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CA 2577404 A1 2006/03/09

(21) 2 577 404

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(86) Date de dépôt PCT/PCT Filing Date: 2005/08/26
(87) Date publication PCT/PCT Publication Date: 2006/03/09
(85) Entrée phase nationale/National Entry: 2007/02/16
(86) N° demande PCT/PCT Application No.: NL 2005/000617
(87) N° publication PCT/PCT Publication No.: 2006/025729
(30) Priorité/Priority: 2004/08/30 (NL1026925)

(51) Cl.Int./Int.Cl. *A61F 2/30* (2006.01), *A61B 17/84* (2006.01), *A61F 2/40* (2006.01)

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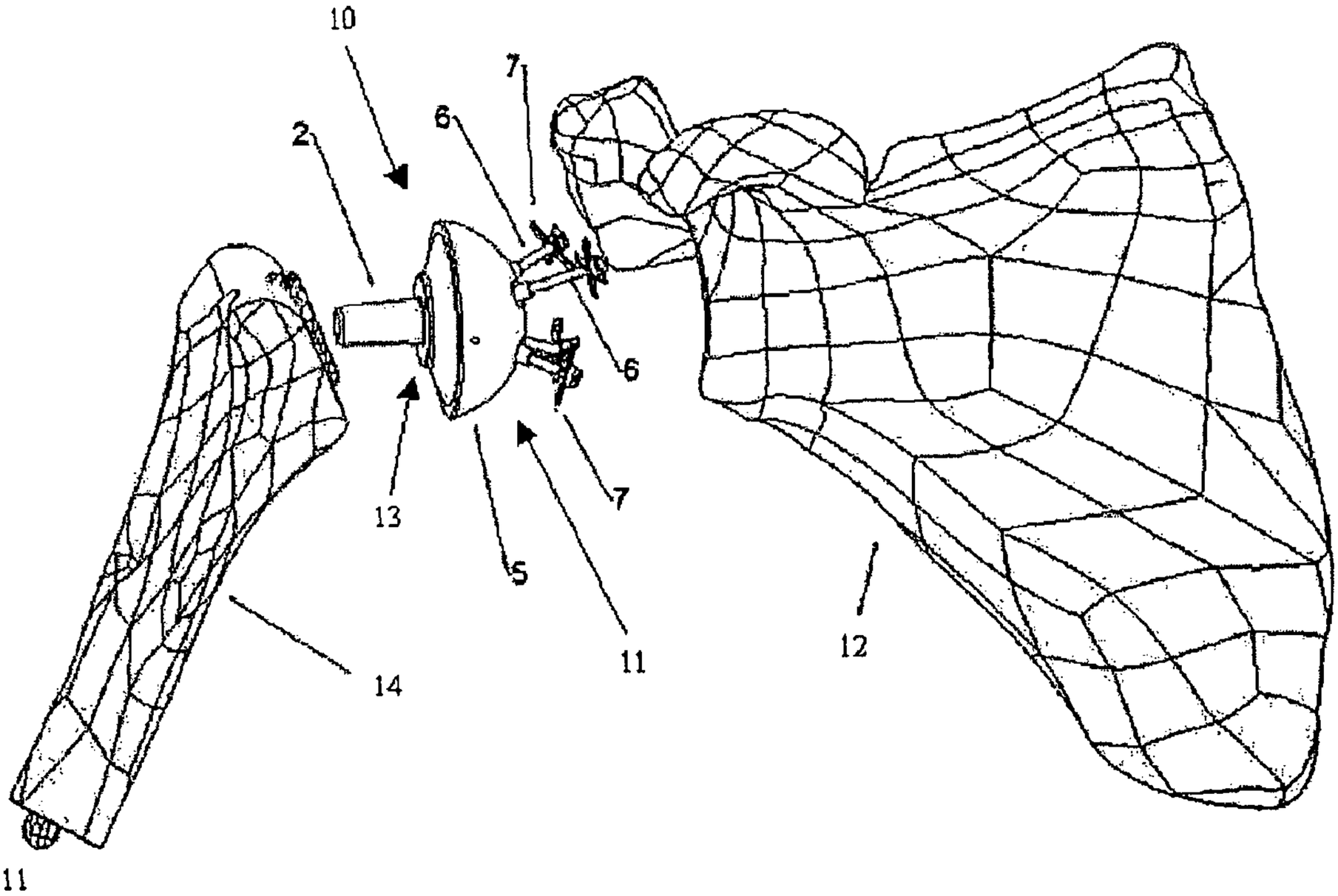
(54) Titre : PROTHESE ARTICULAIRE ET PROCEDE DE FIXATION OSSEUSE
(54) Title: JOINT PROSTHESIS AND METHOD OF BONE FIXATION



(57) Abrégé/Abstract:
The invention relates to a joint prosthesis (10), for example, a knee joint or shoulder joint prosthesis comprising a first, socket-holding prosthesis part (11) for attachment to a first bone (12) and a second, ball-holding prosthesis part (13) for attachment to a second bone (14) that intermates with the first prosthesis part, wherein the first bone and the second bone are situated at either side of a joint, and wherein the ball (2) of the second prosthesis part is rotatably received in the socket (5) of the first prosthesis part, wherein the first prosÞthesis part can be coupled with the first bone by applying tensile strain bearing rods (6), wherein when the mounted prosÞthesis is in a virtually unloaded condition, there is no significant tensile force in the rods.

ABSTRACT

The invention relates to a joint prosthesis (10), for example, a knee joint or shoulder joint prosthesis comprising a first, socket-holding prosthesis part (11) for attachment to a first bone (12) and a second, ball-holding prosthesis part (13) for attachment to a second bone (14) that intermates with the first prosthesis part, wherein the first bone and the second bone are situated at either side of a joint, and wherein the ball (2) of the second prosthesis part is rotatably received in the socket (5) of the first prosthesis part, wherein the first prosthesis part can be coupled with the first bone by applying tensile strain bearing rods (6), wherein when the mounted prosthesis is in a virtually unloaded condition, there is no significant tensile force in the rods.

Joint prosthesis and method of bone fixation

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The invention relates to a joint prosthesis, for example, a knee joint or shoulder joint prosthesis comprising a first, socket-holding prosthesis part for attachment to a first bone and a second, ball-holding prosthesis part for attachment to a second bone that intermates with the first prosthesis part, wherein the first bone and the second bone are situated at either side of a joint, and wherein the ball of the second prosthesis part is rotatably received in the socket of the first prosthesis part.

Such a joint prosthesis is known in the form of a shoulder joint prosthesis from the article 'Bipolar Shoulder Arthroplasty for painful conditions of the Shoulder', by Richard L. Warland and Jorge Aradondo, published in 'The Journal of Arthroplasty' Vol. 13 No. 6 1998, pages 631 to 637.

Both from DE-C-41 33 433 and EP-A-0 628 294 hip prostheses are known that comprise a socket-like part, and each of which requires the prosthesis design to precisely match the anatomy of the patient.

Although the joint prosthesis according to the invention is particularly suitable to be applied as shoulder joint prosthesis, the invention is not limited to this application; it is also possible to create other joints with the aid of the joint prosthesis of the invention. Nevertheless, the invention will be elucidated by way of a shoulder joint prosthesis. To the person skilled in the art it is completely obvious how a corresponding operation needs to be performed in, for example, a knee joint or hip joint.

Joint pathology that may result from fractures or joint diseases such as rheumatoid arthritis and arthrosis may seriously diminish the bone quality of the joint surfaces and the stabilising effect of the surrounding tissue. The joint becomes stiff and painful and will eventually cause chronic pain and will seriously limit the activities of day-to-day life. In order to alleviate the pain and to restore the function of the joint, a total joint reconstruction may be

performed. In a conventional joint replacement, both joint surfaces are replaced by a metal ball in the upper arm (humerus) and a polyethylene socket implanted in the shoulder blade (glenoid fossa). Apart from alleviating the pain, the object of this operation is the restoration of the joint stability and the joint functionality. The postoperative results of this procedure depend on, among other things, the quality of the bone and of the surrounding capsule and muscle tissue, on the medical history and age of the patient and on the skill of the surgeon. The most prevalent postoperative complications are instability of the joint and loosening of the glenoid component.

In the case of rheumatoid arthritis there are two important conflicting factors regarding the implantation of a conventional shoulder prosthesis: (1) the lack of the mechanical bone quality necessary for a durable attachment, (2) the loss of the function of surrounding muscles and ligaments of the shoulder, which reduces the necessary joint compression required for stabilising the joint.

From the above-mentioned prior art the use of a so-called bipolar prosthesis is known. This prosthesis consists of a metal ball that articulates in a conforming synthetic dish. The dish is placed without fixing into a steel shell that is placed against the shoulder blade. The metal ball is placed into the humerus (upper arm). This prosthesis ensures sufficient rotation of the upper arm in relation to the torso, with less wear of the underlying bone. However, the prior art is unable to guarantee stability of the joint.

It is the object of the invention to eliminate this problem and to gain advantages that will be clarified hereinafter.

EP-A-0 314 951 teaches a joint prosthesis, for example, a knee joint or shoulder joint prosthesis comprising a first, socket-holding prosthesis part for attachment to a first bone and a second, ball-holding prosthesis part for attachment to a second bone that intermates with the first prosthesis part, wherein the first bone and the second bone are situated at either side of a joint, and wherein the ball

of the second prosthesis part is rotatably received in the socket of the first prosthesis part, and further comprising rods having a tensile strain bearing capacity for coupling the first prosthesis part with the first bone wherein the rods extend through openings in the first prosthesis part and are each designed to project through a drilling in the first bone, and are provided with an enlarged end at the side facing away from the first prosthesis part.

The joint prosthesis of the invention is characterised in that said rods are provided with a locking element formed like a sleeve with an inside diameter that is smaller than the diameter of the enlarged end, which sleeve is movable around the rods and forms a closed ring, which is provided with anchor arms that in a first position extend along the rods, and being adjustable to a second position, in which said anchor arms have a substantially radial orientation in relation to the rods.

One thing and another makes it possible for the prosthesis according to the invention to be implanted and fastened by means of a one-sided operation. In such a case the operation can then be of a minimally invasive nature.

With the prosthesis of the invention it is possible to fasten the prosthesis in the first bone such as to provide an anchoring of sufficient strength and of a durable nature, also in the case of rheumatoid arthritis.

The rods form artificial ligaments and through translation of the upper arm in any arbitrary direction, they draw the first prosthesis portion against the shoulder blade in such a way as to provide a stabilised power-retaining system.

In a preferred embodiment, the rods divert in the mounted situation preferably in such a manner as to approximately create a virtual point of intersection, which substantially coincides with a stationary point of rotation of the ball of the second prosthesis part in the socket of the first prosthesis part.

As the lines of force in the artificial ligaments formed by the rods coincide with the point of rotation of the

second prosthesis part, the forces exerted on the prosthesis do not cause it to rotate.

The stability of the joint prosthesis is enhanced by applying at least three rods having a tensile strain bearing capacity.

To serve convenience and simplicity when implanting the prosthesis, each of the rods is provided with thread so that an insert nut can be fitted in a socket of the first prosthesis part.

It is worth noting that fastening the prosthesis by using these rods prevents said artificial ligaments from coming under strain of bending. These rods should only absorb tensile forces. This helps to extend the mechanical life of the prosthesis and avoids post-operative complications.

An above-mentioned embodiment of the locking element to be used for bone fixation is designed like a sleeve that forms a closed ring provided with anchor arms, which in a first position are oriented parallel to the axis of the sleeve body, and being adjustable to a second position in which the anchor arms extend substantially radially from the sleeve.

With this locking element a new method of bone fixation can be applied with which it is also possible to repair bone fractures, and with which it is possible to realise the above-elucidated advantages of tensile strain tolerance in the absence of flexural strain, which would lead to premature loosening of the connecting bone parts.

In this connection, the invention is also embodied in a method of bone fixation, which is characterized in that the bone is provided with at least one drilling, a draw rod provided with an enlarged end is inserted through the drilling, and a locking element is used that prevents the removal of the draw rod from the drilling.

This may be realised, for example, by inserting the locking element into the drilling to prevent the enlarged end from passing through the drilling.

Another possibility is to fit the locking element onto the draw rod, so that the locking element is embodied in accordance with claim 10.

The advantages of the invention particularly come available when each draw rod is mounted such that when the mounted prosthesis is in a virtually unloaded condition, there is no significant tensile force in the rod.

It is further beneficial for the stability that the rods are mounted so as to be free of stress of bending.

Hereinafter the invention will be further elucidated by way of a non-limiting exemplary embodiment and with reference to the drawing.

The drawing shows in:

- Fig. 1, an exploded view of the joint prosthesis according to the invention such as can be used as shoulder joint prosthesis;

- Fig. 2, the joint prosthesis shown in Fig. 1 in the mounted situation;

- Fig. 3, the joint prosthesis according to the invention in an exploded view;

- Fig. 4, the locking element that serves for mounting the joint prosthesis in the pre-mounted and in the mounted situation.

Similar parts in the figures carry identical reference numerals.

In Fig. 1, the joint prosthesis is indicated with reference numeral 10. This joint prosthesis 10 comprises a first, socket-holding prosthesis part 11 for fastening to a first bone 12, and a second, ball-holding prosthesis part 13 for fastening to a second bone 14, that intermates with the first prosthesis part 11.

In the case shown, the first bone concerns the shoulder blade or the glenoid fossa 12, while the second bone in the case shown is the upper arm or the humerus 14.

The second prosthesis part 13 comprises a ball 2 that is rotatably received in the socket 5 of the first prosthesis part 11. This can be clearly understood from the exploded view in Fig. 3.

In accordance with the invention, the first prosthesis part 11 can be coupled with the first bone 12 by using three or four rods 6 having a tensile strain bearing capacity.

Fig. 3 clearly shows that in the mounted situation, the at least three rods 6 have a diverging orientation. The divergence of the orientation should be such as to create approximately a virtual point of intersection that substantially coincides with a stationary rotational point of the ball 2 of the second prosthesis part 13 in the socket 5 of the first prosthesis part 11.

Fig. 2 shows the joint prosthesis in the mounted situation. Viewing Fig. 2 in association with Fig. 3, shows that the at least three rods 6 extend through openings in the socket 5 of the first prosthesis part 11 and are designed to project through a drilling in the first bone 12 and that at the side of the bone 12 facing away from the socket 5, the rods 6 are provided with locking elements 7.

Each of the just-mentioned locking elements 7 is embodied as a sleeve 7, moveable on the artificial ligaments, that is to say the rods 6, and forms a closed ring that in the pre-mounted condition has a first position with anchor arms extending along the rods 6. This is shown by the two sleeves 7 on the left in Fig. 4. The inside diameter of the sleeves 7 is smaller than the diameter of the enlarged end 15 of the rods 6 such that this end 15 forms an obstruction preventing the sleeves 7 from sliding off.

The locking elements 7 can be brought into the mounted situation, as shown in Fig. 2 and like the two sleeves 7 shown on the right in Fig. 4, with the anchor arms 8 extending substantially radially in relation to the rods 6. This is also clearly shown in Fig. 2.

An alternative manner of securing the rods 6 relates to the use of a locking element in the form of a sleeve to be inserted into the bone drillings and having an inside diameter that is smaller than the diameter of the enlarged end 15 of the rods 6. Such sleeves have to be positioned after the insertion of the rods 6. One thing and another is quite

obvious to the person skilled in the art so that a further elucidation by way of a figure is not necessary.

Fig. 3 shows that to fasten the rods 6, they can be fixed at the inside of the socket 5 by means of an insert nut 4. To this end the rods 6 are preferably provided with an external thread.

Finally, it is worth noting that in the completed situation, the ball 2 of the second prosthesis part 13 is placed in the socket 5 of the first prosthesis part 11, with the ball 2 preferably being received in a polyethylene inner socket 3. The position of the ball 2 is secured by using a retaining ring 1.

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CLAIMS

1. A joint prosthesis (10), for example, a knee joint or shoulder joint prosthesis comprising a first, socket-holding prosthesis part (11) for attachment to a first bone (12) and a second, ball-holding prosthesis part (13) for attachment to a second bone (14) that intermates with the first prosthesis part (11), wherein the first bone (12) and the second bone (14) are situated at either side of a joint, and wherein the ball (2) of the second prosthesis part (13) is rotatably received in the socket (5) of the first prosthesis part (11), and further comprising rods (6) having a tensile strain bearing capacity for coupling the first prosthesis part (11) with the first bone (12) wherein the rods (6) extend through openings in the first prosthesis part (11) and are each designed to project through a drilling in the first bone (12), and are provided with an enlarged end (15) at the side facing away from the first prosthesis part (11), **characterized** in that said rods (6) are provided with a locking element formed like a sleeve with an inside diameter that is smaller than the diameter of the enlarged end (15), which sleeve is movable around the rods (6) and forms a closed ring, which is provided with anchor arms (8) that in a first position extend along the rods, and being adjustable to a second position, in which said anchor arms (8) have a substantially radial orientation in relation to the rods (6).

2. A joint prosthesis according to claim 1, **characterised** in that there are at least three rods having a tensile strain bearing capacity.

3. A joint prosthesis according to one of the claims 1-2, **characterised** in that in the mounted situation, the rods have a diverging orientation such that they approximately possess a virtual point of intersection that substantially coincides with a stationary rotational point of the ball (2) of the second prosthesis part (13) in the socket (5) of the first prosthesis part (11).

4. A joint prosthesis according to one of the claims 1-3, **characterised** in that each of the rods (6) is provided with thread so that an insert nut (4) can be fitted in a socket (5) of the first prosthesis part (11).

5. A method of bone fixation, **characterised** in that the bone is provided with at least one drilling, a draw rod (6) provided with an enlarged end (15) is inserted through the drilling, and a locking element (7) is used that prevents the removal of the draw rod (6) from the drilling.

6. A method according to claim 5, **characterised** in that the locking element (7) is inserted into the drilling to prevent the enlarged end (15) from passing through the drilling.

7. A method according to claim 5, **characterised** in that the locking element (7) is provided on the draw rod (6), wherein the locking element (7) is embodied in accordance with claim 6.

8. A method according to any of claims 5-7, **characterised** in that the draw rod (6) is mounted such that when the mounted prosthesis is in a virtually unloaded condition, there is no significant tensile force in the rod (6).

9. A method according to claim 8, **characterised** in that the rods are mounted free of stress of bending.

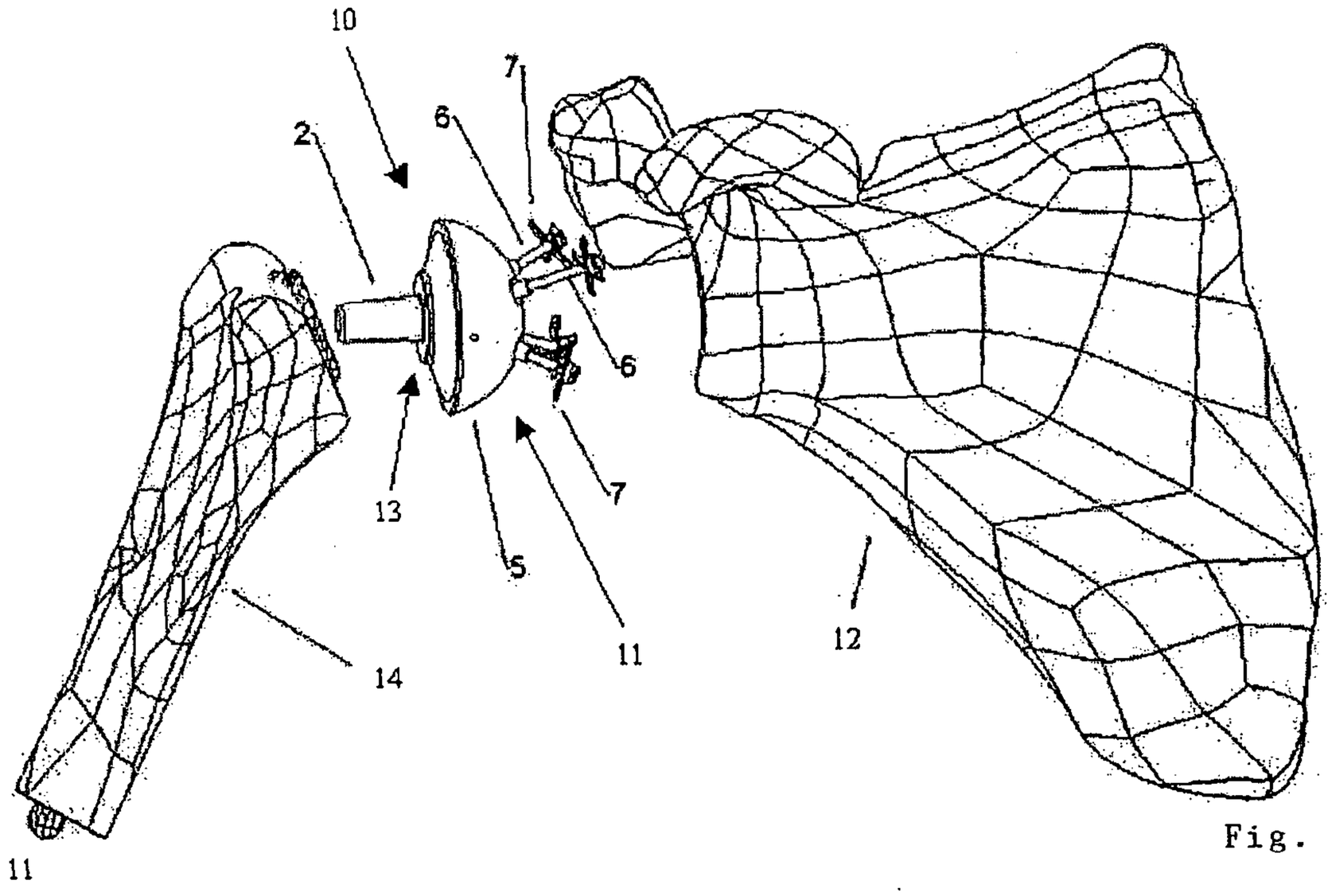


Fig. 1

Fig. 2

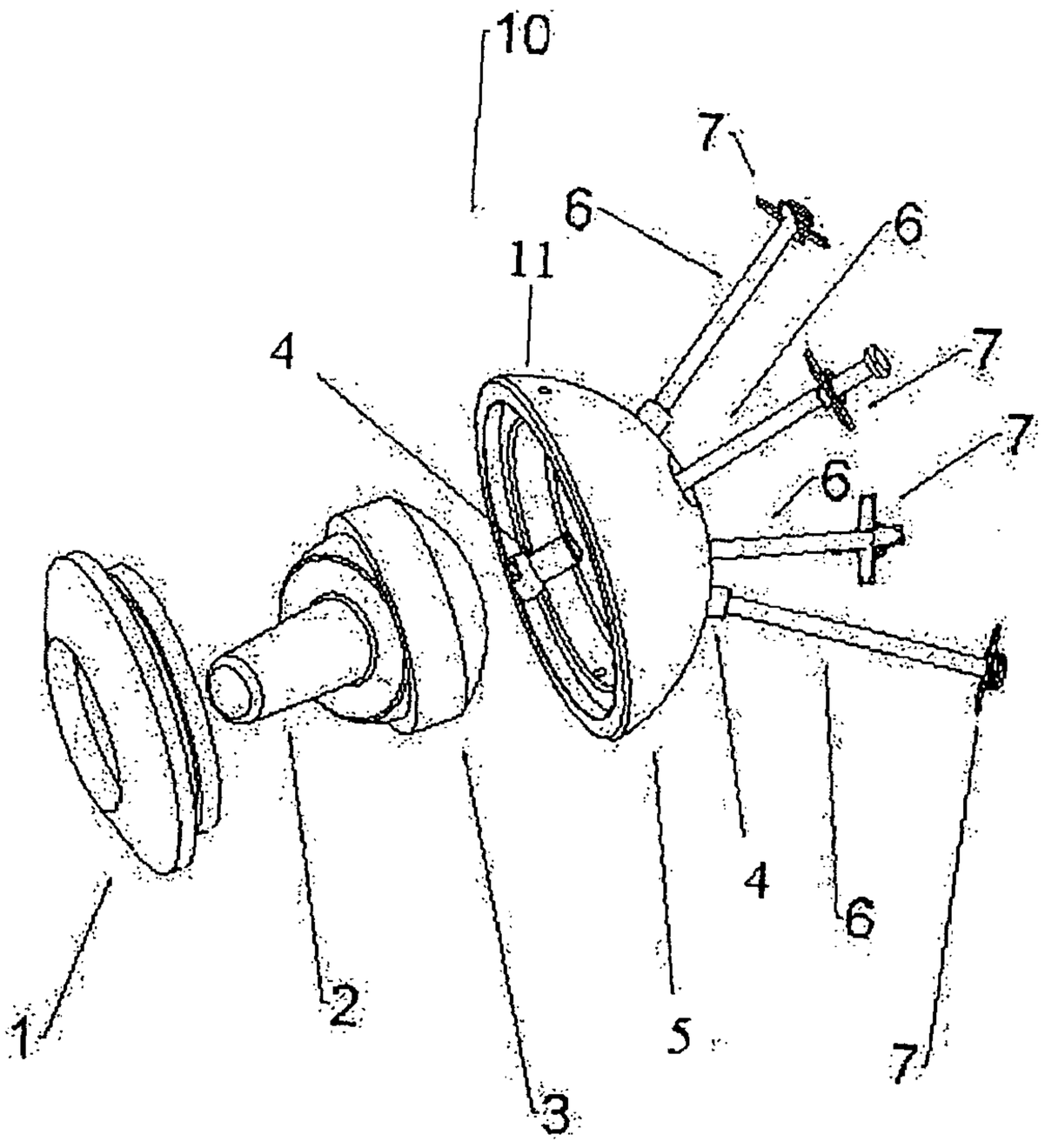


Fig. 3

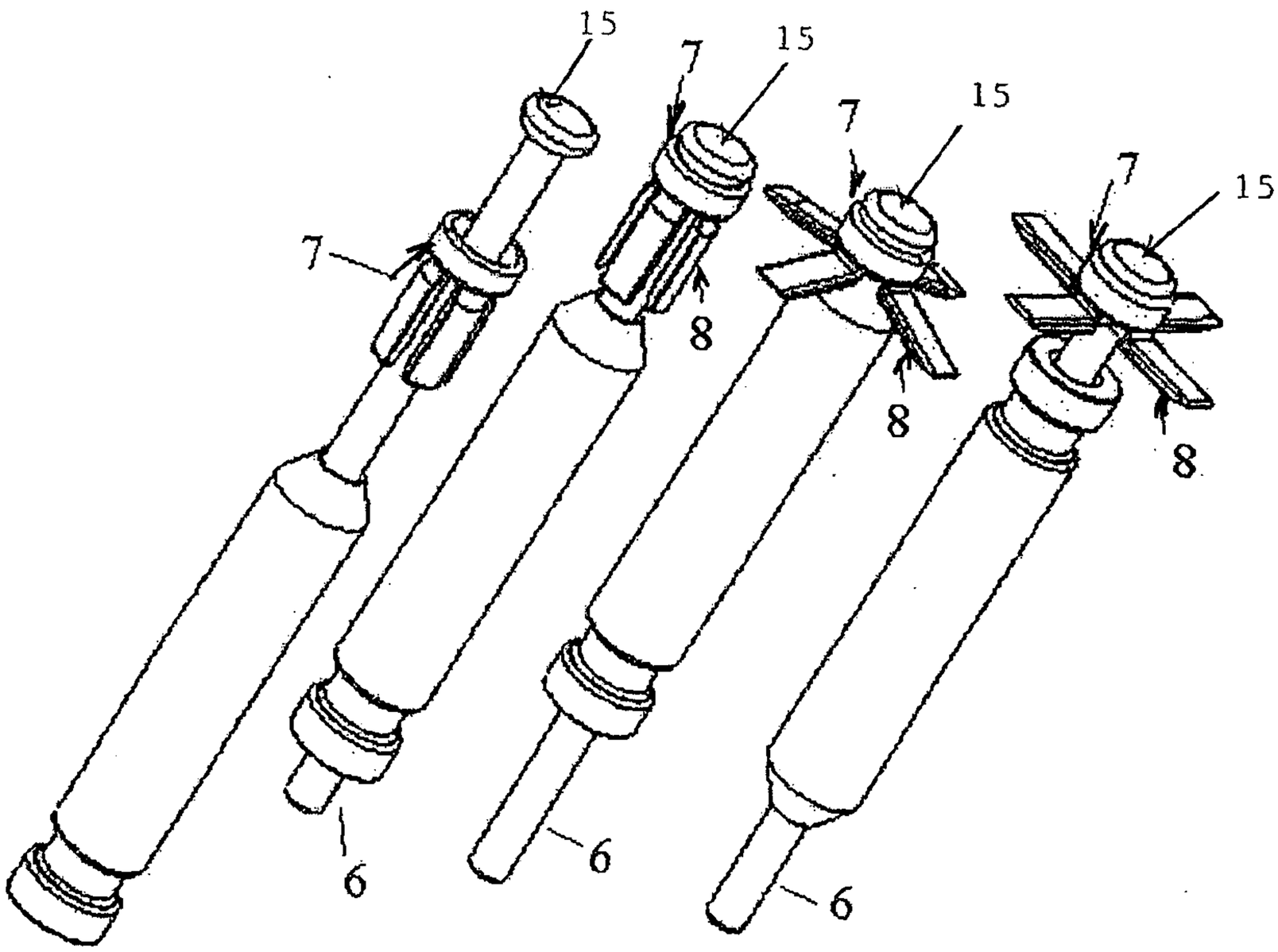
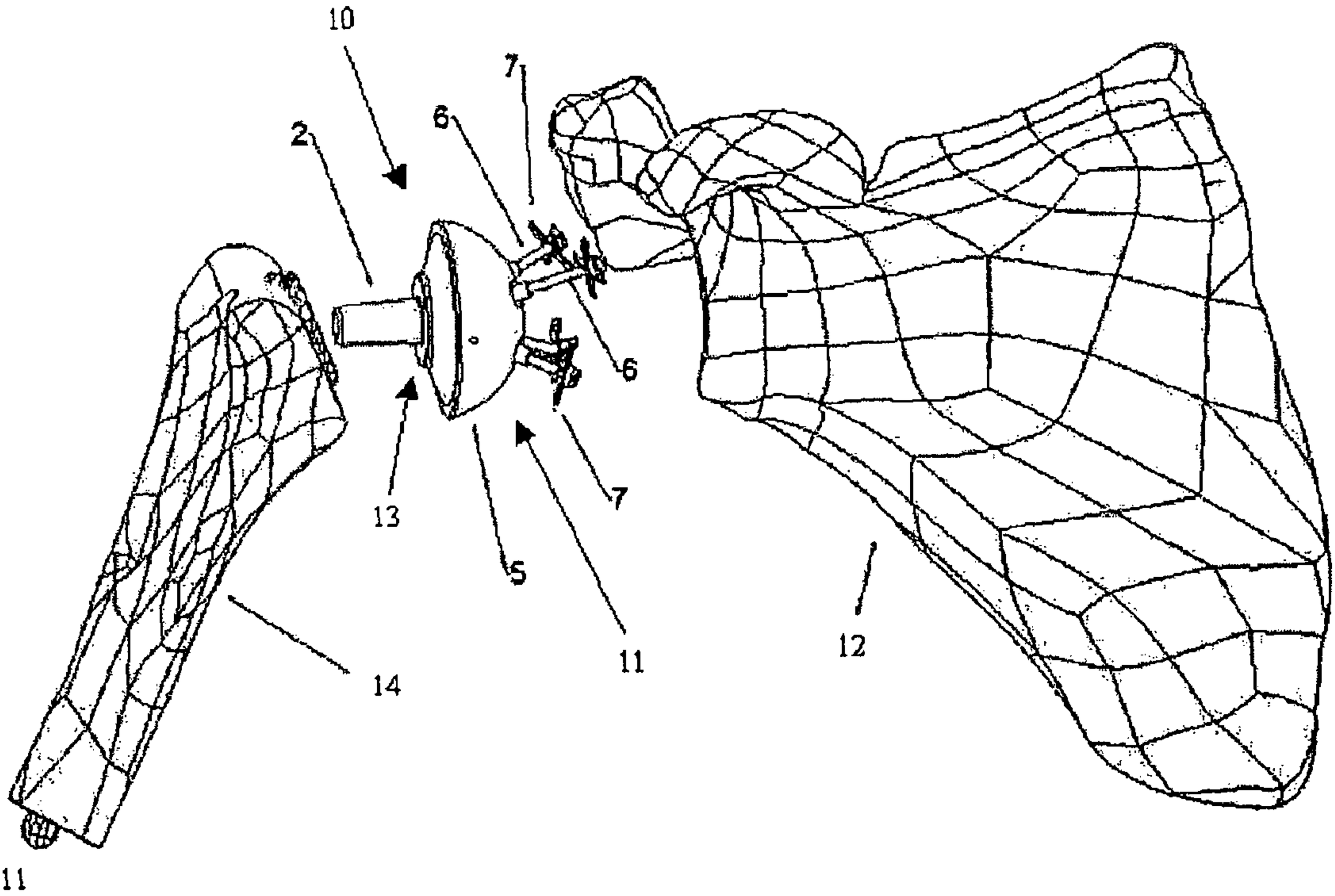


Fig. 4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