



(51) International Patent Classification:

A61F 2/38 (2006.01)

(21) International Application Number:

PCT/EP2017/061203

(22) International Filing Date:

10 May 2017 (10.05.2017)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

102016000048667 12 May 2016 (12.05.2016) IT

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(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, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, 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.

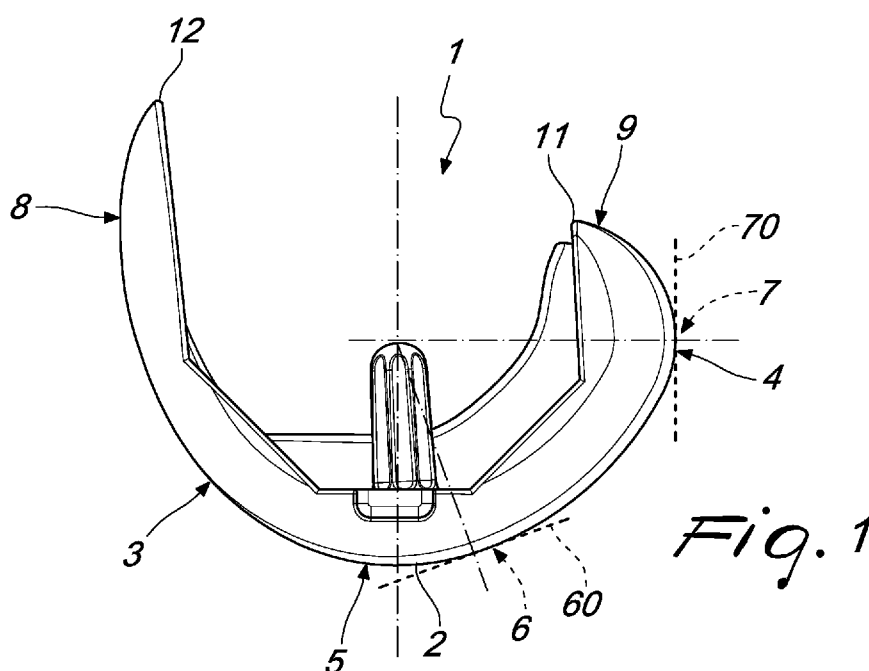
(84) Designated States (unless otherwise indicated, for every

kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, 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, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

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

(54) Title: FEMORAL COMPONENT FOR KNEE PROSTHESIS AND RELATED KNEE PROSTHESIS



(57) Abstract: A femoral component (1) for a knee prosthesis, comprising at least one convex articular surface (2, 22) that defines at least one femoral condyle (3, 23); the posterior portion (4, 24) of the femoral condyle (3, 23) is thicker than the distal portion (5, 25).



FEMORAL COMPONENT FOR KNEE PROSTHESIS AND RELATED KNEE PROSTHESIS

The present invention relates to a femoral component for a knee prosthesis and the related knee prosthesis.

5 The knee is the biggest joint in the human body and it is necessary for carrying out normal everyday activities.

The knee joint is constituted by the lower end of the femur (distal epiphysis), by the upper end of the tibia (proximal epiphysis), and by the patella.

10 The distal epiphysis of the femur has two convex surfaces called femoral condyles (one medial and the other lateral).

Between the two condyles is a groove called the intercondylar cavity.

The proximal epiphysis of the tibia has two concave surfaces called tibial hemiplateaus.

15 The femoral condyles rotate and slide on the tibial hemiplateaus with the menisci interposed, while the patella slides in the intercondylar cavity.

The ligaments are further present, which give stability to the joint.

In the presence of serious diseases and/or in the event of trauma, surgery is necessary to substitute the knee joint with an artificial joint.

20 An artificial knee prostheses is constituted by a femoral component, a tibial component and a tibial insert.

The femoral component, usually made of cobalt/chrome/molybdenum alloy, substitutes the distal epiphysis of the femur and, like the latter, has two convex surfaces.

25 The tibial component, which is usually made of metal, substitutes the proximal epiphysis of the tibia, and the tibial insert is mounted on it.

The latter, which is usually made of polyethylene, has a lower, flat surface in contact with the tibial component and an upper, concave surface that articulates with the femoral component.

A distinction can be made between fixed plateau prostheses and mobile plateau prostheses. In fixed plateau prostheses, the tibial insert is fully coupled, by way of an adapted system, to the tibial component, while in mobile plateau prostheses the insert is free to rotate, within certain limits,
5 on the metallic tibial component.

A variation of fixed plateau prostheses which, although little used, is worthy of mention is the single-piece "All-Polythene" prosthesis where the tibial component and the tibial insert are combined in a single component, made of polyethylene.

10 During the prothesization intervention, it is common to find oneself dealing with a knee that has damaged ligamentous structures.

In particular, the anterior cruciate ligament, except in very few cases, is usually damaged and, as a consequence, artificial knee prostheses usually do not allow for its presence.

15 The posterior cruciate ligament, on the other hand, is often present and even, in a certain number of cases, efficient.

There are therefore artificial knee prostheses for patients who have an efficient posterior cruciate ligament, and prostheses for patients whose posterior cruciate ligament is damaged and is in any case judged no longer
20 capable of stabilizing the joint.

In this latter case, during the surgical operation, the posterior cruciate ligament is removed and its function is performed by a prostheses with a pin-and-cam mechanism.

The pin is present on the tibial insert and extends from the insert
25 toward the femoral component, where the cam is present between the two condyles.

During flexion, the pin and cam interact, limiting the translation of the femur on the tibia, and preventing the dislocation of the joint.

It is known from the literature that a major effect of the removal of the
30 posterior cruciate ligament is the increase in the articular space, or gap, in

flexion, but this increase is not seen in extension.

The posterior cruciate ligament, in fact, is tensioned in flexion and, in this manner, pulls the femur toward the tibia.

By removing the posterior cruciate ligament, the femur moves away
5 from the tibia and therefore the distance between the two increases. The result is an unstable joint with associated increase of the risk of dislocation.

It is also known from the literature that, after the implant of a prosthesis, a reduced flexion, indicatively less than 110° , and in any case a joint that is unstable limit the carrying out of normal everyday activities, a
10 situation that is nowadays considered unacceptable.

The aim of the present invention consists in providing a femoral component for a knee prosthesis, as well as a knee prosthesis, that overcomes the drawbacks of the known art by making it possible to stabilize the joint.

15 Within this aim, an object of the present invention is to provide a femoral component that can offer a degree of movement in flexion that is such as to allow the prothesized individual to carry out the physical activities that are usually required.

Another object of the present invention consists in providing a
20 femoral component that ensures a long survival of the knee prosthesis.

Another object of the present invention consists in providing a knee prosthesis that is capable of offering the widest guarantees of reliability and safety in use.

Another object of the present invention consists in providing a knee
25 prosthesis that is easy to implement and economically competitive when compared to the known art.

This aim and these and other objects which will become better apparent hereinafter are achieved by a femoral component for a knee prosthesis, comprising at least one convex articular surface that defines at
30 least one femoral condyle, characterized in that the posterior portion of said

femoral condyle is thicker than the distal portion of said femoral condyle.

Further characteristics and advantages of the invention will become better apparent from the detailed description of a preferred, but not exclusive, embodiment of a femoral component for a knee prosthesis, which is illustrated by way of non-limiting example with the aid of the accompanying drawings wherein:

Figure 1 is a first side view of an embodiment of a femoral component, according to the invention;

Figure 2 is a second side view of the femoral component of Figure 1, according to the invention;

Figure 3 is a plan view from above of the femoral component of Figure 1, according to the invention;

Figure 4 is a cross-sectional view of the femoral component shown in Figure 3, taken along the line IV-IV;

Figure 5 is a cross-sectional view of the femoral component shown in Figure 3, taken along the line V-V;

Figure 6 is a cross-sectional view of the femoral component shown in Figure 3, taken along the line VI-VI;

Figure 7 is a perspective view of a tibial insert that can be associated with the femoral component of Figure 1, according to the invention;

Figure 8 is a plan view from above of the tibial insert of Figure 7;

Figure 9 is a cross-sectional view of the tibial insert shown in Figure 8, taken along the line IX-IX;

Figure 10 is a cross-sectional view of the tibial insert shown in Figure 8, taken along the line X-X.

The terms “distal”, “proximal”, “anterior”, “posterior”, “lateral” and “medial” used in the description refer to a system of anatomical reference axes. In particular the terms “distal” and “proximal” relate to the direction of the longitudinal axis, the terms “anterior” and “posterior” relate to the direction of the sagittal axis, while the terms “lateral” and “medial” relate to

the direction of the transverse axis.

With reference to the figures, the femoral component for a knee prosthesis, generally designated by the reference numeral 1, comprises at least one convex articular surface 2, 22 which defines at least one femoral condyle 3, 23.

According to the invention, the posterior portion 4, 24 of the femoral condyle 3, 23 is thicker than the distal portion 5, 25.

The femoral component 1 comprises two convex articular surfaces 2, 22 which define respectively a lateral femoral condyle 3 and a medial femoral condyle 23. The posterior portion 4 of the lateral femoral condyle 3 is thicker than the distal portion 5. Similarly, the posterior portion 24 of the medial femoral condyle 23 is thicker than the distal portion 25.

Advantageously the maximum difference between the thickness of the posterior portion 4, 24 of the femoral condyle 3, 23 and the thickness of the distal portion 5, 25 is comprised in the interval between 1.5 and 3.5 millimeters, and is preferably substantially equal to 2.5 millimeters.

Advantageously the thickness of the femoral condyle 3, 23 increases progressively starting from the distal portion 5, 25 up to the posterior portion 4, 24, reaching the aforementioned maximum difference in thickness at the posterior portion 4, 24.

Advantageously the thickness of the femoral condyle 3, 23 further increases progressively between 20° of flexion and 90° of flexion of the knee.

Figures 1 and 2 show, in dotted lines, the ideal tibial planes 60 and 70 for contact with the femoral component 1 respectively when the knee is flexed at 20° (configuration designated with the reference numeral 6) and when the knee is flexed at 90° (configuration designated with the reference numeral 7).

Advantageously the posterior portion 4, 24 of the femoral condyles 3, 23 has, with respect to the thickness of the distal portion 5, 25 of the

femoral condyles 3, 23, a gradual increase in thickness that, between 20° and 90° of flexion of the knee, reaches 2.5 millimeters.

The anterior portion 8, 28 and the distal portion 5, 25 of the femoral condyle 3, 23 advantageously have a substantially constant thickness.

5 The posterior and proximal portion 9, 29 of the femoral condyle 3, 23 advantageously has a thickness that decreases progressively starting from 90° of flexion (configuration designated with the reference numeral 7) of the knee up to the rear and proximal end 11, 31 of the femoral condyle 3, 23.

Advantageously the convex surface 2, 22 has:

10 - a first radius of curvature adapted to define, in the distal portion 5, 25 of the femoral condyle 3, 23 and up to 20° of flexion (configuration designated with the reference numeral 6) of the knee, a substantially constant thickness of the femoral condyle 3, 23;

15 - a second radius of curvature adapted to define, between 20° of flexion (configuration designated with the reference numeral 6) and 90° of flexion (configuration designated with the reference numeral 7) of the knee, a progressively increasing thickness of the femoral condyle 3, 23;

20 - a third radius of curvature adapted to define, starting from 90° of flexion (configuration designated with the reference numeral 7) of the knee up to the posterior and proximal end 11, 31, a progressively decreasing thickness of the femoral condyle 3, 23.

Advantageously the femoral component 1 has three radii of curvature, and is in fact defined as a multi-radius femoral component.

25 For example, starting from 40° in the anterior part of the femoral component 1, for each size, the value of a radius and the position of the center of rotation are chosen such that the thickness of the femoral condyles 3, 23 remains constant up to 20°, toward the posterior part, i.e. up to the configuration designated with the reference numeral 6.

30 Also toward the posterior part, from 20° to 90° of flexion of the knee the centers of rotation and the radii are chosen so that the femoral condyles

3, 23 increase in thickness from 8 millimeters to 10.5 millimeters, where the thickness of 8 millimeters can be found at 20° of flexion of the knee, while the thickness of 10.5 millimeters can be found at 90° of flexion.

From 90° of flexion at the end of the length of the posterior portions 4, 24 of the femoral condyles 3, 23, the radius decreases, allowing the closing of the condyles 3, 23.

Advantageously the femoral component 1 comprises, centrally and at the distal portion 5, 25, a cam 26 adapted to engage a corresponding pin 51 of a tibial insert 50.

10 The femoral component 1 is advantageously made of chrome-cobalt alloy, and advantageously exists both in a cemented version and in a version without cement.

Advantageously the surface of the femoral component 1 in contact with the bone has a shape that enables a good coupling on the conveniently-prepared distal end of the femur.

The present invention also relates to a knee prosthesis that comprises a femoral component 1 as described above and which further comprises a tibial component which in turn comprises a tibial insert 50 which comprises a pin 51 that engages the cam 26 of the femoral component 1.

20 The tibial component substitutes the removed part of the tibia and has a lower, distal part in contact with the bone. The upper, proximal part has a flat surface that accommodates the tibial insert 50.

The tibial component can exist both in a cemented version and in a non-cemented version.

25 The tibial component can be made of a material of the type of titanium alloy and be coupled to a tibial insert that is fixed by way of an adapted locking mechanism.

Alternatively the tibial component can be made of a material of the type of cobalt-chrome alloy, or of the type of cobalt-chrome-molybdenum alloy, and be coupled to a moveable tibial insert. In this second case, the

tibial component is provided with an adapted opening for the movement of the insert.

The tibial insert 50 is advantageously made of a material of the type of polyethylene, and preferably of a material of the type of ultra-high molecular weight polyethylene (UHMWPE). The tibial insert 50 advantageously has a lower, flat surface 52 in contact with the tibial component and an upper, concave surface 53 that articulates with the femoral component 1.

As explained above, the tibial insert 50 advantageously comprises a pin 51, also made of ultra-high molecular weight polyethylene, which extends toward the femoral component 1 where, with the cam 26, it provides a "Posterior Stability (PS)" joint.

The shape and the size of the pin 51 and of the corresponding cam 26 are configured so as to minimize the wear of the polyethylene.

The tibial insert 50 is advantageously available in two versions: fixed and moveable.

The fixed tibial insert is fully coupled, by way of an adapted mechanism, to the tibial component which is usually made of a material of the type of titanium alloy.

The moveable tibial insert is provided in the lower part with a pin, also made of polyethylene, which rotates in the adapted opening of the tibial component made of cobalt-chrome-molybdenum alloy.

In practice it has been found that the femoral component, according to the present invention, as well as the corresponding knee prosthesis, achieves the intended aim and objects since it makes it possible to obtain an excellent stabilization of the prosthetic joint.

Another advantage of the femoral component according to the invention consists in that the increased thickness of the posterior condyles makes it possible to fill the articular space (gap) that is created in flexion, owing to the absence of the posterior cruciate ligament, in this way

succeeding in stabilizing the joint even in flexion and therefore reducing the risk of dislocation.

Another advantage of the femoral component according to the invention consists in that the increased thickness of the posterior condyles
5 makes it possible to also increase the offset of the posterior condyles, thus making it possible to reach degrees of flexion greater than those obtainable with normal knee prostheses, and adequate for carrying out a normal physical activity.

The femoral component for a knee prosthesis thus conceived is
10 susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

Moreover, all the details may be substituted by other, technically equivalent elements.

In practice the materials employed, provided they are compatible with
15 the specific use, and the contingent dimensions and shapes, may be any according to requirements and to the state of the art.

The disclosures in Italian Patent Application No. 102016000048667 (UA2016A003373) from which this application claims priority are incorporated herein by reference.

20 Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

CLAIMS

1. A femoral component (1) for a knee prosthesis, comprising at least one convex articular surface (2, 22) that defines at least one femoral condyle (3, 23), characterized in that the posterior portion (4, 24) of said femoral
5 condyle (3, 23) is thicker than the distal portion (5, 25) of said femoral condyle (3, 23).

2. The femoral component (1) according to claim 1, characterized in that the maximum difference between the thickness of said posterior portion (4, 24) of said femoral condyle (3, 23) and the thickness of said distal
10 portion (5, 25) of said femoral condyle (3, 23) is comprised in the interval between 1.5 and 3.5 millimeters and is preferably substantially equal to 2.5 millimeters.

3. The femoral component (1) according to claim 1 or 2, characterized in that the thickness of said femoral condyle (3, 23) increases progressively
15 from said distal portion (5, 25) to said posterior portion (4, 24), reaching said maximum difference in thickness at said posterior portion (4, 24).

4. The femoral component (1) according to one or more of the preceding claims, characterized in that the thickness of said femoral condyle (3, 23) increases progressively between 20° of flexion (6) and 90° of flexion
20 (7) of said knee.

5. The femoral component (1) according to one or more of the preceding claims, characterized in that the anterior portion (8, 28) and the distal portion (5, 25) of said femoral condyle (3, 23) have a substantially constant thickness.

25 6. The femoral component (1) according to one or more of the preceding claims, characterized in that the posterior and proximal portion (9, 29) of said femoral condyle (3, 23) has a thickness that decreases progressively starting from 90° of flexion (7) of said knee up to the posterior and proximal end (11, 31) of said femoral condyle (3, 23).

30 7. The femoral component (1) according to one or more of the

preceding claims, characterized in that said convex surface (2, 22) has:

- a first radius of curvature adapted to define, in said distal portion (5, 25), up to 20° of flexion (6) of said knee, a substantially constant thickness of said femoral condyle (3, 23);

5 - a second radius of curvature adapted to define, between 20° of flexion (6) and 90° of flexion (7) of said knee, a progressively increasing thickness of said femoral condyle (3, 23);

- a third radius of curvature adapted to define, starting from 90° of flexion (7) of said knee up to said posterior and proximal end (11, 31), a

10 progressively decreasing thickness of said femoral condyle (3, 23).

8. The femoral component (1) according to one or more of the preceding claims, characterized in that it comprises two convex articular surfaces (2, 22), which define respectively a lateral femoral condyle (3) and a medial femoral condyle (23), the posterior portion (4) of said lateral

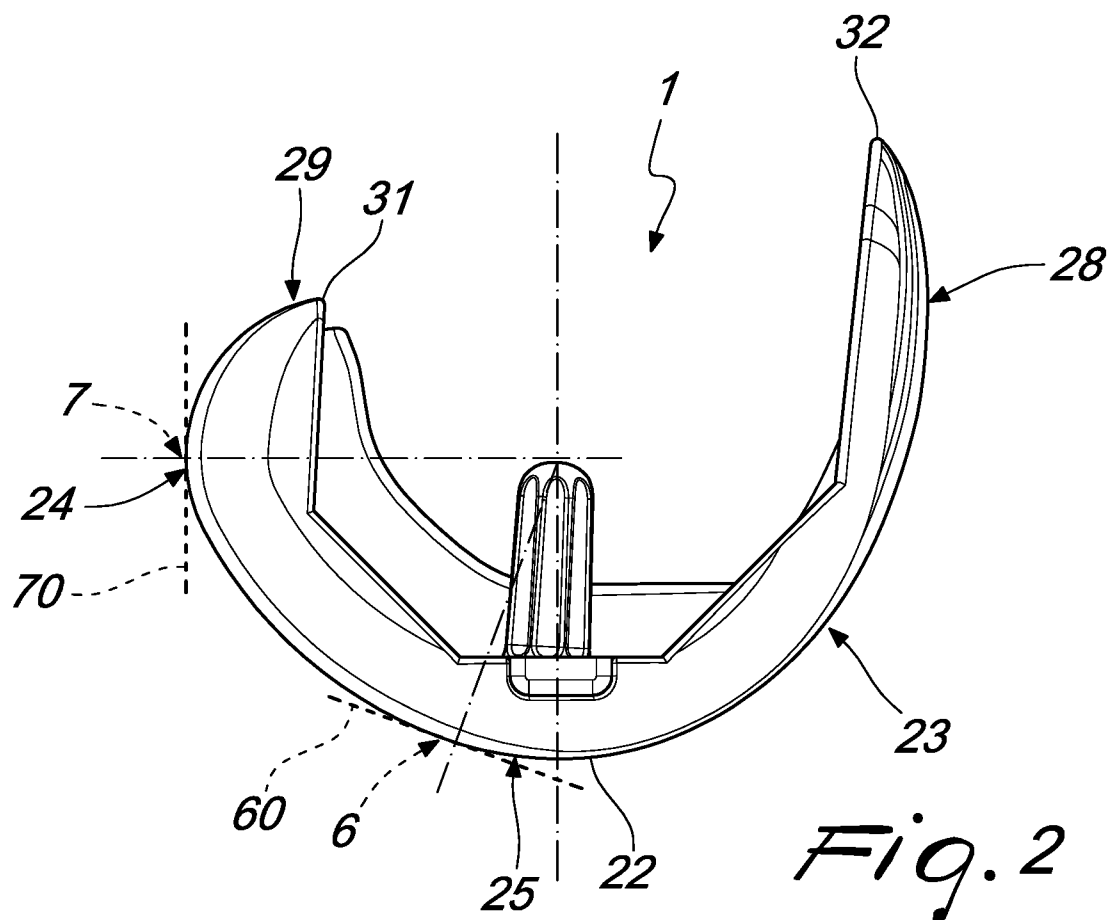
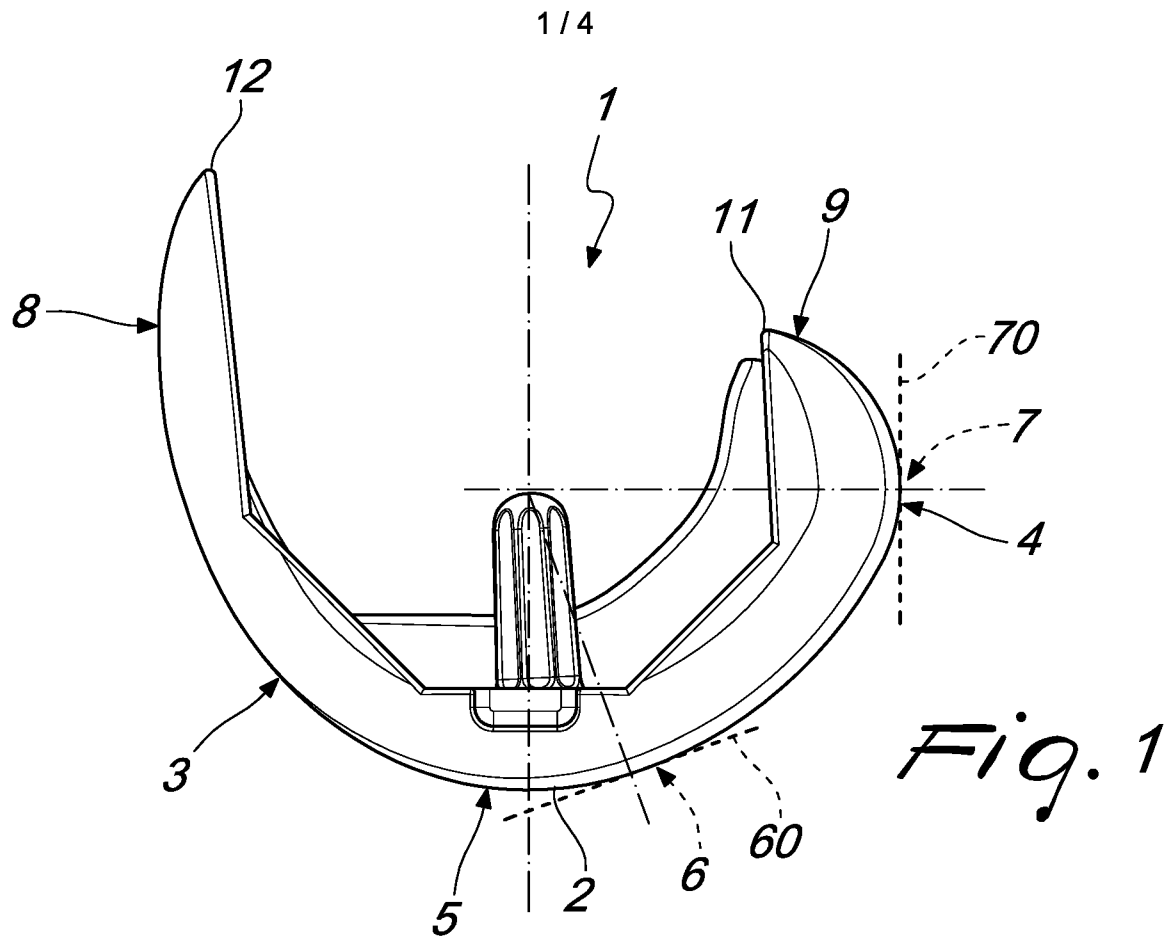
15 femoral condyle (3) being thicker than the distal portion (5) of said lateral femoral condyle (3), and the posterior portion (24) of said medial femoral condyle (23) being thicker than the distal portion (25) of said medial femoral condyle (23).

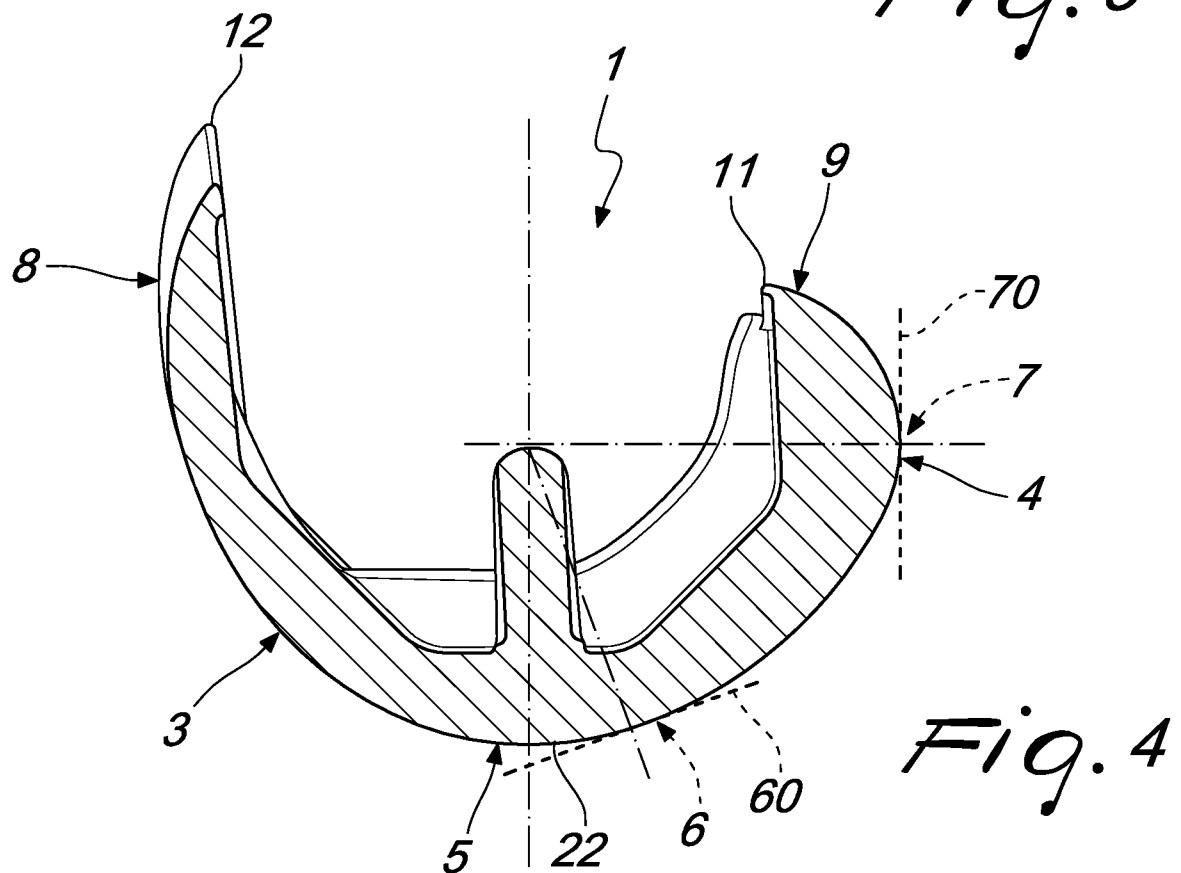
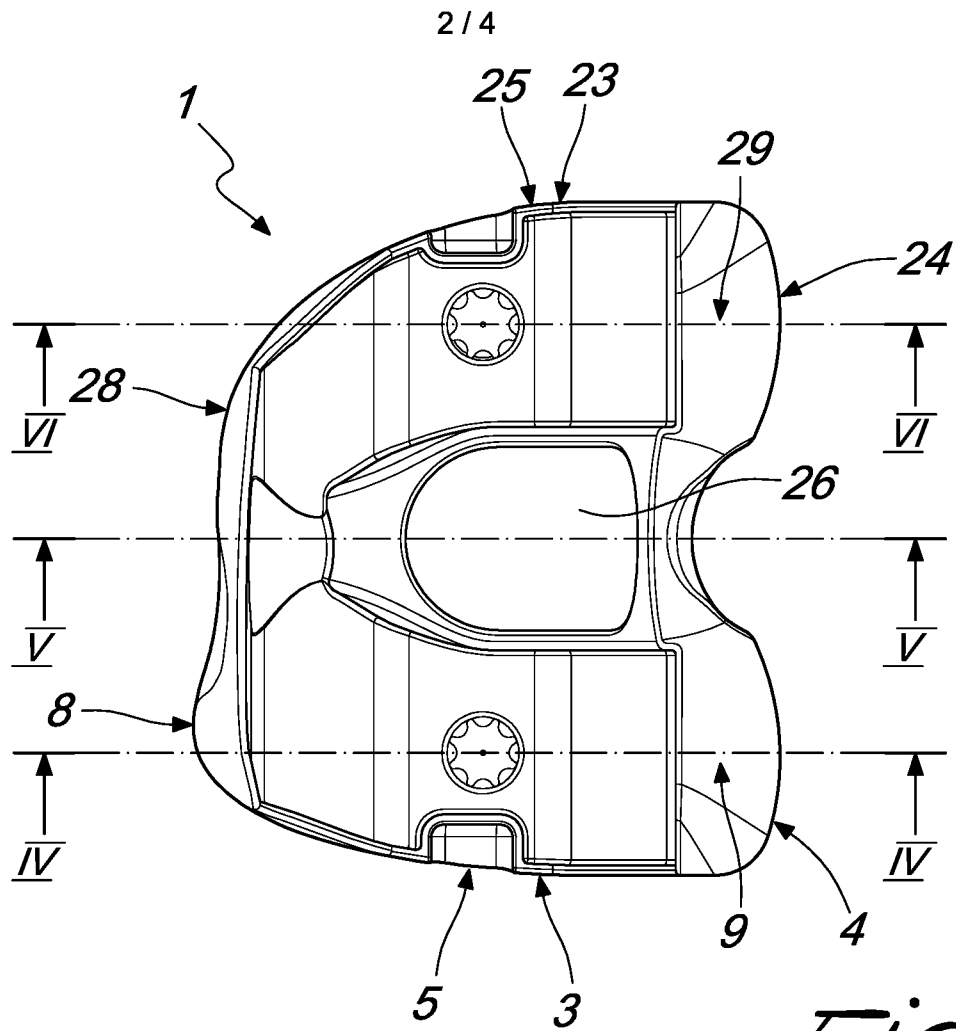
9. The femoral component (1) according to one or more of the

20 preceding claims, characterized in that it comprises, centrally and at said distal portion (5, 25), a cam (26) adapted to engage a corresponding pin (51) of a tibial insert (50).

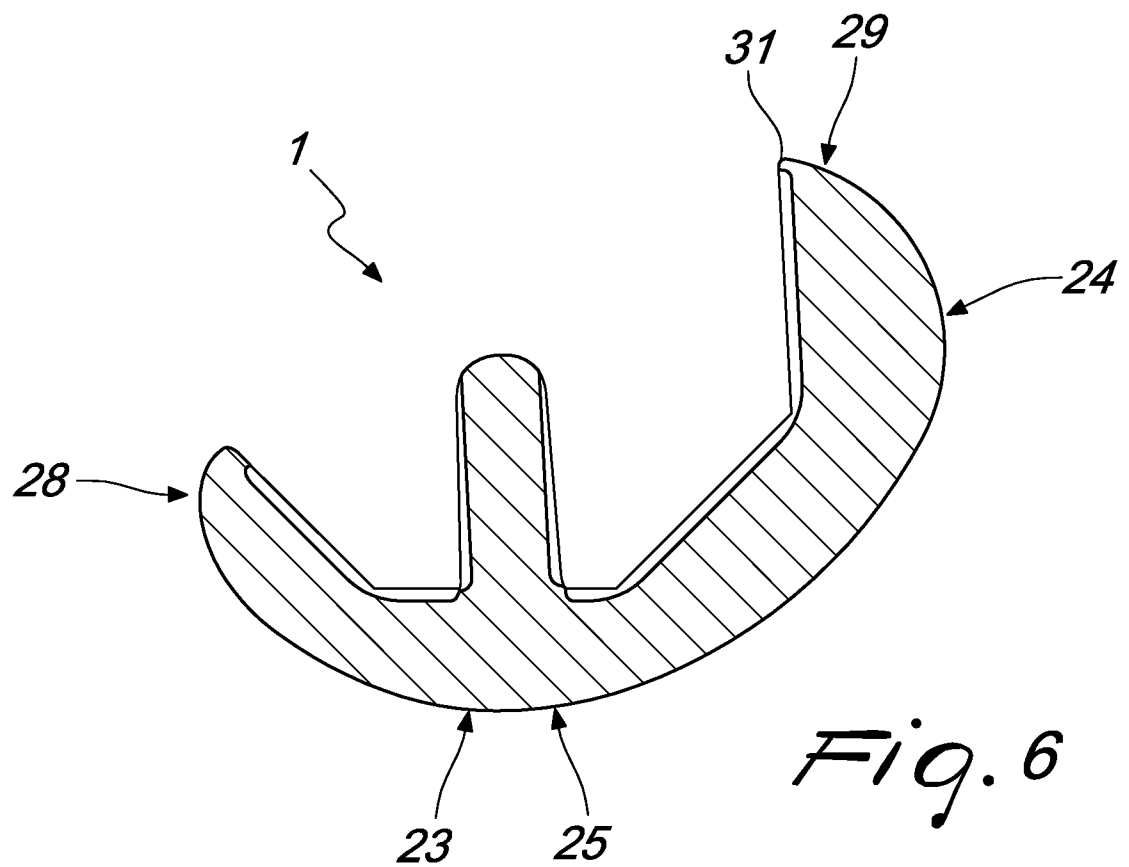
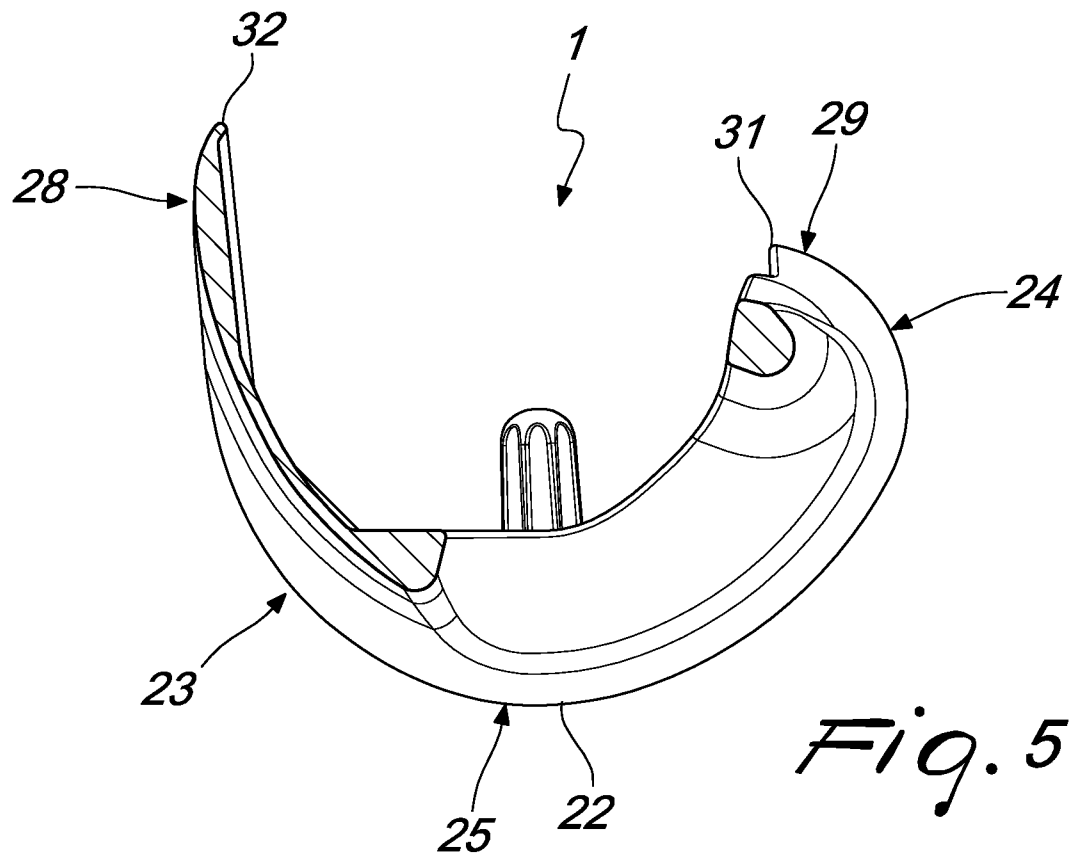
10. A knee prosthesis, comprising a femoral component (1) according to one or more of the preceding claims, characterized in that it comprises a

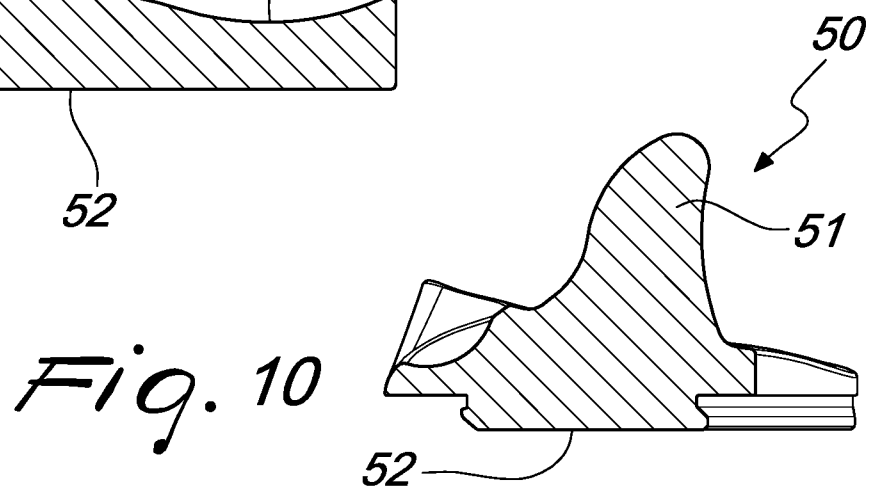
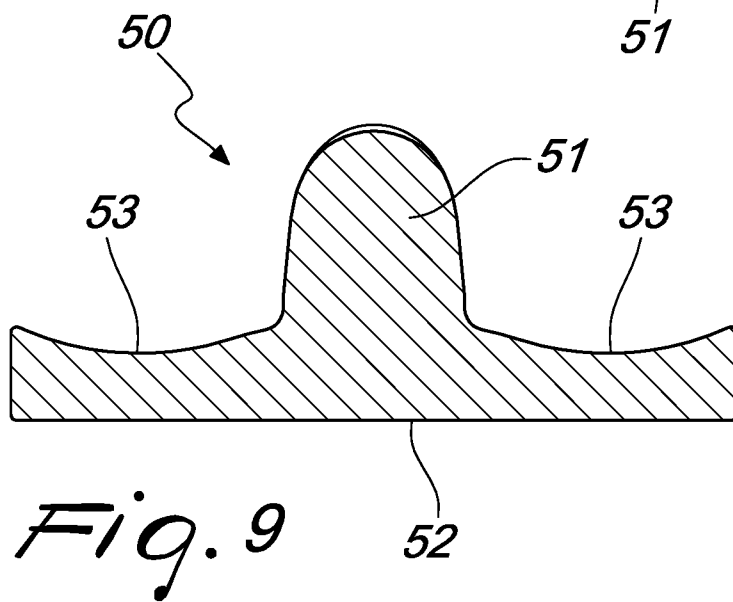
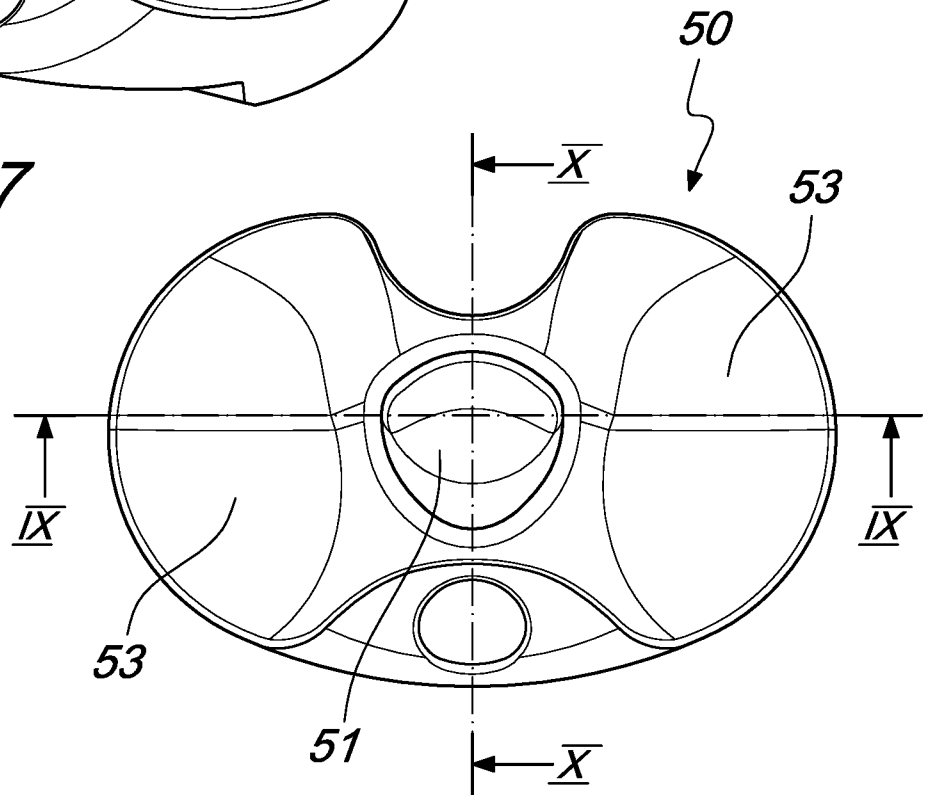
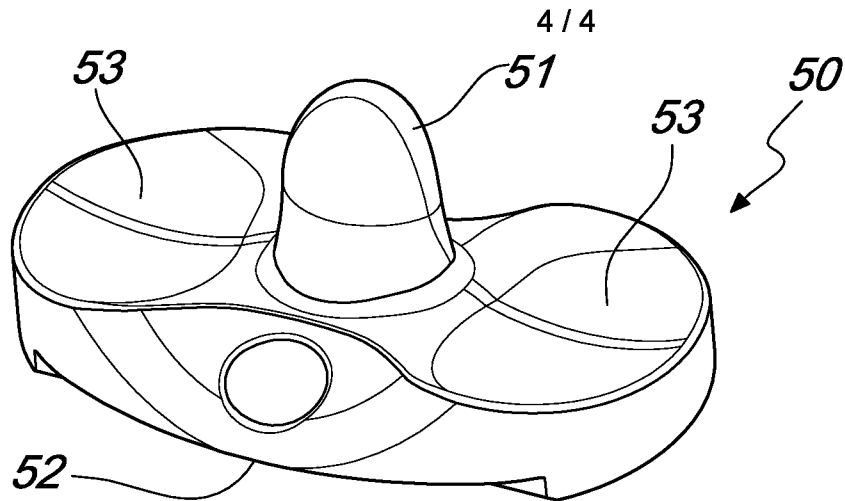
25 tibial component that comprises a tibial insert (50), which comprises a pin (51) that engages said cam (26) of said femoral component (1).





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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/061203

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61F2/38
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 practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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	-/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

9 June 2017

Date of mailing of the international search report

21/06/2017

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2017/061203

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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