United States Patent [19]

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[45] **June 26, 1973**

[54] **PROSTHESIS FOR HIP JOINTS**

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[52] **U.S. Cl.** ..... **3/1,** 128/92 C, 128/92 CA

[51] **Int. Cl.** **A61f 1/24**

[58] **Field of Search** ..... 128/92 C, 92 CA, 128/92 R; 3/1

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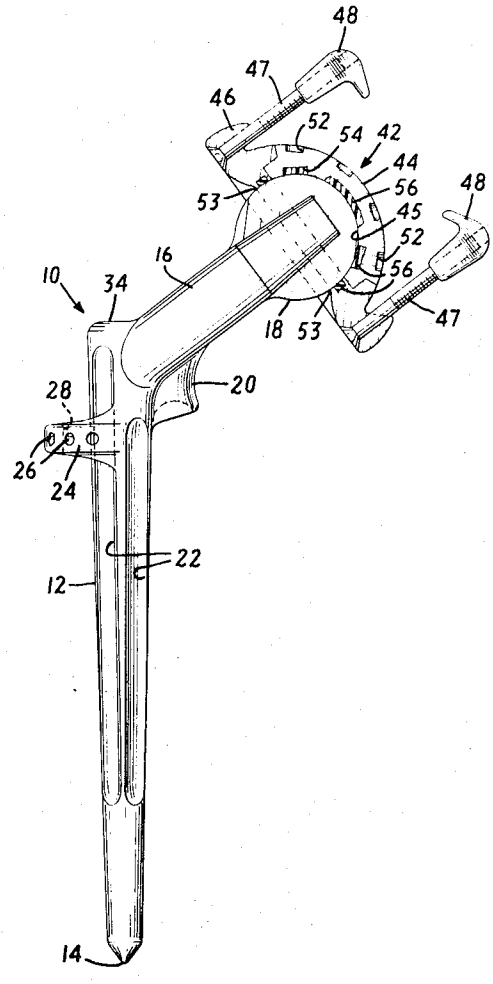
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[57] **ABSTRACT**

A prosthesis for hip joints is formed as a one-piece unit and has a spike-like stem that is inserted axially into the femur. An arm integral with the upper end of the stem projects outwardly at an obtuse angle relative to it and a ball is attached at the outer end of the arm for connecting the prosthesis to the acetabulum or artificial socket, whichever is used. A cup-shaped indexing means dimensioned and positioned to fit over the lesser trochanter projects outwardly from the stem. The axis of the arm and a ball is disposed at an angle relative to the cross-sectional axes of the stem so that when the indexing means engages the lesser trochanter, the arm and ball are aligned at the proper angle of anteversion.

3 Claims, 6 Drawing Figures



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SHEET 1 OF 2

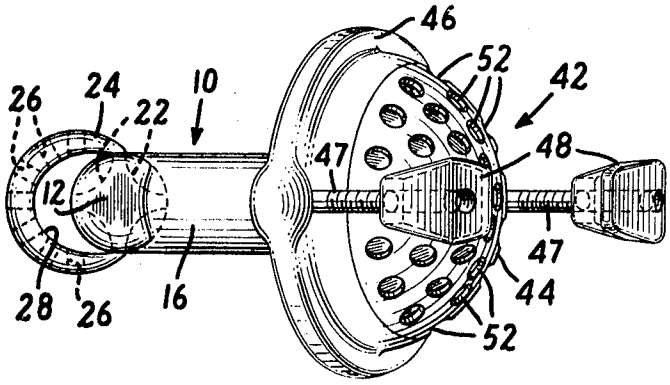


FIG. 2

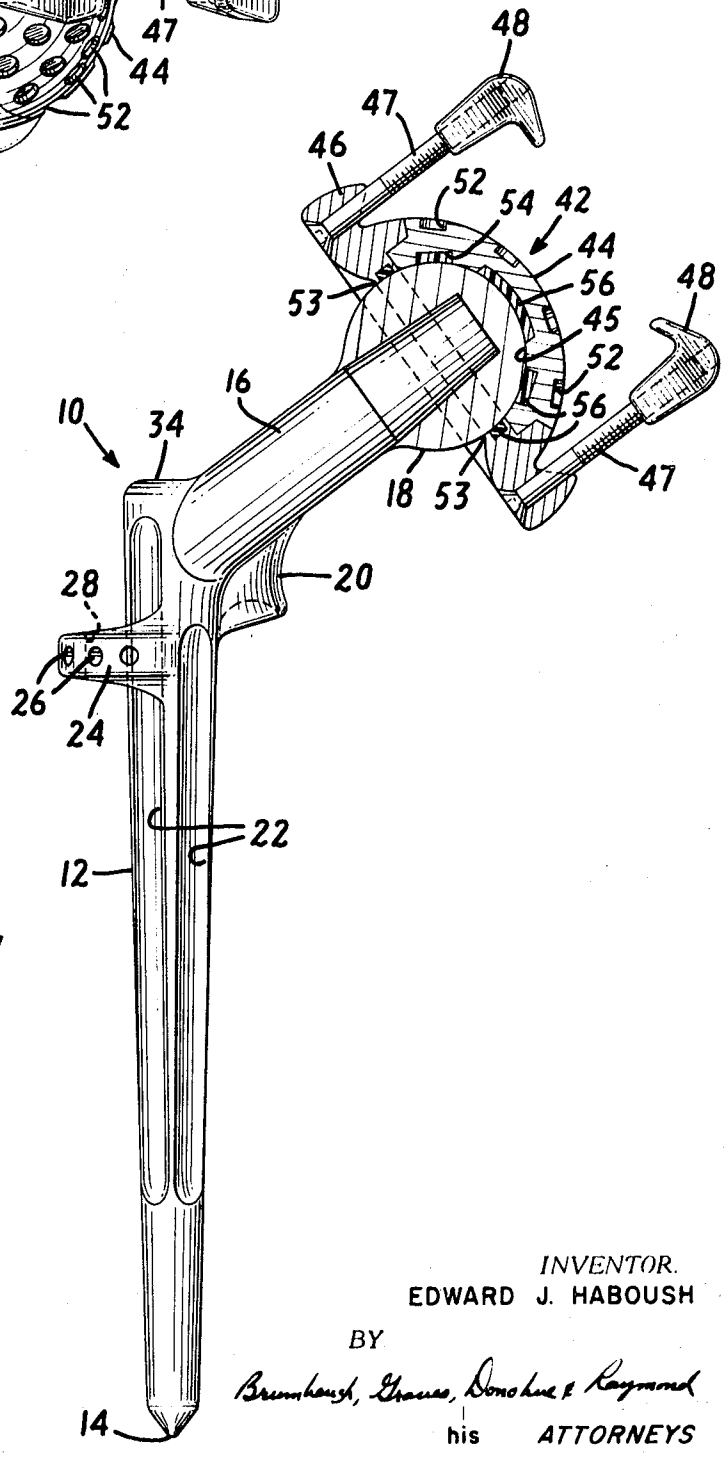


FIG. 1

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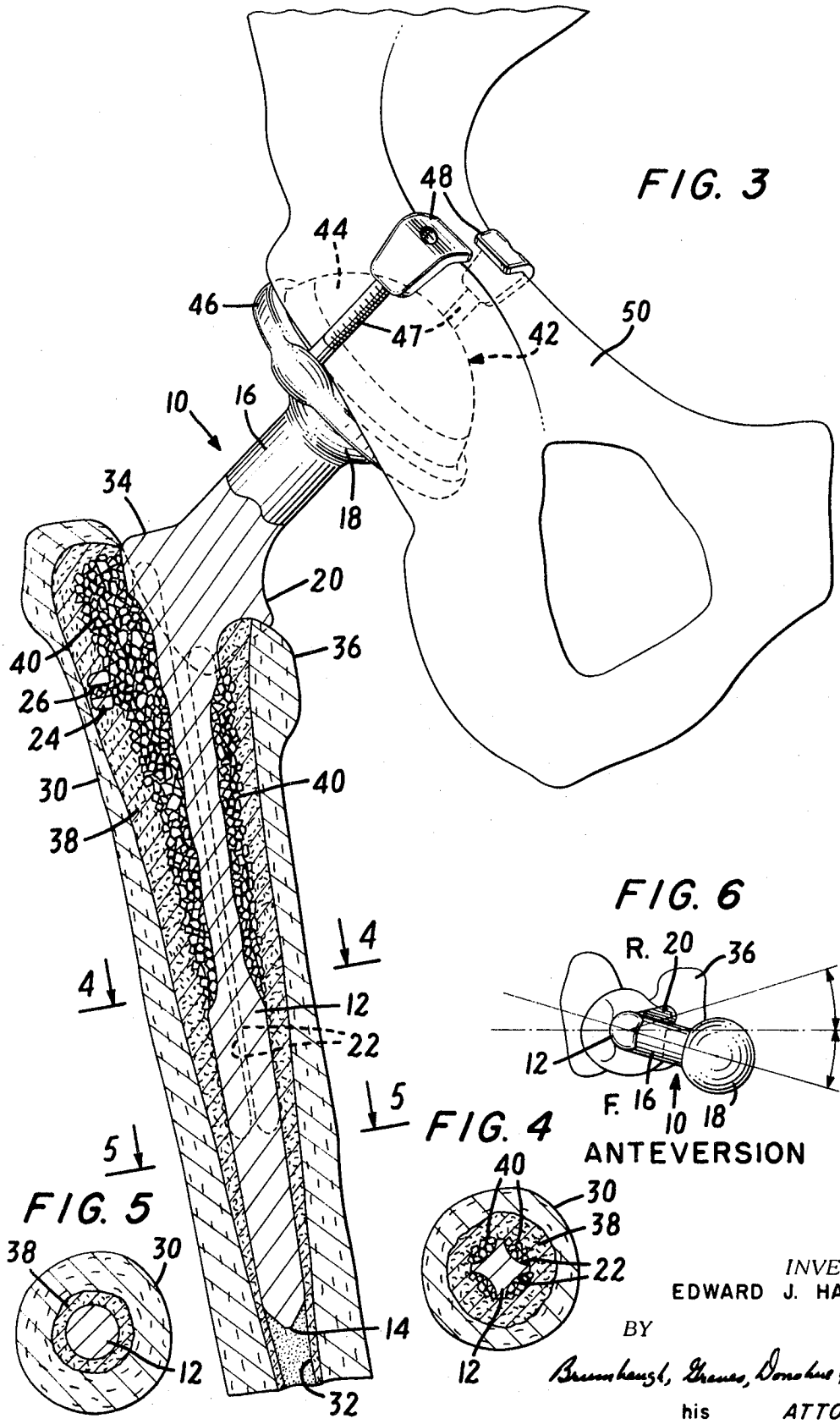


FIG. 3

FIG. 6

ANTEVERSION

FIG. 4

FIG. 5

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PROSTHESIS FOR HIP JOINTS

BACKGROUND OF THE INVENTION

This invention relates to prosthetic devices and more particularly to hip joint prostheses.

In cases of injury to the hip joint, the head and/or neck of the femur can be so badly fractured or chipped that complete replacement of that portion of the bone is needed to render the leg operable. Prostheses of diverse shapes and designs have been developed to repair such an injury, but most of these devices have proved unsatisfactory.

Proper alignment of the prosthesis so that the patient's leg will be oriented relative to the hip at the same angle of anteversion as before the injury is of critical importance for preventing the patient's foot from "toeing in" or "toeing out." Moreover, the prosthesis must be anchored securely enough to the femur so that it cannot shift as the patient moves about. If the prosthesis is not properly fitted, another serious and painful operation may have to be performed to correct the alignment.

The importance of properly aligning a hip joint prosthesis has been recognized and attempts have been made to solve this problem. However, most of these devices have proved unsatisfactory in that during the operation the physician must guess at the proper orientation of the device relative to the leg, and satisfactory installation depends primarily upon his ability to position the device properly under difficult operating conditions.

In several known hip joint prosthesis, a globular head is attached to a neck that projects from one end of an extended stem which is to be inserted axially into the femur. In these devices the globular head is attached to the stem at what is considered to be the proper anteversional angle. However, in order to align the globular head with respect to the femur, the surgeon must insert the stem accurately. It has been found that this is extremely difficult to accomplish.

These problems were recognized in my U.S. Pat. No. 3,067,740, in which a hip joint prosthesis was described and shown as having a femur engaging nail and a removable arm with a ball attached to it. The arm is securely mounted on the nail after the nail has been inserted into the femur, so that the arm and ball can be aligned at a selected anteversional angle without having to guess at the proper orientation of the nail as it is being inserted. Although this arrangement reduced the guesswork in properly aligning a hip joint prosthesis, it has not proven entirely satisfactory because of its unwieldyness and lack of conformity to the natural contours of the femur and because of the number of movable parts.

SUMMARY OF THE INVENTION

There is provided, in accordance with the invention, a novel and unique hip joint prosthesis that if formed in one piece and has an indexing means to guide the device into proper alignment during installation.

More specifically, the prosthesis has an elongated spike-like stem that is inserted axially into the femur, and an arm, integral with the stem and shaped to conform to the replaced portion of the bone, projects outwardly from its upper end at an obtuse angle relative to the stem. A ball is attached at the outer end of the arm

for connecting the prosthesis to the acetabulum or an artificial socket, if one is provided.

To ensure proper alignment of the prosthesis as the stem is being inserted into the femur, a cup-shaped indexing means projects outwardly from the stem near where the arm is located and is designed to fit over the lesser trochanter portion of the femur. The axis of the arm and ball is disposed at an angle relative to the stem so that when the cup engages the lesser trochanter, the arm and ball are aligned at the proper anteversional angle. In this way, the cup acts as a guide for the stem during insertion, thereby eliminating the guesswork in properly aligning the prosthesis.

A more precise fit can be attained between the indexing means and the lesser trochanter by shaping the inner surface of the cup to coincide with grooves that are formed along the sides of the lesser trochanter.

Once the arm and ball portion of the prosthesis are properly aligned relative to the femur, the device must be securely anchored to prevent it from shifting. This is done preferably by forming flutes or similarly shaped recesses along a substantial portion of the length of the stem and providing a perforated collar near the upper end. After the stem has been inserted axially into the femur, bone chips and/or bone shavings are packed around the stem in the flutes and through the perforations in the collar and the space between it and the stem, which fuse together and with the femur so that in time the stem is firmly anchored within the femur and is prevented from shifting as the patient moves about.

An artificial socket can be provided to accommodate the ball portion of the prosthesis if the acetabulum has been damaged. Many physicians believe that one should be provided even if the acetabulum is intact so that a better fit can be had and balls of a uniform size can be used for recipients of varying sizes. To install an artificial socket, the acetabulum is reamed out by a suitable instrument and the socket is inserted and held in place with a ring that is clamped to the hip bone by means of vice-like grippers that pass through the ring and fit over portions of the hip bone to form a force-fit assembly.

The inner surface of the socket and ring, which engages the ball, extends slightly beyond the diametrical center of the ball so that it is "captured" and held in place, while, at the same time, providing the leg with a full range of movement. Teflon plugs or rings can be inserted around the inner surface of the socket and ring for lubricating the ball until natural body lubrication is reassumed (which normally occurs from 6 to 12 weeks after the operation). Recesses can be formed on the outer surface of the socket adjacent the hip bone so that when the bone grows into the recesses the socket is firmly anchored in place.

Thus, a hip joint prosthesis is provided, in accordance with the invention, which has the advantages of an indexing means that guides the prosthesis into the femur at the proper angle so that any guesswork during the operation is eliminated, and the device is shaped so that when it is in place it closely resembles the contours of the natural bone to prevent irritation and possible damage of surrounding tissue. Moreover, the stem portion of the prosthesis is designed so that bone chips can most advantageously be packed around it for firmly anchoring the device within the femur.

DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention, reference may be had to the following description of the preferred embodiment, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a front pictorial view of the prosthesis with the ball being seated in an artificial socket, the ball and socket being shown in section for greater clarity;

FIG. 2 is a top pictorial view of the prosthesis shown in conjunction with the artificial socket, the view showing primarily the artificial socket, the arm and the perforated collar portions of the device;

FIG. 3 is a front view of the prosthesis after it has been inserted into the femur and bone chips have been packed around the stem, that portion being shown in section, and the artificial socket is shown as being clamped to the hip bone;

FIG. 4 is a sectional view of the femur and the stem portion of the prosthesis, taken along line 4—4 as shown in FIG. 3, showing primarily the flutes that extend along the surface of the stem and the bone chips which have been inserted for anchoring the prosthesis;

FIG. 5 is a sectional view of the femur and the stem portion of the prosthesis, taken along line 5—5 as shown in FIG. 3, showing a portion of the stem without the flutes; and

FIG. 6 is a top elevational view of the prosthesis after it has been inserted into the femur, showing primarily the proper alignment of the arm and ball relative to the femur.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Now, referring to FIG. 1, the prosthesis for hip joints is generally designated by reference numeral **10**. The prosthesis **10** has an elongated spike-like stem **12** which is preferably cone shaped and tapered at about ½ inch in 10 inches. The stem **12** is pointed at its lower end **14** to facilitate insertion into a femur. An arm **16**, integral with the stem **12**, projects outwardly from its upper end at an obtuse angle relative to the stem **12**. The outer end of the arm **16** is preferably tapered so that a ball **18** can be attached for connecting the prosthesis **10** with the acetabulum or an artificial socket, if one is used. The ball **18**, alternatively, can be formed as an integral portion of the arm **16**, instead of separately.

An indexing cup **20** is preferably formed as an integral part of the prosthesis **10** and projects outwardly from the stem **12** at or near the intersection of the stem **12** and the arm **16**; the inner surface of the cup **20** has a shape that coincides with the lesser trochanter portion of the femur. The cup **20** is positioned on the stem **12** relative to the axis of the arm **16** and the ball **18** such that when the stem **12** is inserted into the femur and the cup **20** engages the lesser trochanter, the arm **16** and ball **18** are aligned at the proper angle of anteversion relative to the femur, as shown in FIG. **6**.

The stem **12**, in the embodiment shown in FIG. **1**, has flutes **22** or similarly shaped recesses extending along a substantial portion of its length. At best shown in FIG. **2**, the stem **12** has a collar **24** integral with it and projecting outwardly from the side opposite the arm **16**. A plurality of spaced apart holes or perforations **26** extend entirely through the collar **24**, and an opening **28** is formed between the inner surface of the collar **24** and the stem **12**. As best shown in FIG. **3**, bone chips or shavings are packed around the stem **12** and collar **24** so that the prosthesis **10** will be firmly anchored in the femur, which will be discussed in greater detail below.

Referring now to FIG. **3**, a femur **30** which has had its head and neck portions removed and replaced by the prosthesis **10** is shown in section. The stem **12** is driven like a wedge into the isthmus **32**, which is the most dense portion of the femur **30**. A flat surface **34** is provided on the upper end of the stem **12** so that it can be driven by any suitable instrument.

As the stem **12** is being inserted, the cup **20** is lined-up relative to the lesser trochanter **36**, and the stem **12** is guided into the femur **30** so that when the cup **20** engages the lesser trochanter **36**, as shown in FIG. **3**, the arm **16** and ball **18** are aligned at the proper angle of anteversion. This alignment is shown in FIG. **6** where "F" and "R" indicate the front and rear, respectively, of the femur **30** and the angle of anteversion is shown as being preferably about 15° relative to the sagital axis **37** of the femur **30**, which is perpendicular to the central axis of the foot (not shown).

For a more precise fit between the cup **20** and the lesser trochanter **36**, grooves or other suitable indentations can be cut or otherwise formed along the sides of the lesser trochanter **36**, and the inner surface of the cup **20** can be shaped to coincide with those indentations.

As the stem **12** is driven into the isthmus **32** of the femur **30**, the collar **24** passes down through the spongy porous bone marrow in the femur **30**, which is designated by reference numeral **38**, and encounters little resistance. The collar **24** is provided to absorb tensional stress that normally would be imparted onto the stem **12**. After the stem **12** has been fully inserted into the femur **30**, bone chips or shavings, generally designated by reference numeral **40**, which are about one-fourth inch in size and smaller, are packed around the stem **12** and the collar **24**, and in the flutes **22**, the perforations **26** and the opening **28**. As best shown in FIG. **1**, the flutes **22** extend as close as possible to the upper end of the stem **12** to facilitate insertion of the bone chips and shavings **40**.

These bone chips and shavings **40** will eventually fuse together and with the femur **30** so that the prosthesis **10** is firmly anchored in place to prevent it from shifting. To provide the prosthesis **10** with an extra measure of rigidity before the fusion occurs, the bone chips and/or shavings **40** are packed around the stem **12** together with a cement formed of a dry homogenized, hydrogenated bone flour that has been dehydrated at about 100°C., to draw moisture from the surrounding bone. FIG. **4** is a sectional view of a portion of the femur **30** in which a stem **12** has been inserted, showing the bone chips **40** packed in the flutes **22**, as contrasted with the sectional view in FIG. **5** which shows a portion of the stem **12** in which the flutes **22** do not extend.

As best shown in FIG. **3**, the portion of the prosthesis **10** that projects from the femur **30** is rounded along all of its edges and generally shaped to conform to the portion of the bone that was replaced, so that the prosthesis **10** is "blended" with the femur **30** for preventing surrounding tissue from becoming damaged. The portion of the prosthesis **10** that projects from the femur **30** is polished to a mirror finish so that surrounding tissue will not adhere to it.

In many cases, the acetabulum (not shown) is replaced by an artificial socket in which the ball **18** is seated. Such an artificial socket is best shown in FIGS. **1** and **2**, and is generally designated by reference numeral **42**. First, the acetabulum is reamed out by a suitable instrument to a size sufficient to accommodate the socket portion **44**, which has an inner surface **45** that coincides with the diameter of the ball **18**. The ball **18** is then seated in the socket portion **44**, and a ring **46**, which is shaped for fitting engagement with the outer edge of the socket portion **44**, is clamped to the hip bone **50** by means of the screws **47** that pass through the ring **46** and the gripper jaws **48** that are threadedly engaged by the screws **47** and shaped to coincide with portions of the hip bone **50** (see FIG. **3**). In this way, a vice-like, force-fit assembly is provided to maintain the socket **42** in a fixed position relative to the hip bone **50**. Recesses **52** are spaced around the surface of the socket portion **44** adjacent the hip bone **50** so that the bone **50** can grow into the recesses **52** and firmly anchor the artificial socket **42** in place. As with the prosthesis **10**, all of the edges on the artificial socket **42** are rounded so that surrounding tissue is not damaged.

The outer edge **53** of the ring **46** extends slightly below the diametrical center of the ball **18** so that the ball **18** is "captured" within the socket **42**, while permitting the leg to have a full range of movement. A plurality of recesses **54** are spaced around the inner surface **45** of the ring **46** and the socket portion **44**, and rings or plugs **56**, formed of Teflon or other suitable material, are inserted in the recesses **54** for lubricating the surfaces of the socket **42** and ball **18** until the body reassumes natural lubrication of the joint, which usually takes about **6** to **12** weeks from the date of the operation. The use of the artificial socket **42** with the prosthesis **10**, eliminates the chance of an ill fitting connection between the ball **18** and the acetabulum and enables prostheses to be produced with balls of uniform size.

Prostheses can be made that fit people of different sizes by varying the length of the stem **12** and the arm **16** and the diameter of the outer surface of the socket **44**. In this way, the prostheses can be preformed and sized at, for example, ⅛ inch increments so that there is no delay in providing a prosthesis of the proper size.

Thus, there is provided, in accordance with the invention, a prosthesis for hip joints that can be inserted into the femur without having to guess at the proper alignment and that has a stem which is shaped so that the prosthesis can be rigidly fixed within the femur. All the edges of the prosthesis are rounded and the portion that projects from the femur is shaped to conform to the shape of the replaced bone for preventing nearby tissue from becoming damaged. The embodiment of the invention described above is intended to be merely exemplary, and those skilled in the art will be able to make modifications and variations without departing from the spirit and scope of the appended claims.

I claim:

1. A prosthesis for hip joints comprising an elongated spike-like stem adapted to be inserted axially into the upper portion of the femur, an arm attached at the upper end of the stem and projecting outwardly therefrom at an obtuse angle relative to the stem, a ball-shaped member attached at the outer end of the arm for connecting the prosthesis to a socket, and means on the stem indexed relative to a designated portion of the femur, the arm and ball being disposed at an angle relative to said means so that when the stem is fully inserted in the femur and said means coincides with said designated portion of the femur, the arm and ball are aligned at a predetermined angle relative to the transverse axes of the femur, said means including a

cup-shaped member projecting outwardly from the side of the stem near the intersection of the stem and the arm, the cup-shaped member being shaped and dimensioned to fit over the upper portion of the lesser trochanter portion of the femur.

2. A prosthesis for hip joints according to claim **1**, wherein the stem is generally cone-shaped and has a plurality of flutes spaced apart around the outer surface and extending along a substantial portion of the length thereof, the stem further includes a collar portion projecting outwardly therefrom opposite the arm, thereby forming an opening between the collar and the stem, and the collar has a plurality of holes therein.

3. A prosthesis for hip joints comprising an elongated spike-like stem adapted to be inserted axially into the upper portion of the femur, an arm attached at the upper end of the stem and projecting outwardly therefrom at an obtuse angle relative to the stem, a ball-shaped member attached at the outer end of the arm for connecting the prosthesis to a socket, a cup-shaped member projecting outwardly from the side of the stem near the intersection of the stem and the arm, the cup-shaped member being shaped and dimensioned to fit over the upper portion of the lesser trochanter portion of the femur, the arm and ball being disposed at an angle relative to said cup-shaped member so that when the stem is fully inserted in the femur, the arm and ball are aligned at a predetermined angle relative to the transverse axes of the femur, said stem being generally cone-shaped and having a plurality of flutes spaced apart around the outer surface and extending along a substantial portion of the length thereof, the stem further including a collar portion projecting outwardly therefrom opposite the arm, thereby forming an opening between the collar and the stem, the collar including a plurality of holes therein, and an artificial socket receiving the ball, the artificial socket including an inner socket portion and a separate outer ring portion that engages the socket along the outer edge thereof, both of said portions having an inner surface shaped and dimensioned to accommodate the ball and extending a short distance beyond the diametrical center of the ball so that when the artificial socket engages the ball, said ball is movably captured therein, a pair of threaded screws pass through holes located in the ring and project outwardly from the artificial socket away from the arm of the prosthesis, and gripper jaws are threaded onto the outer ends of the screws, the jaws being shaped to fit over portions of the hip bone for securing the artificial socket to the hip bone.

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