United States Patent [19]

Weber

[11] **3,806,960**

[45] **Apr. 30, 1974**

[54] **ACETABULUM IMPLANT**

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[73] Assignee: **Sulzer Brothers Ltd.,** Winterthur, Switzerland

[22] Filed: **Feb. 1, 1973**

[21] Appl. No.: **328,672**

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

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

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

[56] **References Cited**

UNITED STATES PATENTS

2,668,531	2/1954	Haboush	128/92 CA
3,064,645	11/1962	Ficat et al.	128/92 CA
3,685,058	8/1972	Tronzo	3/1

FOREIGN PATENTS OR APPLICATIONS

1,122,634	5/1956	France	128/92 C

Primary Examiner—Richard A. Gaudet
Assistant Examiner—Ronald L. Frinks
Attorney, Agent, or Firm—Kenyon & Kenyon Reilly Carr & Chapin

[57] **ABSTRACT**

The acetabulum is formed of a rigid cup shaped body which has a layer of highly resilient material, such as silicone rubber, secured on the outside. The resilient layer is bonded via a suitable cement to the pelvis and acts to insure against loosening of the rigid body from the pelvis under vibrations while also acting as a cushion.

7 Claims, 5 Drawing Figures

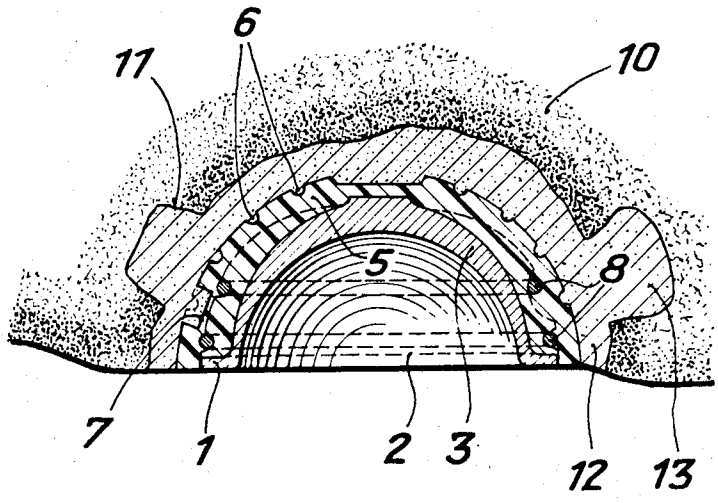


Fig. 1

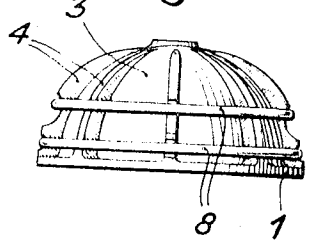


Fig. 2

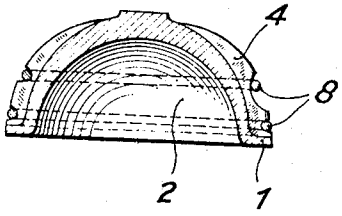


Fig. 3

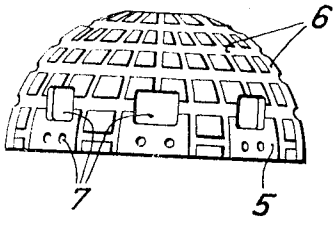


Fig. 5

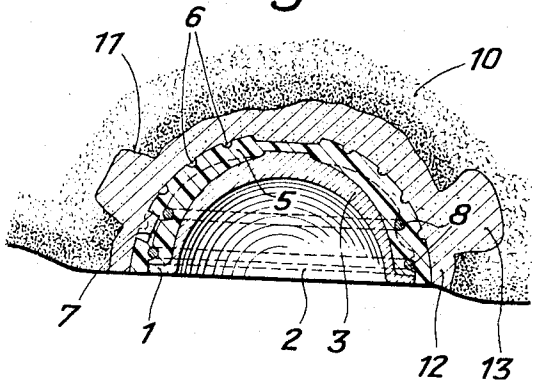
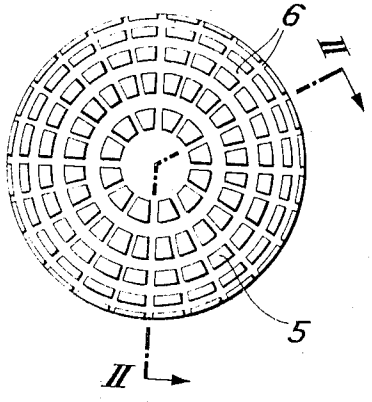


Fig. 4



ACETABULUM IMPLANT

This invention relates to an acetabulum and more particularly to an implant for placement in the pelvis to function as the normal acetabulum.

Heretofore, it has been known to fabricate artificial acetabula or sockets for use as components of a prosthetic hip joint. Generally, the acetebulum which has been used has been secured in a pelvis by means of a conventional bone cement. However, in the course of time, it has been found that the acetabulum has worked loose. It is supposed that the main reason for this is microvibrations which, when the joint experiences loading and movement, are transmitted from the acetabulum or socket through the bone cement to the bone, probably with the result of local necroses and/or bone recession.

In order to overcome this problem it has been known to use a shell-like acetabulum whose edges are secured in the pelvis as disclosed in French patent specification 1,122,634 and whose shell-like recess, which receives either the natural femur head or an artifical metal or plastics femur head, is coated with a resilient material to damp impact loads transmitted via the joint to the bone. However, since the loading on the acetabulum may be as much as 300 kg, this known construction does not lead to a serviceable hip joint. That is, under loads of this nature, the femur head ceases to be able to move at all in a resilient layer or coating because of excessive friction. The resilient layer must therefore be given a strong load-resistant contact or sliding surface which, to prevent the resilient material from moving away and being extruded under load, should bear on the shell-like acetabulum at least in the fashion of a cover. Unfortunately, this rigid connection of the known construction leads to impact and vibrations being directly transmitted from the contact surface to the shell and therefore to the bone. Thus, the resilient layer has been found to have no effect.

Accordingly, it is an object of the invention to obviate loosening of an implanted acetabulum in a hip joint.

It is another object of the invention to avoid microvibrations in the interface between a pelvic bone and the bone cement used to implant an acetabulum.

Briefly, the invention provides an acetabulum for mounting in a pelvis comprising a rigid body defining an internal recess on one side for a femur head and having an anchorage surface on an opposite side, and a layer of highly resilient material secured to the anchorage surface. In addition, the layer of highly resilient material includes a plurality of external grooves and recesses for receiving bone cement when the acetabulum is implanted in a pelvis.

The rigid body can be made of any suitable metal or plastics material.

The term "highly resilient material" is to be understood herein as denoting substances having a final aftercure hardness in Shore A values of less than or equal to ($\leq$) 90. As well as being resilient, the material must, of course, be compatible with the body and highly resistant to the body. The material should also have high shear strength and high tensile strength, more particularly high tear resistance. A silicone rubber commercially available under the registered trademark "Silastic" E RTV of the Dow Corning International Ltd. company has proved a very satisfactory substance. Of

course, other substances, such as natural rubber, can be used as the highly resilient material subject to meeting the conditions set.

The layer of resilient material serves to damp impact as well as vibrations. To this end, the resilient layer must be firmly anchored to the rigid body which, in turn, must be able to deal with the loads which occur which are, as already mentioned, up to 300 kilograms (kg). In order to achieve this, the acetabulum is provided with ribs on the anchorage surface, in known manner, as well as anchorage elements which extend peripherally at a varying spacing from the edge of the acetabulum. These anchorage elements can be, e.g., wire rings brazed to the ribs.

These and other objects and advantages of the invention will become more apparent from the following detailed description and appended claims taken in conjunction with the accompanying drawings in which:

FIG. 1 illustrates a side view of a rigid load-bearing acetabulum body according to the invention;

FIG. 2 illustrates a cross-sectional view of the body of FIG. 1;

FIG. 3 illustrates a side elevational view of a completed acetabulum accoding to the invention;

FIG. 4 illustrates a plan view of the acetabulum of FIG. 3; and

FIG. 5 illustrates a sectioned view similar to FIG. 2 showing an acetabulum anchored in a pelvis according to the invention.

Referring to FIGS. 1 and 2, the acetabulum body or socket 1 which is rigid and which does not distort permanently when subjected to the loads previously referred to, i.e., which is load bearing, is made in known manner of a metal alloy compatible with the human organism or of a physiologically innocuous plastics. The body 1 is formed with a part-spherical internal recess 2 on one side which can be seen in FIG. 2 and which is adapted to receive a femur head (not shown). In addition, an outside anchorage surface 3 of the acetabulum body 1 has, in known manner, integral ribs 4 disposed in upstanding manner and extending in a meridial direction. Generally, where such a body has been used as the acetabulum per se, often being anchored in the pelvis, the ribs 4 have served to prevent relative movements between the socket or acetabulum 1 and the material applied to the socket. Conventionally, such material has usually been a bone cement.

Referring to FIGS. 3, 4 and 5, in accordance with the invention, an intermediate layer 5 of highly resilient material is secured to the body 1 about the ribs 4. In order to improve the anchorage of the intermediate layer 5 on the surface 3, anchorage elements are provided in the form of wire rings 8 which are secured to the ribs 4, e.g., by brazing, and which extend peripherally at various distances from the peripheral edge of the acetabulum body 1.

The highly resilient substance for the layer 5 is, for instance, a silicone rubber known under the registered trademark "Silastic" E RTV of Dow Corning International Ltd. In addition, the outside surface of the rubber layer 5 is formed with grooves 6 which extend peripherally and meridianally as well as with recesses 7.

In order to apply the rubber composition to the anchorage surface 3, the body 1 is first located at a distance from a mold (not shown) forming the negative of the outside surface of the layer 5. After intimate mixing

with the associated catalyst or cross-linking agent, Dow Corning RTV catalyst E in the example mentioned, in the specified ratio of, e.g., 1:10, the silicone rubber is introduced into the mold, e.g., by pouring. Flowability can be increased, if necessary, by means of a diluent.

The silicone rubber specified polymerizes or vulcanizes at room temperatures of 25°C within 24 hours after the addition of the catalyst, so that a non-shifting anchorage results between the body **1** and the layer **5.** The resilient layer **5** cures much faster at higher temperatures. At room temperatures, the rubber specified reaches its final hardness of approximately Shore A 35 to 45 after a few days.

After the material for the layer **5** has reached its final hardness, the completed acetabulum **1** can be anchored conventionally in a pelvis **10** (FIG. **5**) by means of a known bone cement **12,** e.g., methyl methacrylate. The bone cement **12** which flows into artificial recesses **11** in the pelvis, which recesses **11** extend through the relatively compact bony tissue, forms anchorage pins **13** or projections or the like. The cement **12** also enters the grooves **6** and recesses **7,** thus giving a non-shifting connection between the layer **5** and the bone cement **12.** This connection is very well able to withstand turning and movements along the outside surface of the layer **5.**

The vibration-damping effect of the intermediate layer **5** very likely depends upon the very considerable differences between the elasticity modulii of the body **1,** of the components making the anchorage and of the bone. In the example described, these modulii, expressed in kp/mm^2, are about 20,000 for the metal body, about two or three for the layer **5,** about 100 to 200 for the bone cement and about 1000 for the actual bone. There is probably very little transmission of vibratory energy from the very soft silicone rubber to the less resilient bone cement **12,** more particularly at the boundary or interface between the layer **5** and the cement **12.**

What is claimed is:

1. An acetabulum implant for mounting in a pelvis comprising a rigid body defining an internal recess on one side for receiving a femur head and having an anchorage surface on an opposite side, and a layer of highly resilient material secured to said anchorage surface, said highly resilient material having a final after-cure hardness in Shore A values of less than or equal to 90, the external surface of said layer including a plurality of external grooves therein and a plurality of recesses therein for receiving a suitable bone cement when implanted in a pelvis.

2. An acetabulum as set forth in claim **1** further comprising a plurality of integral ribs on said anchorage surface of said body extending into said layer and at least one anchorage element extending peripherally of said anchorage surface and said ribs.

3. An acetabulum as set forth in claim **2** comprising a plurality of said anchorage elements extending at various spacings from the peripheral edge of said body.

4. An acetabulum as set forth in claim **1** wherein said layer is made of silicone rubber.

5. An acetabulum as set forth in claim **1** wherein said rigid body is of cup-shape and said internal recess is part-spherical in shape.

6. An acetabulum as set forth in claim **5** further comprising a plurality of integral ribs on said anchorage surface extending into said layer.

7. An acetabulum as set forth in claim **6** wherein said layer is made of silicone rubber.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,806,960 Dated April 30, 1974

Inventor(s) Bernhard Georg Weber

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Insert the following on the title page of the patent:

This application is based on Swiss Patent Application No. 1467/72 filed February 1, 1972 to which the right of priority is claimed.

Signed and sealed this 17th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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