

[54] **ARTIFICIAL HIP JOINT AND METHOD OF IMPLANTING IN A PATIENT**

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

[56] **References Cited**

UNITED STATES PATENTS

3,228,393 1/1966 Michele..... 128/92 CA

OTHER PUBLICATIONS

"Arthroplasty of the Hip Using Foreign Materials: A History" by J. T. Scales, Proceedings The Institution of Mechanical Engineers, Vol. 181, Part 3J, 1966-1967, pages 72 and 80-81 relied upon.

"Teflon Hip Prostheses in Dogs" by J. D. Leidholt et

al., Journal of Bone & Joint Surgery, Vol. 47-A, No. 7, pp. 1414-1420, Oct. 1965.

Richards Manufacturing Co. (catalog), Memphis, Tenn., 1966, Smith-Peterson Smo Hip Cups, page 147.

Richards Bechtol Femoral Prosthesis, (Advertisement), Richards Manufacturing Co., Memphis, Tenn., Received Aug. 24, 1966.

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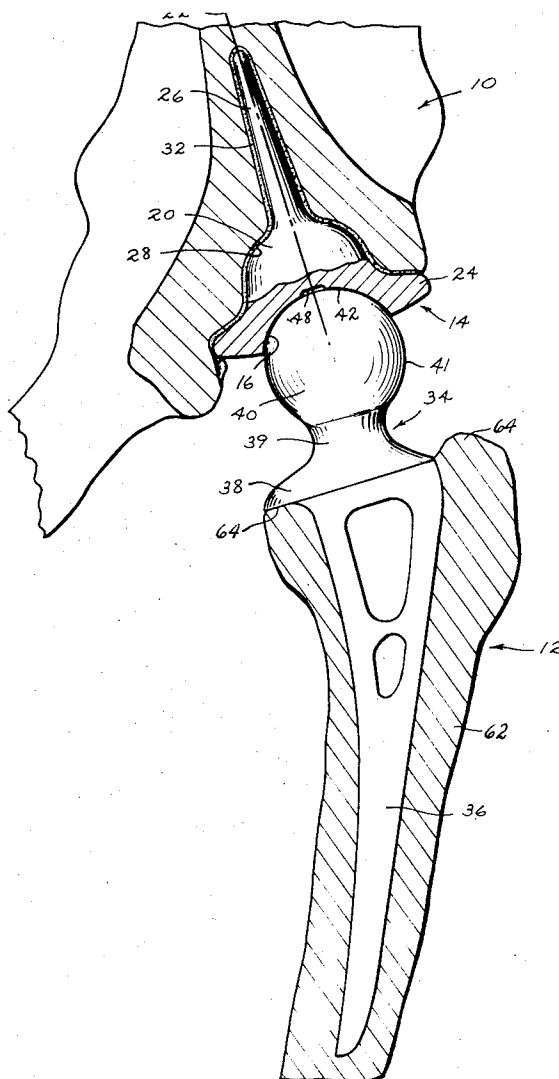
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ABSTRACT

An artificial hip joint having a cup-shaped acetabular component and a femoral component carrying a ball in which the acetabular component when inserted into the acetabulum of a patient shifts about a controlled axis of rotation. The ball of the femoral component fits within the socket of the acetabular component and makes rolling contact with the socket wall spaced from the axis of rotation of the acetabular component during walking movement of the femur.

20 Claims, 11 Drawing Figures



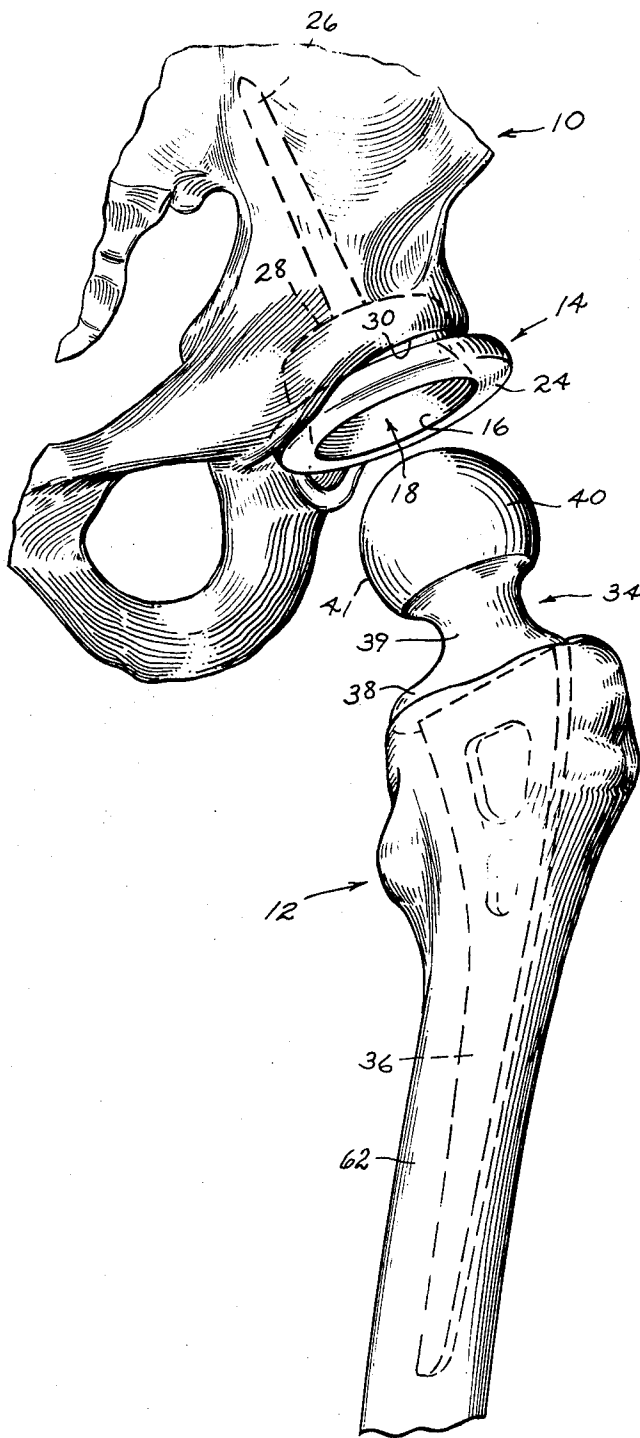
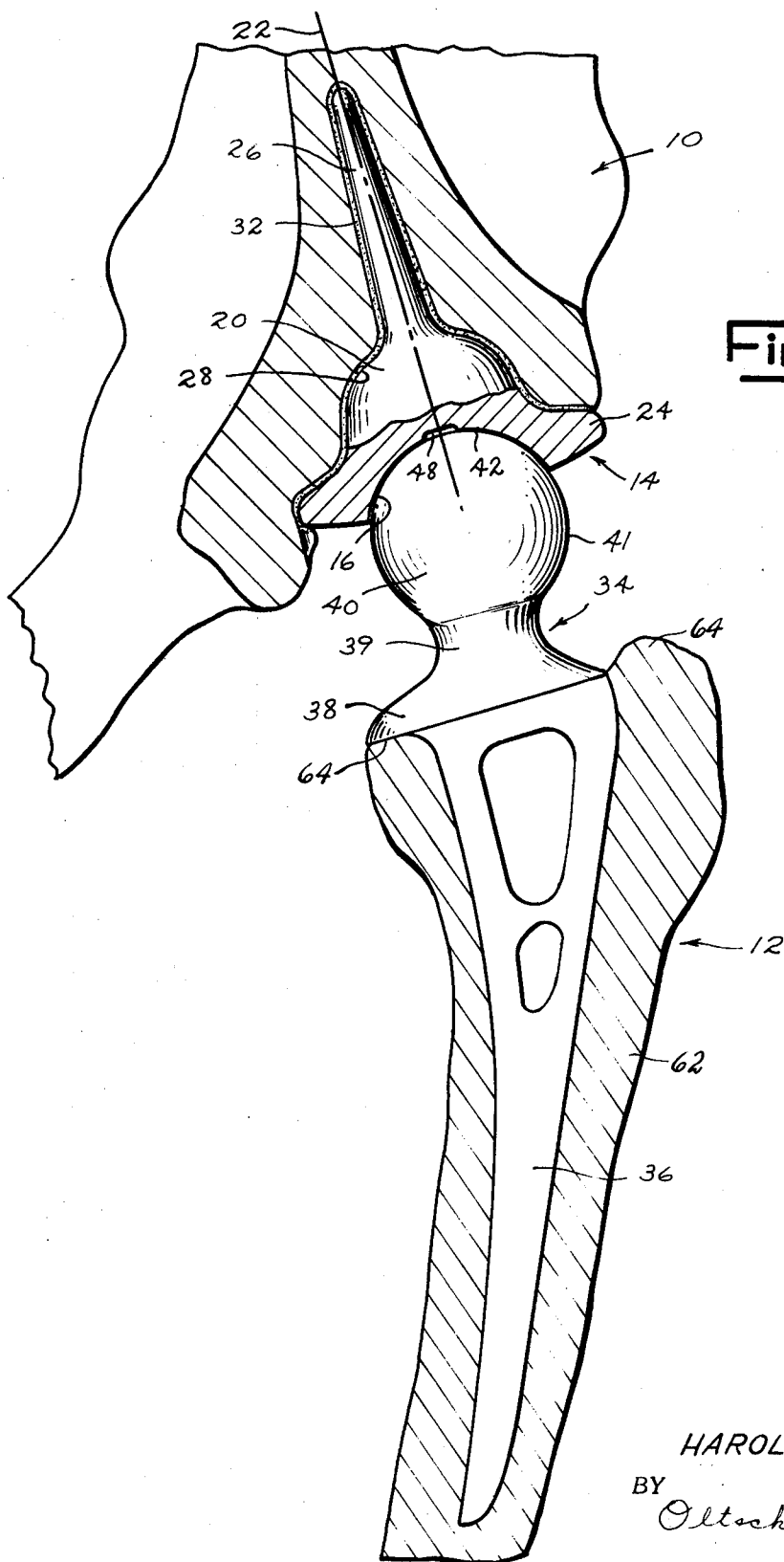
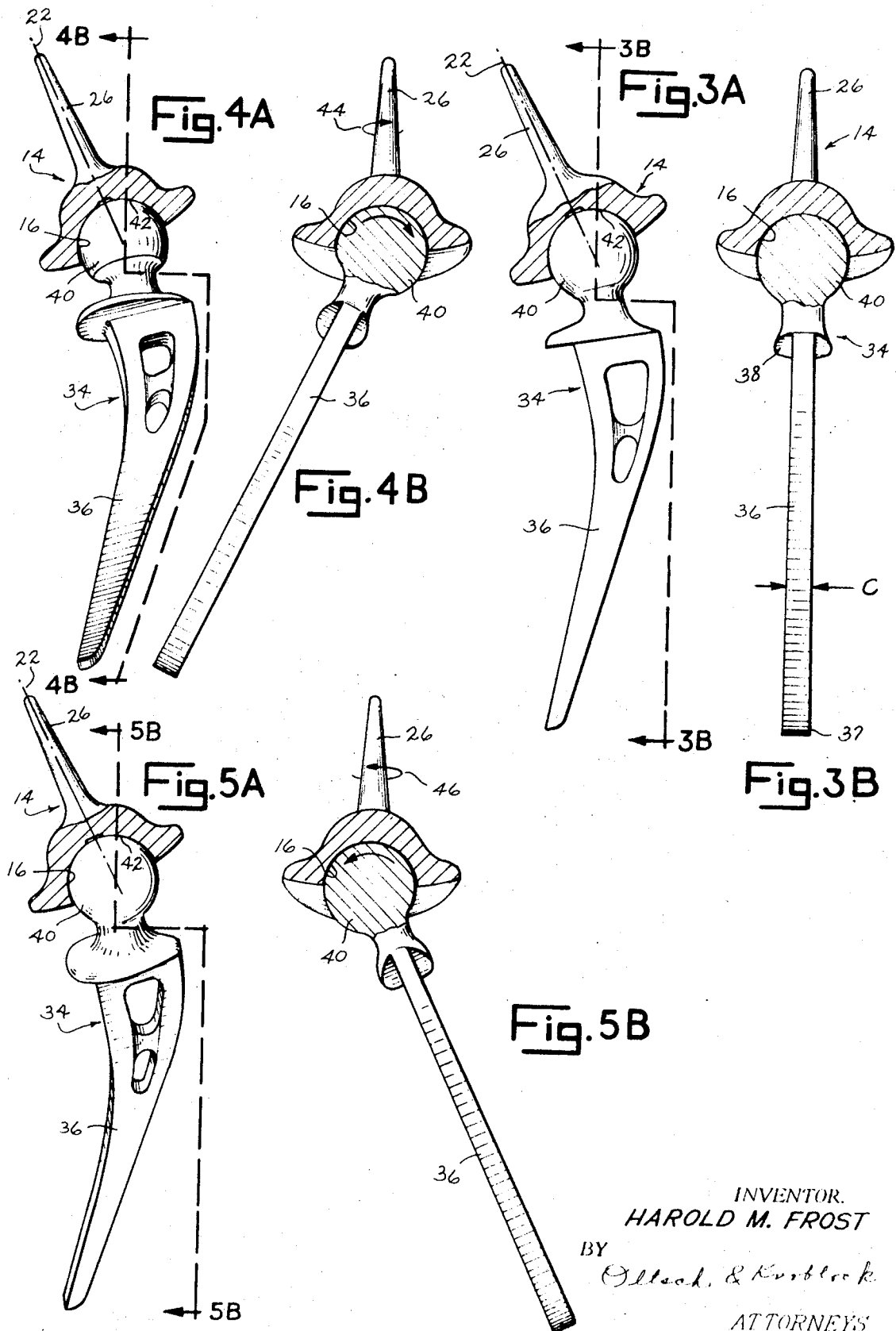


Fig. 1

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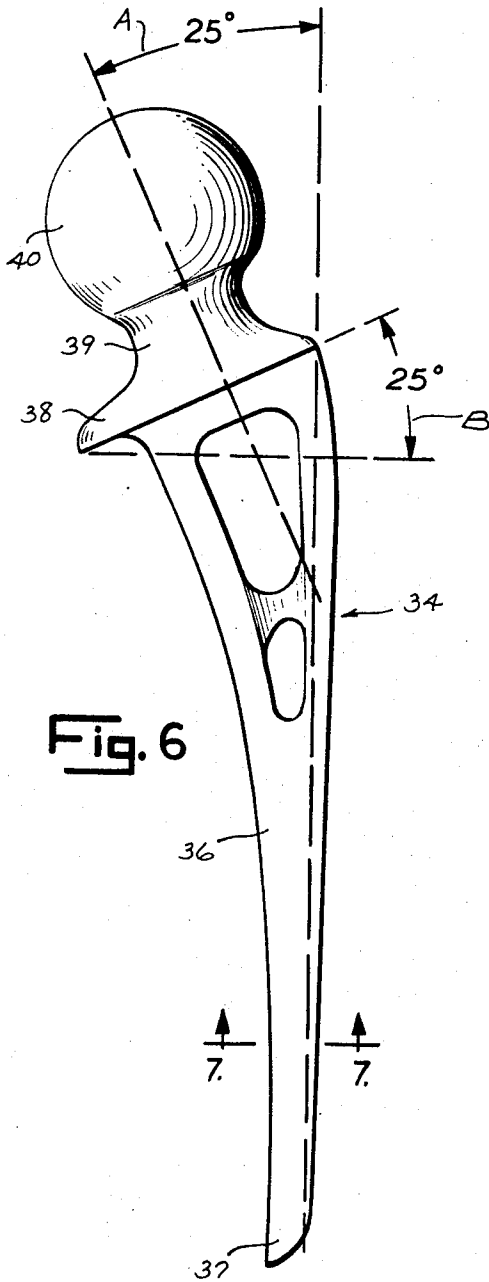


Fig. 6

Fig. 7

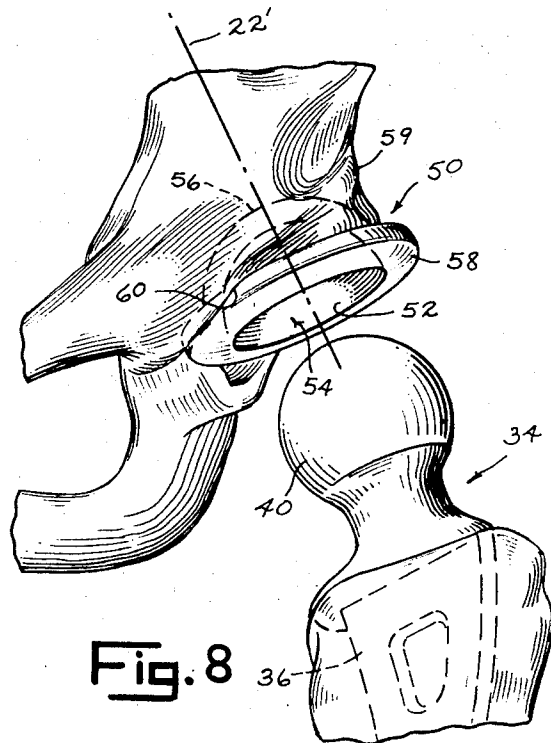
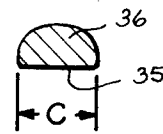


Fig. 8

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ARTIFICIAL HIP JOINT AND METHOD OF IMPLANTING IN A PATIENT

BACKGROUND OF THE INVENTION

This invention relates to the field of orthopaedic surgery and has particular application to a total artificial hip joint and the implantation thereof.

A means of total surgical correction of a deteriorated or otherwise malfunctioning hip joint is to replace the femoral head and neck with an artificial ball which fits within an artificial cup inserted into the acetabulum of the patient. The artificial ball and cup are generally constructed from a hard material, such as a cobalt-chromium alloy, which is biologically acceptable to the patient. It has heretofore been the general practice either to cement the acetabular component to the pelvic bone, such as in the manner described in U.S. Pat. No. 3,521,302, or to provide the acetabular component with retainer means, such as the spikes found in U.S. Pat. No. 2,910,978, for anchoring the acetabular component to the pelvic bone. When the artificial ball carried by the femur of the patient is inserted into an artificial cup which is rigidly attached to the pelvic bone and walking movement of the femur takes place, there is sliding or rubbing action between the ball and cup of the hip joint which creates wear of the components and a resulting deposit of minute fragments from the cup and ball about the joint area. This rubbing action between the cup and ball not only creates undesirable wear pockets on the ball and within the socket of the cup, but the deposit of the cup and ball fragments about the joint area can cause inflammation of the joint and discomfort to the patient. Even in the type of surgery in which a Smith-Peterson type acetabular cup is inserted into the acetabulum of the patient and not attached to the pelvic bone there still exists a sliding motion between the implanted cup and ball which creates an undesirable wear effect upon the artificial hip joint and the deposit of wear fragments about the joint area.

In this invention, the artificial cup and ball of the hip joint are designed to materially reduce wear between the components.

SUMMARY OF THE INVENTION

In this invention, the acetabular component of the artificial hip joint includes a cup which is designed so that when inserted into the acetabulum of the patient it will rotate freely about a controlled axis of rotation. The femoral component of this invention includes a ball which is designed so as to fit with slight clearance within the socket of the acetabular cup and there contact the inner surface of the cup at all times during fore and aft walking movement of the femur at points spaced from the axis of rotation of the cup. This structural relationship between the acetabular cup and the femoral ball of the artificial hip joint permits the ball to experience rolling action relative to the cup during walking movement of the femur, thus materially reducing wear between the cup and ball which, in turn, reduces the deposit of fragments from the artificial components about the joint area.

The artificial acetabular and femoral components of this invention are of a sufficient strength so as to minimize the risk of fatigue failure of the components after extended periods of use. Also the components of this invention can be implanted within the patient by persons skilled in orthopaedic surgery in less time and with

less tissue manipulation than the standard prior art hip arthroplasty devices utilized presently. Additionally, the acetabular component of this invention because of its large area of surface contact with the pelvic bone serves to reduce the concentration of hip load forces at the acetabulum, thus minimizing any tendency for the component to migrate into the pelvic bone and further minimizing the bursting loads acting upon the pelvis about the area of the acetabular component.

The design of the femoral component of this artificial hip joint serves to position the femoral shaft more nearly under the acetabulum of the hip, thereby causing a shortening of the abductor and obturator muscles of the hip which in turn weakens such muscles and reduces the total load upon the corrected hip. Additionally, by moving the shaft of the femur more nearly under the acetabulum of the patient, the hip loads are directed more closely along the shank of the femur, thereby reducing any tendency for the stem of the femoral component to wiggle or experience a "toggle" motion when seated within the femur.

Accordingly, it is an object of this invention to provide an artificial hip joint having an acetabular component carried by the pelvis and a femoral component which is received within the acetabular component and secured to the femur and which upon walking motion of the femur causes the acetabular component to experience shiftable movement within the pelvis about an axis of rotation.

Another object of this invention is to provide a hip joint replacement having an acetabular component and a femoral component in which the femoral and acetabular components experience rolling movement relative to each other upon fore and aft walking movement of the femur which carries the femoral component.

Another object of this invention is to provide an artificial hip joint having a long useful life while providing minimal patient discomfort.

It is a further object of this invention to provide an artificial hip joint having an acetabular component which in cooperating with an artificial femoral component of the joint is designed to distribute the hip load over the pelvic bone area which receives the acetabular component, thereby reducing the unit load and bursting force to which the pelvic bone is subjected during use of the joint.

Still another object of this invention is to describe a method for providing an artificial hip joint for a patient.

And still another object of this invention is to provide a prosthesis for the femoral head and neck which reduces the operational load upon the hip joint.

Further objects of this invention will become apparent upon a reading of the invention's description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of one embodiment of the artificial hip joint of this invention showing the acetabular and femoral components of the joint implanted in their respective body parts but in separated form for purposes of illustration.

FIG. 2 is a sectional view of the hip joint illustrated in FIG. 1 showing the acetabular and femoral components in engagement.

FIG. 3A is illustrative of the hip joint of FIG. 1 showing the acetabular and femoral components of the joint in one operative position.

FIG. 3B is a view taken along line 3B—3B of FIG. 3A.

FIG. 4A is a perspective view of the acetabular and femoral components shown in FIG. 3A showing the stem of the femoral component pivoted forwardly as if the leg were swung forwardly in a walking motion.

FIG. 4B is a view taken along line 4B—4B of FIG. 4A.

FIG. 5A is a perspective view of the acetabular and femoral components of FIG. 3A showing the stem of the femoral component pivoted rearwardly as if the leg were swung rearwardly in a walking motion.

FIG. 5B is a view taken along FIG. 5B—5B of FIG. 5A.

FIG. 6 is a side view of the femoral component of the hip joint illustrated in FIG. 1.

FIG. 7 is a cross sectional view taken along line 7—7 of FIG. 6.

FIG. 8 is a fragmentary perspective view of another embodiment of the hip joint of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments illustrated are not intended to be exhaustive or to limit the invention to the precise forms disclosed. They are chosen and described in order to best explain the principles of the invention and its application and practical use to thereby enable others skilled in the art to best utilize the invention.

Referring to FIGS. 1 and 2, numeral 10 represents the pelvis and numeral 12 represents the femur of a patient. The acetabular component 14 of the embodiment of the artificial hip joint shown in FIGS. 1 and 2 is of a cup-shaped configuration having an inner spherical surface 16 which defines a socket 18. Component 14 includes an axis of rotation, designated by line 22 in FIG. 2, about which inner surface 16 is symmetrically formed and an outer surface 20 of revolution formed symmetrically about axis 22. Surfaces 16 and 20 are circular and concentric in all planes normal to axis 22. The opening or mouth of socket 18 is defined by a coaxial annular outturned flange or lip 24 which forms a part of outer surface 20. Outer surface 20 of component 14 defines a coaxial stem 26 which extends rearwardly of socket 18. Stem 26 is preferably tapered and is separated from lip 24 by an annular coaxial shoulder 28 which forms a part of outer surface 20.

With the patient under anesthetic and the hip joint exposed with the femoral head separated from acetabulum 30 of pelvis 10, a reamer or similar bone cutting tool is utilized to reshape acetabulum 30 to complementarily receive the acetabular component 14. A hole is selectively punched in the bone shell in the acetabulum. The acetabular component 14 is then inserted up into the reshaped acetabulum with stem 26 entering the hole punched therein and thereafter being urged into the cancellous pelvic bone just above the acetabulum. The reformed acetabulum 30 is preferably sized so as to be one to two millimeters larger than the acetabular component for the purpose of permitting fibro cartilage 32 to post-operatively form between the acetabular component and pelvic bone. Outer surface 20 of component 14 is of a smooth finish so as to permit unrestricted rotative movement of the component about its axis of rotation when in acetabulum 30. Lip 24 and shoulder 28 including to a limited extent stem 26 of component 14 serve by engaging pelvis 10 to minimize

wobbling or similar movement of the component within the acetabulum and thus control the position of the axis 22 of rotation of the component and guide the component's movement. Additionally, lip 24 and shoulder 28 provide large bone contact surfaces which serve to widely distribute the hip joint load to the pelvic bone and thus reduce the concentration of bursting forces transmitted to the bone structure of the acetabulum. For an acetabular component 14 having an outer diameter of 57 mm as measured across lip 24, there will be a load carrying cross sectional area of approximately 25.6 cm². Approximately 90 percent, or 23 cm², of this area will make effective bone contact to distribute the hip joint load.

The femoral component 34 of the artificial hip joint illustrated in FIGS. 1 and 2 includes a stem 36, which may be the standard Austin-Moore type if desired, a platform 38 carried at the expanded end of stem 36, and a head or ball 40 which is connected to platform 38 by a neck 39. Ball 40 has a spherical surface 41. Femoral component 34 is inserted into femur 12 by first surgically removing the head and preferably also the neck of the femur. Stem 36 of component 34 is then driven downwardly through the approximate center of shaft 62 of the femur until platform 38 is brought into contact with the trochanter-defining shoulders 64 of the femur as shown in FIGS. 1 and 2. Ball 40 of femoral component 34 is designed to have a smaller radius than the radius of socket 18 of acetabular component 14. The difference in radial dimension between ball 40 and socket 18 is preferably between 0.003 and 0.0003 inches. Referring to FIG. 6, dimension A which represents the angle head ball 40 makes relative to the vertical axis of stem 36 is preferably 25°. This dimension varies from the 35° similar angle in other types of prior art femoral components and the normal 35° to 40° angle that the femoral head makes relative to the shank of the femur in a human. Dimension B in FIG. 6 represents the angle platform 38 makes relative to a horizontal line intersecting the axis of stem 36. Dimension B is preferably 25° which varies from the 35° to 40° angle commonly used in prior art femoral components. The purposes of these angular relationships of ball 40 and platform 38 will be explained later. Acetabular component 14 and femoral component 34 are formed of a hardened, biologically acceptable metal, such as a cobalt-chromium-molybdenum alloy, or a plastic.

In the operative procedure, ball 40 of femoral component 34 is inserted by a surgeon into socket 18 in acetabular component 14 and thereafter is held therein by the muscles of the hip joint. Since ball 40 is of a smaller dimension than socket 18, the ball will contact inner surface 16 of the acetabular component at a location 42 for a given position of stem 36. The term "contact" as used in the description and claims of this invention includes not only load transferring relationships where components 14 and 34 actually physically touch but also those load transferring relationships where ball 40 is slightly separated from inner surface 16 of socket 18 at the point of load transfer by a thin layer of body fluid. Both surface 41 of ball 40 and inner surface 16 of the acetabular component are polished and have a coefficient of friction therebetween which exceeds the coefficient of friction between outer surface 20 of the acetabular component and fibro cartilage 32 formed in the pelvis about the acetabular component. In a construction of this invention in which components 14 and

34 are constructed of a cobalt-chromium-molybdenum composition, the coefficient of friction between surface 41 of ball 40 and the inner surface 16 of component 14 will be approximately 0.2 or 0.3 while the coefficient of friction between the outer surface 20 of the acetabular component and cartilage 32 will be approximately 0.01. As femur 12 in FIG. 2 is swung in a plane normal to the viewing surface of the figure, ball 40 of component 34 will roll over inner surface 16 of the acetabular component as component 14 is caused to rotate about its axis 22 of rotation. This movement is illustrated in FIGS. 3A-5B. In FIGS. 3A and 3B, the femoral component 34 is shown with its stem 36 in a generally vertical position, such as when the leg is held in a straight standing position. As shown in FIGS. 4A and 4B, when stem 36 of femoral component 34 is swung forwardly, as when the leg is pivoted in a forward direction, rolling movement takes place between ball 40 of the femoral component and inner surface 16 of acetabular component 14 which causes the acetabular component to shift about its axis of rotation within the patient's acetabulum in the direction shown by arrow 44. As shown in FIGS. 5A and 5B, when the stem 36 of the femoral component is swung rearwardly, as when the leg is pivoted in a rearward direction, rolling movement in the reverse direction takes place between ball 40 of component 34 and inner surface 16 of component 14 which causes the acetabular component to shift about its axis of rotation in the direction of arrow 46.

It is to be noted from FIGS. 3A-5B that the location 42 of the regions or areas of contact between ball 40 and inner surface 16 of component 14 as stem 36 of the femoral component 34 is pivoted fore and aft do not coincide with the axis of rotation 22 of acetabular component 14 but are spaced from axis 22. Therefore, it is important when inserting the acetabular component 14 into the acetabulum of the patient that component 14 be so situated that its axis of rotation 22 will not coincide with the area of contact between ball 40 and inner surface 16 of components 34 and 14 during fore and aft walking movement of the femur. Should the area or place of contact between ball 40 and inner surface 16 so coincide with the axis of rotation of acetabular component 14, sliding, not rolling, motion with increased wear will take place between components 14 and 34.

By designing femoral component 34 with ball 40 thereof being offset from the axis of stem 36 at an angle of approximately 25° (Dimension A in FIG. 6), the lateral displacement of femur 12 from the acetabulum 30 of the patient is reduced approximately 17 mm from the normal displacement of the femur when a prior art femoral component having a 35 degree ball angle is used. By so locating the femur more nearly under the acetabulum, the abductor and obturator muscles are shortened and the unit load upon the artificial hip joint is reduced so as to act as a safety feature against fracture of the artificial joint components or the pelvic bone or femur. While it is not necessary to construct the femoral component with any specific ball-to-stem axis angle to practice this invention, the utilization of a 25 degree ball angle instead of the normal 35 degree ball angle used in prior art femoral component constructions will, in locating the femur more nearly under the acetabulum of the pelvis reduce the tendency for the location of ball-to-socket inner surface contact to coincide with the axis of rotation of the acetabular component. Inner surface 16 of acetabular component

14 may be interrupted by a small indentation 48 formed about the axis of rotation 22. Indentation 48 will serve to maintain some degree of rotative movement of the acetabular component 14 should the area of ball-to-socket inner surface contact closely approach coincidence with the axis of rotation of component 14.

As illustrated in FIG. 7, the lower end portion of stem 36 of femoral component 34 is of a flattened cross sectional form at face part 35 which when inserted into femoral shaft 62 reduces the tendency for the stem to oscillate or shift laterally within the femur. Thickness C (See FIGS. 3B and 7) of stem 36 preferably progressively increases in size from platform 38 to opposite end 37 of the stem. This increase in thickness or flare of stem 36 reduces the tendency for the stem to wobble within the femur. Additionally, by reducing the angle of platform 38 of femoral component to 25° (Dimension B in FIG. 6) from the normal 35° to 40° platform angle utilized in the prior art femoral components, there is also a reduction in the tendency for the femoral component to shift laterally within the femur.

FIG. 8 is illustrative of another embodiment of the artificial hip joint of this invention. Acetabular component 50 of this embodiment is of a dome shape having an inner spherical surface 52 which defines a socket 54 and an outer spherical surface 56. The opening into socket 54 is defined by an annular outturned flange or lip 58. Acetabular component 50 is designed to be utilized in those patients having a pelvic bone structure which will not permit the utilization of the larger stem-type acetabular component 14 above described. The method of implantation of acetabular component 50 is similar to that described for acetabular component 14. Component 50 also has an axis of revolution 22' about which inner surface 52 and outer surface 56 are symmetrically formed. Lip 58 serves in contacting the pelvic bone 59 to minimize wobbling movement of component 50 within the acetabulum 60 and thus control the position of the axis of rotation 22' of the component and guide the component's movement. Femoral component 34 above described is utilized in this embodiment of the hip joint. Ball 40 of the femoral component 34 is slightly smaller than socket 54 of acetabular component 50. The manner of operation and the relative rolling movement between components 34 and 50 are similar to that described for the embodiment of the hip joint illustrated in FIGS. 1-7.

When the artificial hip joint of this invention is in use, a wedge of body fluid may be formed between the acetabular and femoral components within the socket 18 or 54 of the acetabular component. Due to the fit between ball 40 or femoral component 34 and inner surfaces 16 and 52 of the acetabular components 14 and 50 respectively, the drag of the mating surfaces of the ball 40 and socket 54 or 18 over the body fluid may cause the ball to climb into a wedge of fluid created between the surfaces and thus be lubricated during its rolling motion relative to the acetabular component, thereby further reducing the wear between the femoral and acetabular components 34, 50 and 14.

It is to be understood that this invention is for use in the general healing arts and may be used by veterinarians as well as medical doctors. Additionally, it is to be understood that this invention is not to be limited to the details herein given but may be modified within the scope of the appended claims.

What I claim is:

1. An artificial hip joint comprising a cup adapted to be inserted into the pelvis and a ball having means adapted to be secured to the femur, said cup having an axis of rotation and an inner substantially spherical surface which defines a socket symmetrical about said axis and an outer surface of revolution formed symmetrically about said axis, said cup outer surface define means for guiding shiftable movement of said cup about its axis of rotation when inserted within said pelvis, said ball including a substantially spherical surface having a radius which is less than the radius of said cup inner surface, said ball fitting within said socket and contacting said cup inner surface at locations spaced from the axis of rotation of said cup in all positions of said ball during normal fore and aft walking movement of said femur, whereby said movement of the femur causes rolling movement of said ball relative to said cup and correlative shiftable movement of said cup about its axis of rotation.

2. The hip joint of claim 1 wherein said cup includes an annular outturned lip defining a circular ball-receiving opening into said socket, said lip being symmetrical about said axis of rotation of said cup.

3. The hip joint of claim 2 wherein said cup outer surface defines a stem projecting in the opposite direction of said cup opening and along said axis.

4. The hip joint of claim 3 wherein said stem is tapered.

5. The hip joint of claim 3 wherein said stem is separated from said cup lip by an annular shoulder defined by said cup outer surface, said shoulder and lip defining load bearing surfaces for contacting said pelvis.

6. The hip joint of claim 1 wherein said cup inner surface is interrupted by an indentation formed at the axis of rotation of said cup.

7. An artificial hip joint comprising an artificial acetabular component and an artificial femoral component, said acetabular component constituting a cup having an axis of rotation and an inner substantially spherical surface defining a socket symmetrical about said axis and an outer surface of revolution formed symmetrically about said axis, said outer surface including means for guiding shiftable movement of said cup about its axis of rotation when inserted into the acetabulum of a patient's pelvis, said femoral component including a stem adapted for insertion into the shaft of the femur after removal of the femoral head therefrom, said stem carrying a ball, said ball having a substantially spherical surface the radius of which is less than the radius of the inner surface of said acetabular component, said ball fitting within said socket and contacting the inner surface of said acetabular component at locations spaced from the axis of rotation of said cup in all positions of said ball during normal fore and aft walking movement of said femur whereby said movement of the femur will cause shiftable movement of said cup about its axis of rotation and rolling movement of said ball relative to said cup when said cup and ball are implanted within the acetabulum and femur of said patient.

8. The hip joint of claim 7 and an outturned annular lip defined by said cup outer surface, said lip defining a circular ball-receiving opening into said socket.

9. The hip joint of claim 8 wherein said cup outer surface defines a stem which projects in the opposite direction of said cup opening and along said axis.

10. The hip joint of claim 9 wherein said cup stem is tapered.

11. The hip joint of claim 9 wherein said cup stem is separated from said lip by an annular shoulder constituting a part of said cup outer surface, said shoulder and lip defining load bearing surfaces adapted to contact the pelvis of said patient.

12. An artificial hip joint comprising an artificial acetabular component and an artificial femoral component, said acetabular component constituting a cup having an axis of rotation and an inner substantially spherical surface defining a socket symmetrical about said axis and an outer surface of circular shape on all planes normal to said axis and concentric with said axis, said outer cup surface including means for guiding rotation of said cup about said axis when positioned in the acetabulum of a patient's pelvis with said axis at an angle to the normal direction of weight transfer from the pelvis to the femur when a patient stands erect, said femoral component including a stem adapted for insertion into the shaft of the femur after removal of the femoral head therefrom, said stem carrying a ball, said ball having a substantially spherical surface whose radius is slightly less than the radius of the inner surface of said acetabular component, said ball fitting within said socket and contacting a limited area of the inner surface of said acetabular component at a location spaced from the axis of rotation of said cup in all positions of said ball during normal fore and aft walking movement of said femur, whereby walking movement of the femur causes rotative movement of said cup about its axis and rolling movement of said ball relative to said cup.

13. The hip joint of claim 12 wherein said cup includes an outwardly projecting annular flange defining a lip at the mouth of said cup.

14. The hip joint of claim 13 wherein said cup outer surface defines a stem which projects coaxially of said cup opposite said mouth.

15. The hip joint of claim 14 wherein said cup stem is tapered.

16. The hip joint of claim 14 wherein said cup stem is separated from said flange by an annular shoulder constituting a part of said cup outer surface, said shoulder and flange defining load bearing surfaces adapted to contact the pelvis of said patient.

17. A hip prosthesis comprising interfitting acetabular and femoral components; said acetabular component having a spherical socket and an external configuration including a guide portion for maintaining said acetabular component in predetermined orientation in an acetabular recess of a pelvis during use; said acetabular component having an axis relative to which and on all planes normal to which all internal and all external surfaces are circular and concentric to facilitate rotation in said recess; said femoral component including an elongated stem, a spherical head and a reduced diameter neck portion between said stem and head; said stem anchoring said femoral component in a femur during use; said head and neck having an axis relative to which and on all planes normal to which all surfaces of said head are circular and concentric; said head having a radius slightly less than the radius of said acetabular socket whereby weight transfer contact between said parts occurs only at a limited area of each; said components being designed for installation in an orientation in which said axes are disposed at an angle in all

normal usage in standing and walking whereby said limited area of weight transfer contact in said socket occurs spaced from the axis of said acetabular component.

18. The hip prosthesis of claim 17 wherein said head is offset an approximate 25° angle from the longitudinal axis of said elongated stem.

19. A method of providing an artificial hip joint for a patient comprising the steps:

- a. separating the head of a patient's femur from the patient's pelvic acetabulum;
- b. providing an artificial acetabular component having an axis of rotation, an outer surface of revolution formed concentrically about said axis, and an inner surface defining a socket concentric with said axis;
- c. reshaping the acetabulum of said patient to complementally receive with rotative clearance said acetabular component with said axis of rotation extending obliquely to the direction in which said femur is pivoted during normal fore and aft walking

movement of said patient;

- d. positioning said acetabular component within said reshaped acetabulum for rotation about said axis of rotation and obliquely to said direction of pivotal femur movement;
- e. surgically removing the head of the patient's femur from the shaft of the femur;
- f. providing an artificial femoral component having a stem carrying a ball slightly smaller than the socket of said acetabular component;
- g. anchoring said stem in the femoral shaft with said femoral ball projecting from the end of the femur; and
- h. fitting said ball into the socket of said acetabular component and causing said ball to contact a limited area of the inner surface of said acetabular component spaced from said axis of rotation.

20. The method of claim 19 wherein steps e, f and g precede steps b, c and d.

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