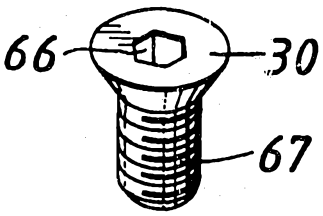


FIG.14.

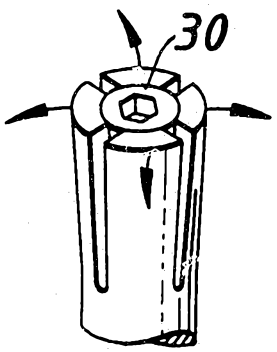


FIG.15.

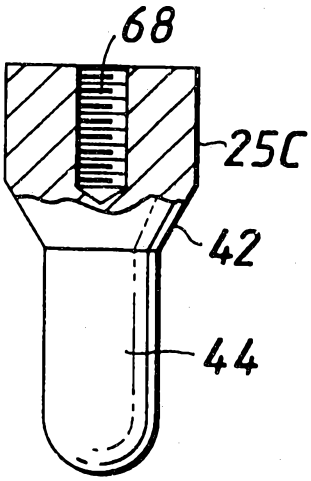


FIG.16.

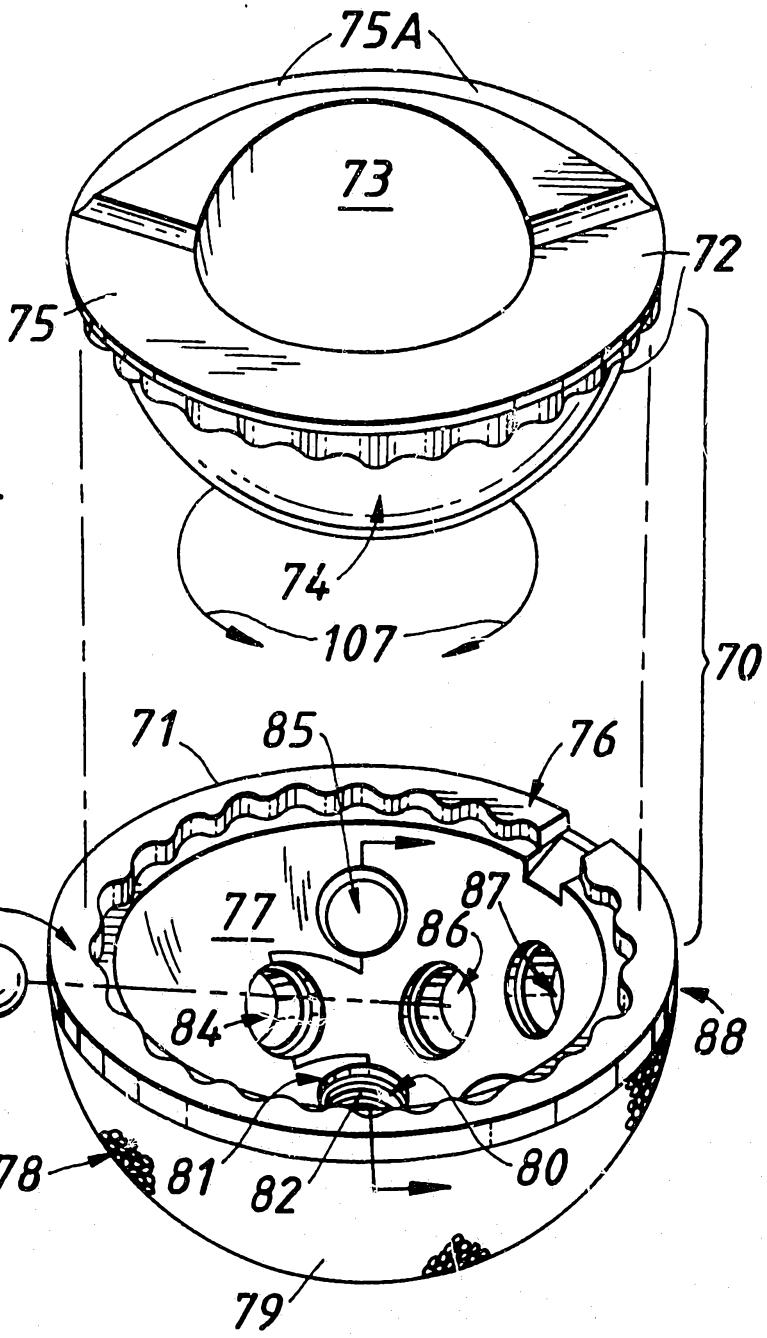


FIG.17.

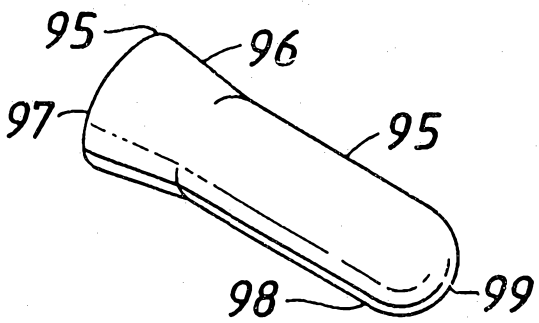


FIG.18.

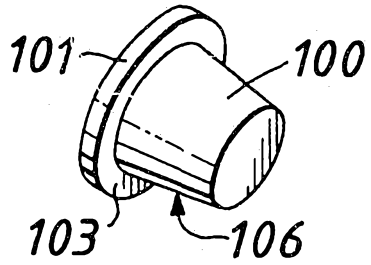


FIG.19.

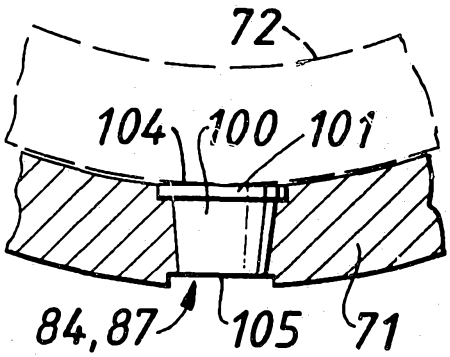


FIG.20.

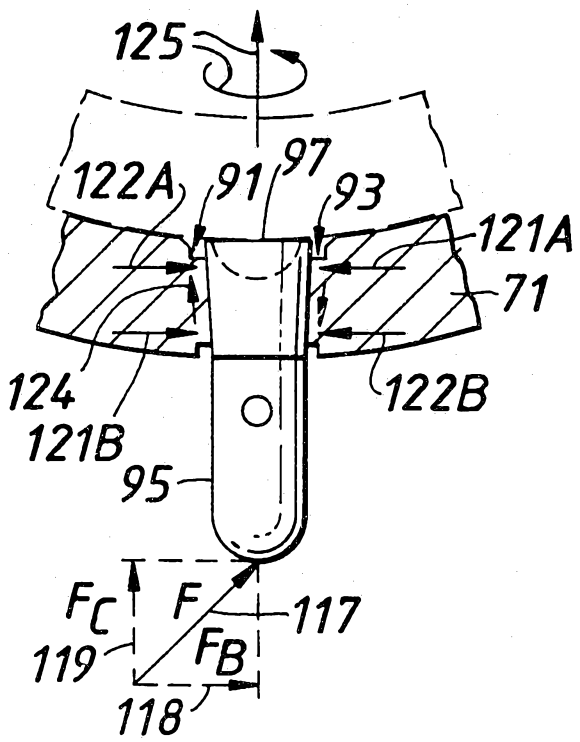

125
122A
91
97
93
121A
71
124
121B
122B
95
F_C
F
117
119
F_B
118

FIG.21.

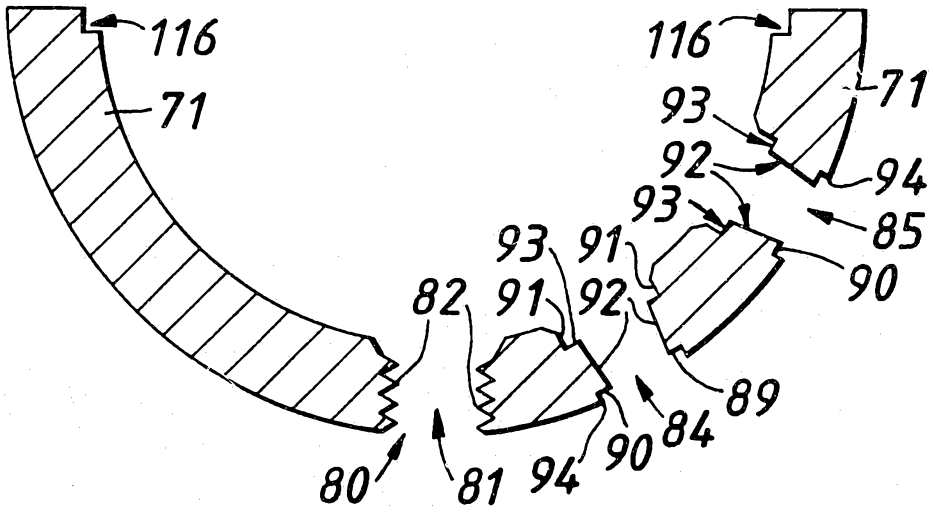

116
71
116
71
93
92
94
93
85
93
91
90
82
91
92
89
84
80
81
94
90

FIG. 22.

