

[54] **ARTICULATED TWO-PART PROSTHESIS
REPLACING THE ANKLE JOINT**

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[58] Field of Search **3/1, 1.9-1.913;
128/92 C, 92 CA, 92 R**

[56] **References Cited**

UNITED STATES PATENTS

3,521,302	7/1970	Muller	3/1
3,728,742	4/1973	Averill et al.	3/1
3,839,742	10/1974	Link	3/1

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[57]

ABSTRACT

A two-part ankle prosthesis comprises components which are implanted, respectively, in the prepared distal end surface of the tibia and the proximal end surface of the talus and which cooperate to provide a substitute articulated ankle joint. The tibial component has a sagittal fin which permits fixation insertion from anterior to posterior into the distal tibial epiphysis and is serrated or grooved at its sides for better fixation and increase of the weight bearing surface area, and has a concave lower surface matching the convex upper surface of the talar component prosthesis, thus increasing the weight bearing surface and improving the distribution of weight bearing. The flat under surface of the talar component is supported on the prepared upper surface of the talus, the original dome of which has been osteotomized or removed. With the two prostheses in correct positions the tibio-talar joint is converted into a ball and socket type of joint. In a preferred form the tibial component is made of 316 LVM stainless steel and the talar component is fabricated from ultra-high molecular weight polyethylene or other suitable implant material.

3 Claims, 5 Drawing Figures

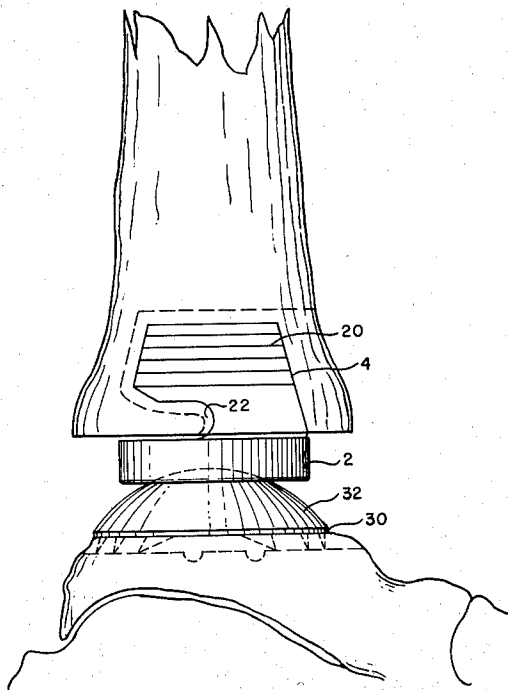
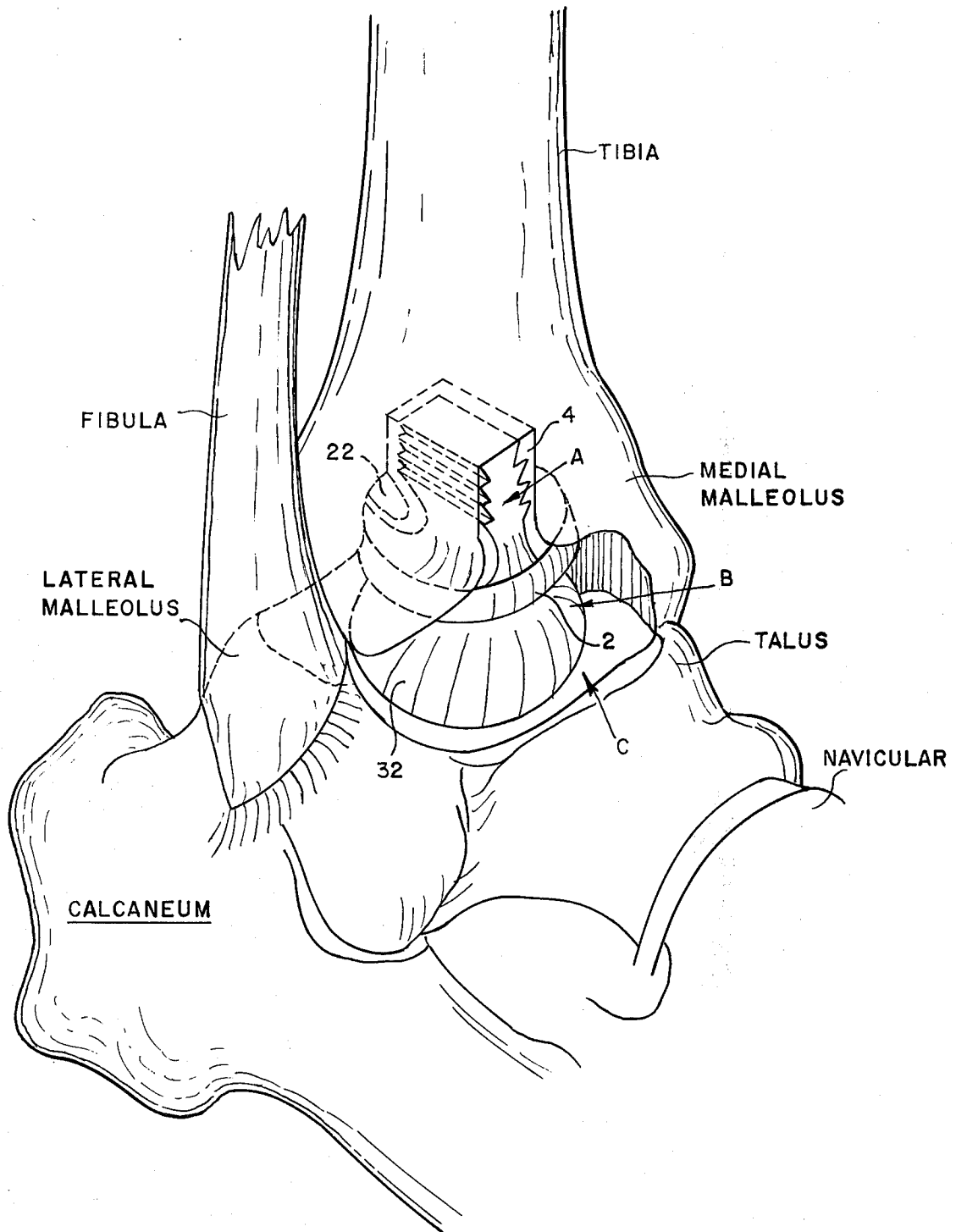
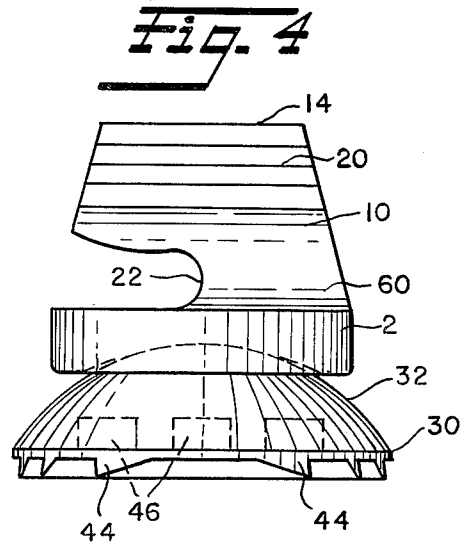
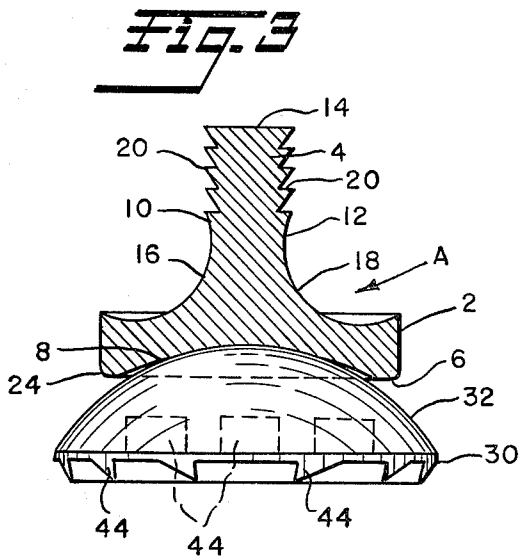
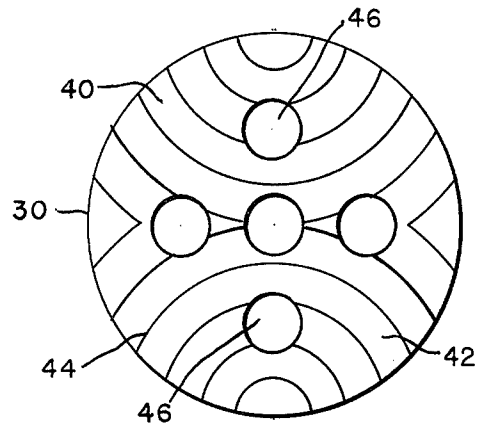
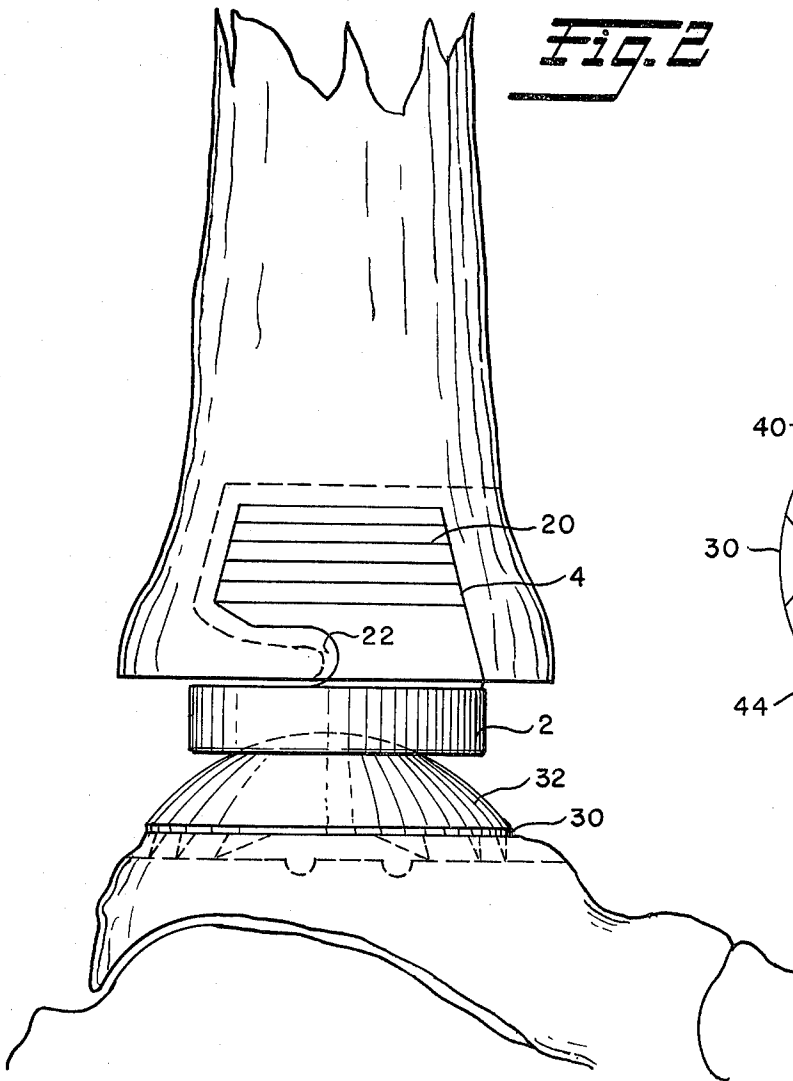


Fig. 1





ARTICULATED TWO-PART PROSTHESIS REPLACING THE ANKLE JOINT

BACKGROUND OF THE INVENTION

The normal human ankle is a joint which is constructed to permit movement in flexion and extension, with some abduction, adduction and rotation capability. Plantar flexion and dorsiflexion are the major movements of the ankle and may be performed through an angular movement of approximately 20° dorsiflexion to 50° plantar flexion. Rotation is the relative movement of the tibia and talus about their substantially common vertical axis, the normal rotation limit being approximately 5° to either side, an arc of approximately 10°.

Disease indications of the ankle joint include severe rheumatoid arthritis, osteoarthritis, traumatic arthritis and painful failed arthrodesis. The diseased ankle joint has heretofore been treated by various local repair procedures or, in advanced cases, by fusion. The desirability of replacement of the ankle joint has been apparent, and momentum toward this end has been accelerated by the successful invention and development of implants and procedures for provision of total hip and total knee prostheses. However, until the present invention no such prostheses or procedures were known or available for providing a replacement for the complete ankle joint.

SUMMARY OF THE INVENTION

In accordance with the invention an articulated two-part prosthesis is substituted for the diseased tibio-talar joint, the structure and implantation of which permits retention of the primary ankle ligaments, and after implantation permits flexion, rotation and sliding movements substantially reproducing the movements of the normal human ankle. The components of the prosthesis are a distal tibial implant having a concave part-spherical surface facing the talus, and a proximal talar implant having a dome-shaped convex part-spherical surface engaging and co-operating with the concave surface of the tibial component. The tibial component is implanted into a recess formed in the distal end of the tibia, and the talar component rests on the prepared upper plateau surface of the talus, both components being formed with means to cause their permanent, immobile attachment to their respective bones with the use of a suitable cement. This two-part prosthesis permits reproduction of the dorsi-flexion and plantar-flexion movements, as well as some of the inversion, eversion and rotational movement components of the joint, all at the level of the tibio-talar joint of the normal human ankle.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the bones forming, and adjacent to, the human ankle joint, showing the two-part prosthesis provided by the invention in place, in substitution for the human ankle;

FIG. 2 is a side elevational view of the two parts of the ankle and the prosthesis shown in FIG. 1, with the ankle parts at neutral;

FIG. 3 is a front view of the two components of the prosthesis, the tibial component being shown in section;

FIG. 4 is a side elevational view of the two components of the prosthesis, and

FIG. 5 is a bottom view of the talar prosthesis.

DESCRIPTION OF THE INVENTION

In FIGS. 1 and 2 of the drawings the principal parts of the human leg and foot adjacent and forming the ankle are shown and labeled, and as these are well known to those skilled in the medical and other arts to which this invention relates they will not be further described here. This figure also shows the two components of the prosthesis provided by this invention, in operative association with the illustrated parts of the body. These components are a tibial component which is constructed and intended to be attached distally to the tibia, and a talar component which is constructed and intended to be attached proximally to the talus.

The distal tibial component is designated generally by the letter A, is formed of metal such as stainless steel, and comprises a lower or base part 2 which is preferably circular in shape and disposed substantially horizontally when implanted, and an upper part 4 which extends upwardly from the base part and is constructed and adapted to be driven into the distal tibial shaft from anterior to posterior, as shown in FIG. 1 in order to attach the component to the tibia.

The base part 2 of the tibial component has a lower surface 6 the central part of which is formed as a concave, downwardly-facing surface 8 of part-spherical shape. This surface, which engages the similarly-shaped upper surface of the talar component, is polished to a mirror finish, while the other parts of the component may have a dull finish. The upper part 4 of this component is a sagittal fin having upwardly extending side walls 10, 12 which are spaced laterally of the anterior-posterior axis of the ankle joint and which at their upper ends join a flat upper surface 14. The lower parts of the side walls are curved to join the base part 2, as shown at 16, 18, and the upper parts are parallel. Upwardly and outwardly extending saw-toothed ridges and grooves 20 are formed in the upper parts of the side walls of the fin and extend in the anterior-posterior direction. The fin has a notch 22 at the distal posterior part of its base, adjacent the upper surface of the base part 2 of the implant, which co-operates with the osteotomy slot prepared in the distal posterior area of the tibia during the implantation procedure for the purpose of locking the component in place in the osteotomized area of the tibia.

Surrounding the central, concave, downwardly facing surface 8 is an annular surface 24 the outer and inner peripheral edges of which are convexly rounded to provide smooth contact with the talar prosthesis, which is most important in the event of an unavoidable "rocking" motion occurring between the two components which would otherwise result in gouging or "digging in" of the plastic talar component by the metal tibial component.

The talar component of the prosthesis is designated generally by the letter B, is formed of a synthetic plastic material, is preferably circular in shape and substantially horizontal when implanted, and which may be somewhat larger in diameter than the circular base 2 of the tibial component as shown in FIG. 3. This base part 30 has a generally flat lower surface which engages and rests on the upper plateau surface C of the talus after suitable preparation thereof. The upper surface of the

component rises above the base 30 to provide an upwardly convex dome 32 which is part-spherical in shape and has the same radius of curvature as the downwardly facing concave lower surface 8 of the tibial component so that the two surfaces will exactly mate.

Means are provided on the lower surface of the base part 30 of the talar component for securely and permanently connecting the component to the prepared plateau surface of the talus, and in its preferred form, which is shown in FIG. 5, this means takes the form of two groups 40, 42 of curved ridges 44 each of which is shaped as a triangle in cross section and has a sharp lower edge, and which by its configuration interlocks with the cement on the talar surface, the ridges of each group being concentric and the centers of the two groups being diametrically opposite each other as shown in FIG. 5. A plurality of holes or recesses 46 extend upwardly from the lower surface of the component and into the body thereof in a direction perpendicular to a tangent of the dome 32, and the cement which is used to connect the component to the talal plateau extends into these holes and provides an additional locking action.

The talar component of the prosthesis is preferably made of ultra-high molecular weight polyethylene or other material suitable for human implant purposes. In accordance with known procedure, a wire may be positioned in a groove formed in an outer surface of one or both components which serves as an X-ray locator and a reference line to permit wear of the prosthesis to be measured while in use, as X-rays taken at one year or at some other interval will indicate any variation in distance between the bottom edge of the tibial component and the wire.

The two prosthetic components are designed to work together as a unit in such a fashion as to emulate the normal motions characteristic of a healthy human ankle. The positions of the bearing surfaces permit flexion of the talus with respect to the tibia with approximately 20° dorsiflexion to approximately 40° plantarflexion, thus substantially reproducing the range of flexional movement of the human ankle. The part-spherical shape of the dome of the talar component permits the bearing surface of the tibial component to ride level on the talar dome during rotational movements of the ankle without riding up on the sides of the dome, which would produce binding between the tibial and talar components. The two components are designed so that in use the theoretical limits of motion are from 20° dorsiflexion to 40° plantar-flexion, and 5° to 10° of rotation and inversion/eversion. The prosthesis has great utility in replacing the rheumatoid, the osteoarthritic, the traumatic arthritic, and the post-failed arthrodesis ankle. Its use produces many good results, among them being improved and more efficient gait, conservation of energy (a study reveals a 6 percent above average energy expenditure with one ankle immobilized, nine percent with two immobilized), less stress and subsequent wear at the knee above and at the forefoot below the prosthesis with better weight distribution on the foot during ambulation, especially over rough ground, improved transfer capability from the seated to the standing posture, especially if the knees are also diseased, ability to wear regular shoes when equinas capability is retained, with women being able to vary heel heights to

meet fashion demands, and easier post-operative recovery as the patient merely awaits soft tissue healing, avoiding the 15 to 20 percent reported incidents of failed bony fusion.

I claim:

1. A two-part prosthetic device for arthroplasty of the human ankle joint, comprising a tibial component for replacing at least a part of the prepared distal end of the tibia, and a talar component for replacing at least a part of the prepared proximate surface of the talus, the tibial component comprising a base part having a downwardly facing concave surface of part-spherical shape and a part extending upwardly from the base part and having spaced side walls extending in an anterior-posterior direction when implanted and having a notch in its distal posterior base to receive an osteotomy slot prepared in the distal tibia to lock the component in place, the talar component comprising a base part having an upwardly facing convex surface which is part-spherical in shape and has the same radius of curvature as that of the concave surface of the tibial component and on which the concave surface rests when the two-part prosthesis is in place, and means on the lower surface of the talar component for engaging into the bone of the talus to increase the connection of the component thereto.

2. As a new article of manufacture, a tibial prosthesis component for replacing at least a part of the prepared distal end of the tibia, the tibial component comprising a unitary integrally formed device constructed and adapted to be connected to the distal end of the tibia and to serve in lieu of the articulating surface thereof, said tibial component comprising a lower base part of circular shape having a polished downwardly facing bearing surface which is spherically concave, and above the base part having an upwardly directed bone fixation element for implantation in the tibial shaft and having a notch in its distal posterior base part to receive an osteotomy slot prepared in the distal tibia to thereby lock the component in place, and a rounded downwardly facing edge surface surrounding the bearing surface to provide smooth transitional contact with a talar prosthesis, whereby the spherical concave bearing surface provides all rotational and sliding capabilities between a two-part prosthesis when implanted and operative.

3. As a new article of manufacture, a talar prosthesis for cooperating with a tibial prosthesis to form an articulated prosthesis replacing the ankle, said talar prosthesis comprising a circular body having a generally flat lower surface for engagement with and connection to a prepared proximate plateau surface of a talus, curved ridges extending downwardly from the lower surface of the talar component and having downwardly directed sharp lower edges for better connection of the talar prosthesis to the prepared surface of the talus, having a convex part-spherical upper surface extending upwardly from the periphery of the lower surface and forming a bearing surface to accept the downwardly facing part spherical concave bearing surface of a tibial prosthesis, and at least one recess formed in the body and opening to the lower surface thereof to receive cement used in connecting the talar prosthesis to the prepared proximate surface of the talus.

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