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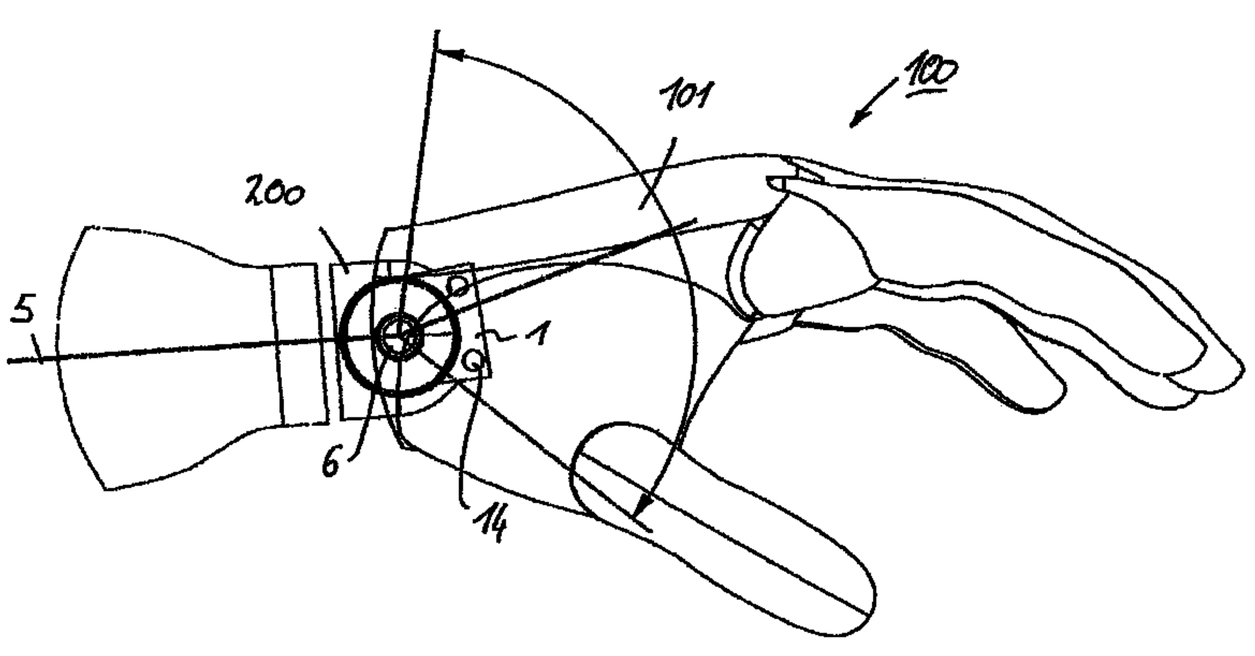

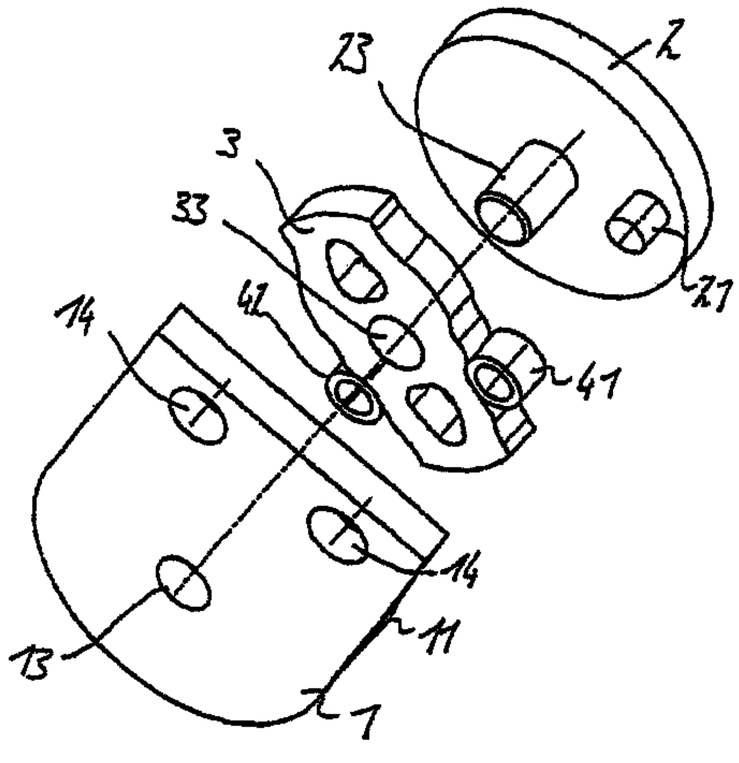

(57) Abrégé/Abstract:
The invention relates to a hand prosthesis comprising a chassis and coupling elements for fastening the hand prosthesis to an arm stump, and also comprising a joint for flexing and extending the hand prosthesis in relation to the coupling elements, the chassis being maintained in a neutral position against a spring bias. The invention is characterized in that at least one spring element is associated with the chassis and has a progressive spring characteristic and provides an increasing counterforce with increasing flexion and extension angle.

Abstract

The invention relates to a hand prosthesis comprising a chassis and coupling elements for fastening the hand prosthesis to an arm stump, and also comprising a joint for flexing and extending the hand prosthesis in relation to the coupling elements, the chassis being maintained in a neutral position against a spring bias. The invention is characterized in that at least one spring element is associated with the chassis and has a progressive spring characteristic and provides an increasing counterforce with increasing flexion and extension angle.

HAND PROSTHESIS

The invention relates to a hand prosthesis comprising a chassis and coupling elements for fastening the hand prosthesis to the stump of an arm and comprising at least one joint for the flexion and extension of the hand prosthesis in relation to the coupling elements, the chassis being kept in a neutral position against a spring force.

US 2004/0015240 A1 discloses a hand prosthesis with gripping elements on a chassis, which has a semicircular rotating element. A torsion spring is arranged between a base plate and a mounting plate and keeps the chassis with the motor-driven gripping elements in a neutral position. The chassis can be locked in different angular positions by means of a displaceable locking plate.

The object of the invention is to improve a hand prosthesis to the extent that it has an appearance that is as natural as possible.

The hand prosthesis according to the invention comprising a chassis and coupling elements for fastening the hand prosthesis to the stump of an arm and comprising at least one joint for the flexion or extension of the hand prosthesis in relation to the coupling elements, with the chassis being kept in a neutral position against a spring force, provides at least one spring element which is assigned to the chassis, has a progressive spring characteristic and, with increasing flexion or extension angles, offers an

increasing counteracting force. To achieve an appearance of the hand prosthesis that is as natural as possible, it is intended to replicate a natural hand in its appearance, both in the way in which it functions and in the way it looks, in order to achieve improved acceptance among wearers of prostheses. In order that the impression of an artificial body part is not given when contact is made with other people or objects, it is necessary for all the parts of the prosthesis that lie at the surface to be soft in the way they are formed and for elastic parts to be included in the hand, and in particular in the region of the wrist. In this case, the joint of the hand prosthesis as such is formed as a loose joint, which is kept in a neutral or starting position by at least one spring element. This spring element is assigned to the chassis and supports the latter with respect to the other part of the joint, in particular the coupling elements or components arranged in between. The spring element is in this case formed in such a way that a progressive spring characteristic is obtained for increasing flexion or extension angles, so that it is possible in the neutral position of the hand to obtain a soft characteristic and easy mobility within the neutral position and in a small angular range around it. Toward the respective end positions of the hand chassis, an increased counteracting force is provided, in order to avoid hard impact with the limits of movement. This increases the natural character of the hand prosthesis.

The spring element may be formed as a torsion spring, which is effective both in the direction of extension and in the direction of flexion. Alternatively, a spring element may be respectively effective against extension and against flexion, it also being possible for a number of spring components that become effective one after the other to form a spring element. It is likewise possible for the spring element to take the

form of an elastomer part which, in dependence on the flexion angle or the extension angle, opposes the turning about the flexion joint with an increased, in particular progressive, spring force. The spring element or elements may be exchangeably formed, to permit adaptation to the respective hand prosthesis or requirements of the prosthesis user.

Apart from flexion and extension alone, it is provided that the chassis is mounted rotatably about an axis substantially parallel to the longitudinal extent of the stump of the arm, in order to allow a further movement component to be provided in the wrist, to make the hand prosthesis appear as natural as possible.

To allow an object to be raised and held after being gripped, it is provided that in the joint there is a locking device, which arrests the joint in a chosen position. This locking device is provided both for the flexion-extension joint and for the rotary joint. In principle, such a locking device may also be fitted separately in a hand prosthesis, without a corresponding spring characteristic or restoring device having to be present. The locking device may in this case have in particular a crown gearing, which can be brought into engagement to arrest the joint. This has the advantage of easy releasability and very fine angle graduation, so that the hand prosthesis can be arrested in virtually any desired angular position.

To be able to provide a hand prosthesis with an appearance that looks as natural as possible, the flexion-extension joint is arranged in the metacarpal region of the chassis. In the same way as in the case of a ballpoint pen, the mechanism for the locking function can be switched on by single actuation and switched off by repeated actuation. The actuation of the locking mechanism may either be performed manually

by means of a pushbutton or be performed by means of an electrically actuable drive unit.

The alignment of the joint axis of the extension-flexion joint at an oblique, in particular obtuse, angle in relation to the longitudinal extent of the stump of the arm combines the properties of flexion and simultaneous abduction of the hand prosthesis. This is favorable for most day-to-day tasks.

An exemplary embodiment of the invention is explained in more detail below on the basis of the accompanying figures, in which:

Figure 1 shows an overall representation of a hand prosthesis in plan view;

Figure 2 shows a hand prosthesis according to Figure 1 in side view;

Figure 3 shows a perspective exploded drawing of a prosthetic joint for a hand;

Figure 4 shows a sectional representation of the prosthetic joint in a neutral position;

Figure 5 shows a section along A-A of Figure 4;

Figure 6 shows a representation according to Figure 4 in a position turned by 60°;

Figure 7 shows a perspective, sectional exploded representation of a flexion lock; and

Figure 8 shows a sectional representation of the flexion lock according to Figure 7 in the fitted position.

Figure 1 shows an overall representation of a hand prosthesis 100 in plan view, said prosthesis comprising a chassis 101, which is articulated both in the direction of flexion and in the direction of extension about a swiveling axis 4 by means of a joint device 10. The joint device 10, referred to hereafter as the joint, has a mounting plate 1 for fastening on the hand chassis 101. Furthermore, a housing 200 for coupling the hand prosthesis 100 to fastening devices on the stump of an arm is formed in the joint 10. The housing 200 may be connected to the mounting plate 1 by way of a coupling element 2. It is likewise provided that the housing 200, and consequently the hand prosthesis 100, permit a rotational movement about an axis 5. The axis of rotation 5 is aligned substantially parallel to the longitudinal extent of the lower arm shaft. The flexion and extension swiveling axis 4 is at right angles to the axis of rotation 5.

Arranged laterally on the joint 10 is an elastic actuating device 6 for a locking device arranged within the joint 10. The actuating element 6 allows the hand chassis 101 to be locked in a chosen angular position. Likewise, the hand chassis 101 can be transferred from the locked position into an unlocked position by renewed actuation.

Figure 2 shows the hand prosthesis 100 in a side view, said prosthesis comprising the chassis 101 and the mounting plate 1, on which the hand chassis 101 is fixed by means of bores 14 and suitable fastening means. In Figure 2, the hand prosthesis 100 is in the neutral position and can perform a counterclockwise extending movement and a clockwise flexing movement, as indicated by the double-headed arrow. The fingers may be driven individually or together by a motor within the chassis 101 or the housing 200. The hand prosthesis 100 is kept in the neutral position by means

of a spring element in the joints 10, making it easily possible for the hand chassis 101 to move into the neutral position.

Figure 3 shows the mounting plate 1 of the hand prosthesis (not represented any further in this figure) with a circular frame 11. Bores 14 for fastening further components of the hand prosthesis are formed in the mounting plate 1. Likewise, a central bore 13 is formed at the center point of the frame 11 for receiving a rotating pin 23 of a coupling element 2. A spring element 3 in the form of an elastomer body is arranged between the coupling element 2 and the mounting plate 1 or a corresponding element of the chassis 101. The spring element 3 has a central bore 23, in which the rotating stud 23 is inserted in the fitted position. The rotating stud 23 protrudes into the bore 13 of the mounting plate 1 in the fitted position.

Arranged or formed on the coupling element 2, which for its part may be fixed on a fastening part or the housing 200 for receiving the stump of an arm, is a pin 21, which receives a rotating sleeve 41. Likewise formed on the mounting plate 1 is a pin 12 (which cannot be seen in Figure 3), which receives an opposing rotating sleeve 42. The rotating sleeves 41, 42 rest on the surface of the spring element 3 and can roll on it.

Figure 4 shows a sectional representation of the prosthetic joint 10 for a hand in the neutral position. The two rotating sleeves 41, 42 are arranged on their respective bearing pins 21, 12 and lie opposite each other on indentations 34 of the spring element 3. The spring element 3 has been placed in the circular frame 11, which is formed on the mounting plate 1, the outer circumference of the spring element 3 corresponding in

certain portions to the inner contour of the frame 11. In the present case, the spring element 3 is formed mirror-symmetrically, so that the same spring rates are obtained both in the direction of extension and in the direction of flexion. This can be varied according to the intended use, so that different spring forces are obtained for extension and flexion. Also formed in the spring element are clearances 35, which influence the spring characteristics. The larger the clearances 35 are, the softer the mounting of the hand prosthesis about the neutral position.

It can be seen in a sectional representation in Figure 5 that the frame 11 is formed in one piece with the mounting plate 1, as is the bearing pin 12 for the rotating sleeve 42. The bearing pin 21 is formed in one piece on the coupling element 2, as is the rotating stud 23.

If the hand prosthesis 100 together with the mounting plate 1 is then turned in relation to the coupling element 2, as represented in Figure 6, the bearing pins 21, 12 are displaced in relation to each other. The spring element 3, formed in the present case as a one-piece elastomer part, is compressed, it being possible to achieve a progressive spring characteristic as a result of the way in which the spring element 3 is configured in the present case. This may occur for example by means of inserted components within the spring element 3 and their sequential activation in dependence on the turning angle, or by means of appropriate shaping. In the neutral position, as represented in Figure 3, the spring element 3 has a relatively soft spring characteristic, so that, when there is movement of the lower arm, the hand prosthesis 100 swings relatively loosely along with it, like a natural hand. The indentations 34 have the effect of bringing about a preferential position of the neutral

position, so that the hand prosthesis 100 is always returned to this position on account of the restoring forces of the spring element 3. The further the hand prosthesis 100 is turned in relation to the coupling element 2, the more the counteracting force produced by the spring element is increased, whereby hard impact against end stops is avoided. This corresponds to the natural sequence of movements and appearance of a hand and additionally reduces the stress on the mechanical components of the hand prosthesis 100.

As an alternative to the one-piece configuration of the spring 3, the latter may also be formed by a number of separate spring elements. For example, different spring elements may be provided for extension and flexion. The hand prosthesis is then kept in the neutral position by means of two springs.

Figure 7 shows a locking device 7, which is attached to the housing 200, in detail. The mounting plate or base plate 1 for fastening the hand chassis 101 is arranged within the locking device 7. In the embodiment of the locking device 7 represented, the spring element described above is not shown. On account of the flat configuration of the spring element 3, however, easy integration within the locking device 7 is possible, or it can easily be accommodated during attachment to the housing 200.

An external toothing 201 with a radially peripheral web 202 is formed on the housing 200. Inserted in the free space between the external toothing 201 and the web 202 is an internal toothing ring 73, which can be turned together with the chassis 101 in relation to the base plate 1. The turning is achieved by bearing balls 8, which run in corresponding ball tracks within the internal toothing ring 73 and the bearing housing 79 of the base plate 1. A sealing ring 9 serves as sealing

between the housing 200 and the bearing housing 79. An internal toothing 17 is formed within the bearing housing 79, in the region of the base plate 1. A crown gearing disk 72 with external toothing and crown gearing engages in the internal toothing ring 73. In the fitted state with the joint locked, this crown gearing disk 72 is in engagement with a second, opposing crown gearing disk 71, which likewise has an external toothing and engages in the internal toothing of the bearing housing 79. The crown gearing disks 71, 72 are pressed against each other and kept in engagement by means of a spring ring 80 and a cup spring 26. The cup spring 26 is supported by way of a pressure cap 77 with respect to an elastic cap 6 as an actuating device. The elastic cap 6 is fixed on the base plate 1 or the bearing housing 79 in a waterproof manner by means of a holding ring 16. The cup spring 26 and the spring disk 80 are supported on the crown gearing disks 71, 72 by way of pressure disks 81, 82.

Arranged within the crown gearing disks 71, 72 is a disengaging mechanism, which when actuated moves the crown gearing disks 71, 72 apart in the axial direction. The pressure cap 77 can be displaced in the direction of the housing 200 and moves a pressure sleeve 76, in which a disengaging pin 75 and a ball 78 are guided, in the direction of the housing 200. The cup springs 26 press the pressure disk 82 in the direction of the housing 200 and exert a force on a disengaging sleeve 74 arranged around the pressure sleeve 76. The disengaging sleeve 74 has a peripheral web, which protrudes between the crown gearing disks 71, 72 and can enter into positive engagement with the crown gearing disk 72 assigned to the internal toothing ring 73. The ball 78 is guided within the pressure sleeve 76 and engages in the disengaging pin 75, in which a track guide is formed, in the form of the developed projection of a cardioid, as in the case of a

ballpoint pen. If the pressure cap is then moved in the direction of the housing 200, the cup spring 26 presses on the disengaging sleeve 74 by way of the pressure disk 82 and moves the crown gearing disk 72 axially away from the crown gearing disk 71, so that a rotation can take place about the joint axis 4. Further pressing of the pressure cap 77 makes the prestressed cup spring 26 begin to move in, the ball 78 being guided on the fixed disengaging pin 75, along the cardioid track guide in the direction of the fixed housing 200, and having the effect that the pressure sleeve 76 remains securely held on the disengaging pin 75 by way of the ball 78. The rotation about the axis 4 consequently continues to be possible.

By renewed actuation of the pressure cap 77, the ball 8 is moved further in the track guide of the disengaging pin 75. By moving the ball 78 out from a locking dead center position, the disengaging sleeve 74 will return to the locked position represented in Figure 8. The mechanism works in a way analogous to a ballpoint pen or a push-push element.

The same mechanism of the locking device 7 can also be used for the locking and unlocking of the rotation about the rotational axis 5.

Claims

1. A hand prosthesis comprising a chassis and coupling elements for fastening the hand prosthesis to the stump of an arm and comprising at least one joint for the flexion and extension of the chassis in relation to the coupling elements, the chassis being kept in a neutral position against a spring force, characterized in that at least one spring element is coupled to the chassis, has a progressive spring characteristic and, with increasing flexion or extension angles, offers an increasing counteracting force.

2. The hand prosthesis as claimed in claim 1, characterized in that the spring element is formed as a torsion spring.

3. The hand prosthesis as claimed in claim 1 or 2, characterized in that a spring element is respectively effective against extension and against flexion.

4. The hand prosthesis as claimed in any one of claims 1 to 3, characterized in that the spring element is formed as an elastomer part.

5. The hand prosthesis as claimed in any one of claims 1 to 4, characterized in that the spring element comprises a number of individual springs.

6. The hand prosthesis as claimed in any one of claims 1 to 5, characterized in that the spring element is exchangeable.

7. The hand prosthesis as claimed in any one of claims 1 to 6, characterized in that, apart from flexion and extension, the chassis is mounted rotatably about an axis substantially parallel to the longitudinal extent of the stump of the arm.

8. The hand prosthesis as claimed in any one of claims 1 to 7, characterized in that a locking device which arrests the joint in a chosen position, is provided in the joint

9. The hand prosthesis as claimed in claim 8, characterized in that the locking device has a crown gearing, which is assigned to the joint and can be brought into engagement to arrest the joint.

10. The hand prosthesis as claimed in any one of claims 1 to 9, characterized in that the axis of the chassis of the flexion extension joint is arranged in the metacarpal region.

11. The hand prosthesis as claimed in any one of claims 1 to 10, characterized in that the joint axis is aligned at an obtuse angle in relation to the longitudinal extent of the stump of the arm.

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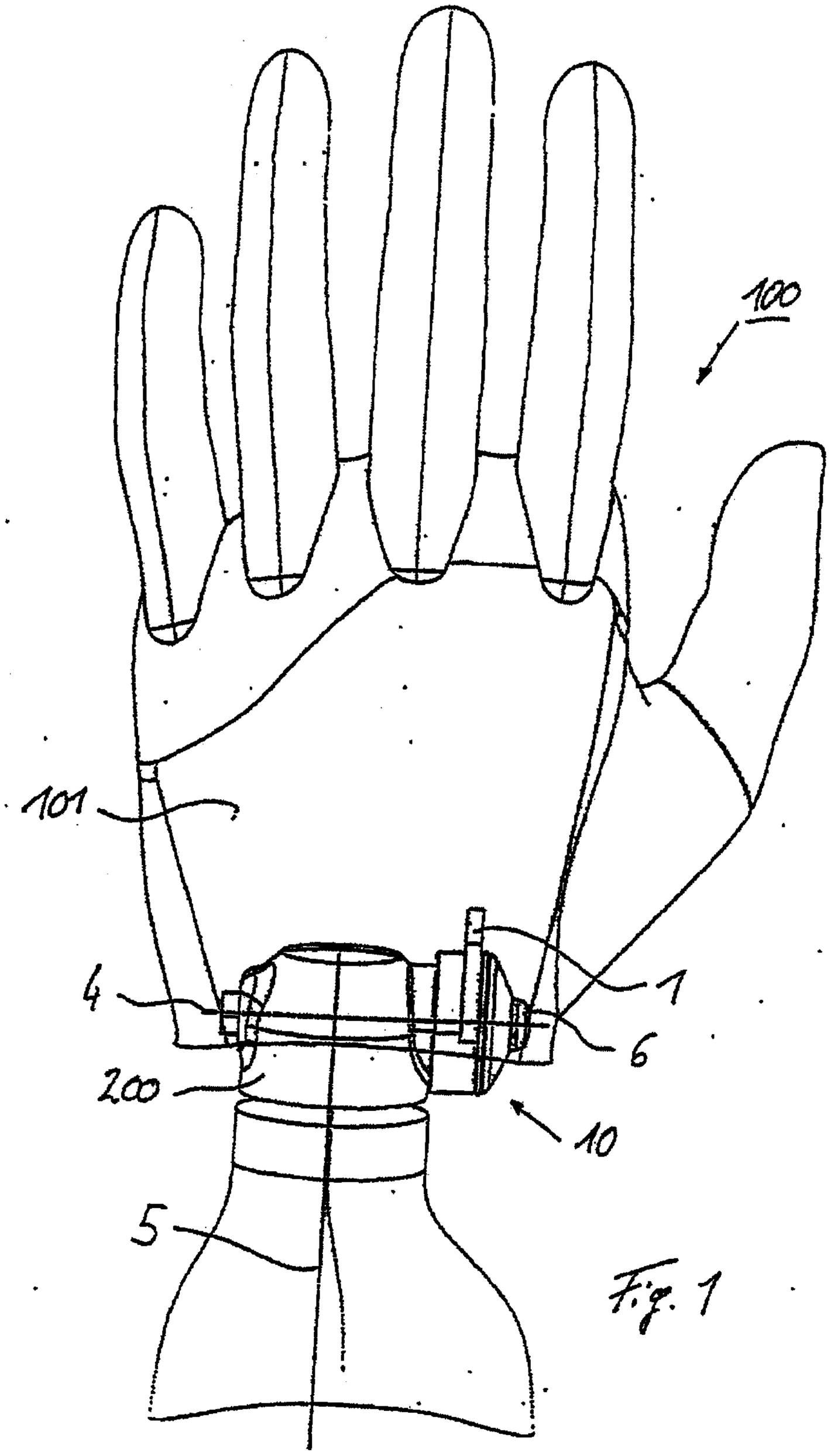

Fig. 1

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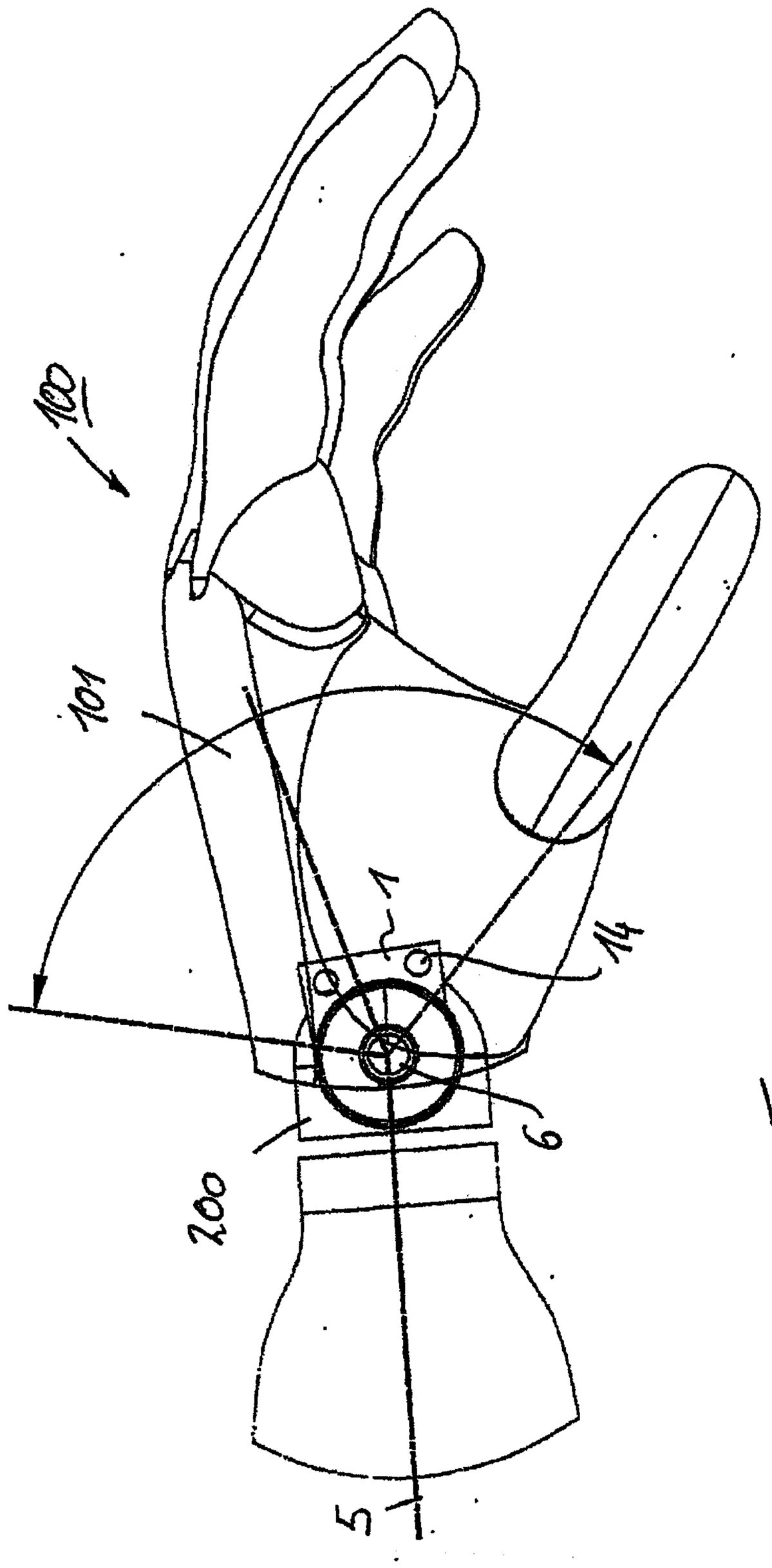

Fig. 2

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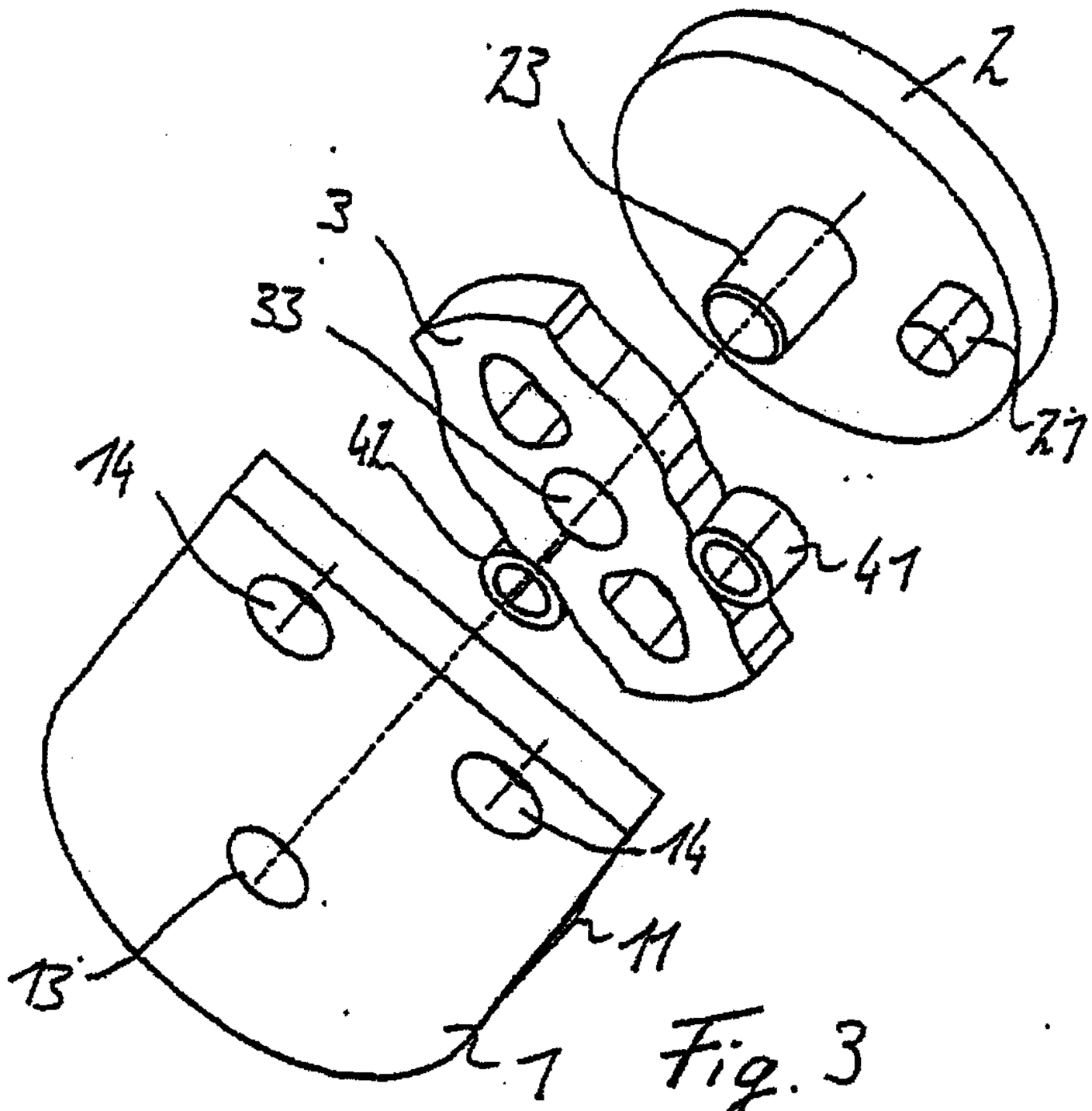

Fig. 3

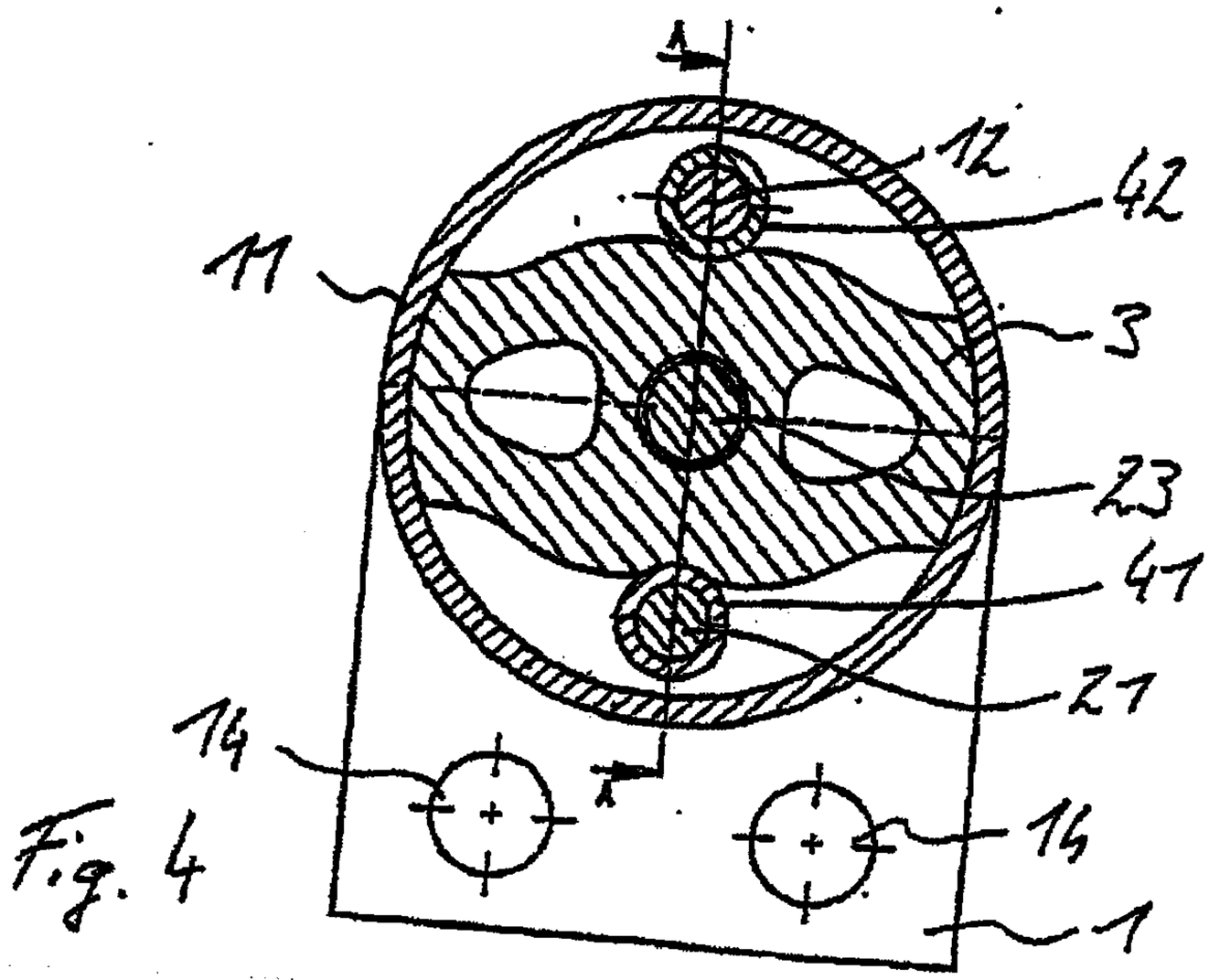

Fig. 4

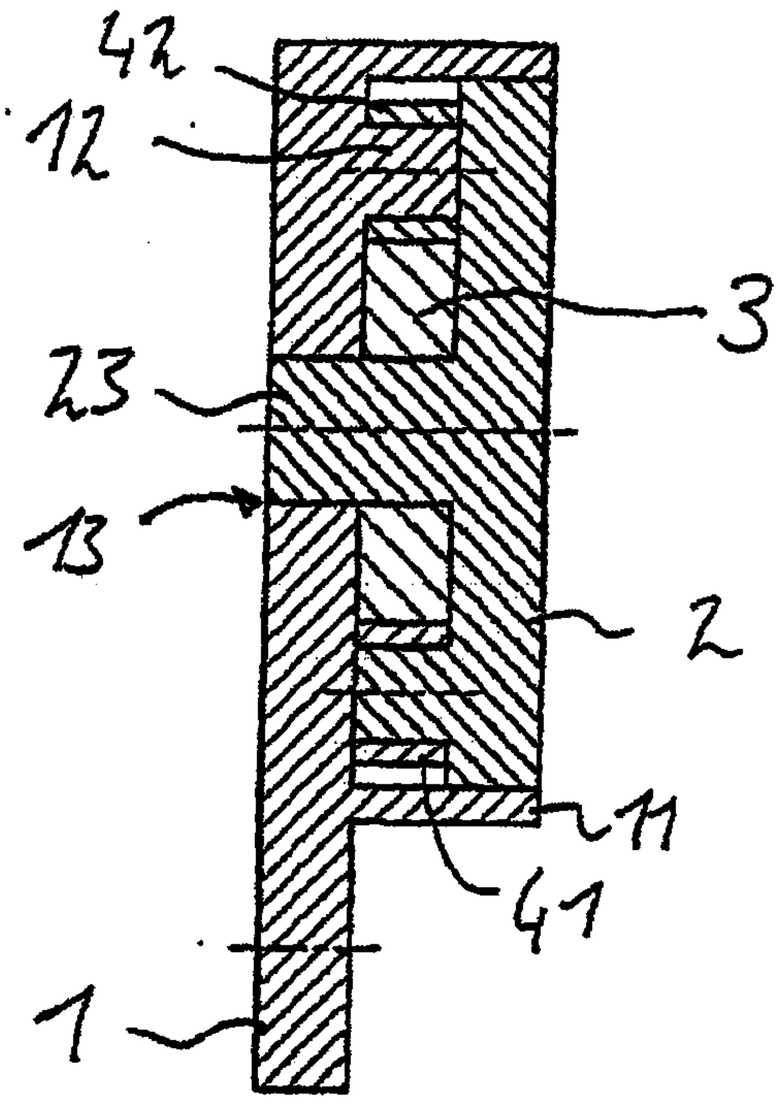

Fig. 5

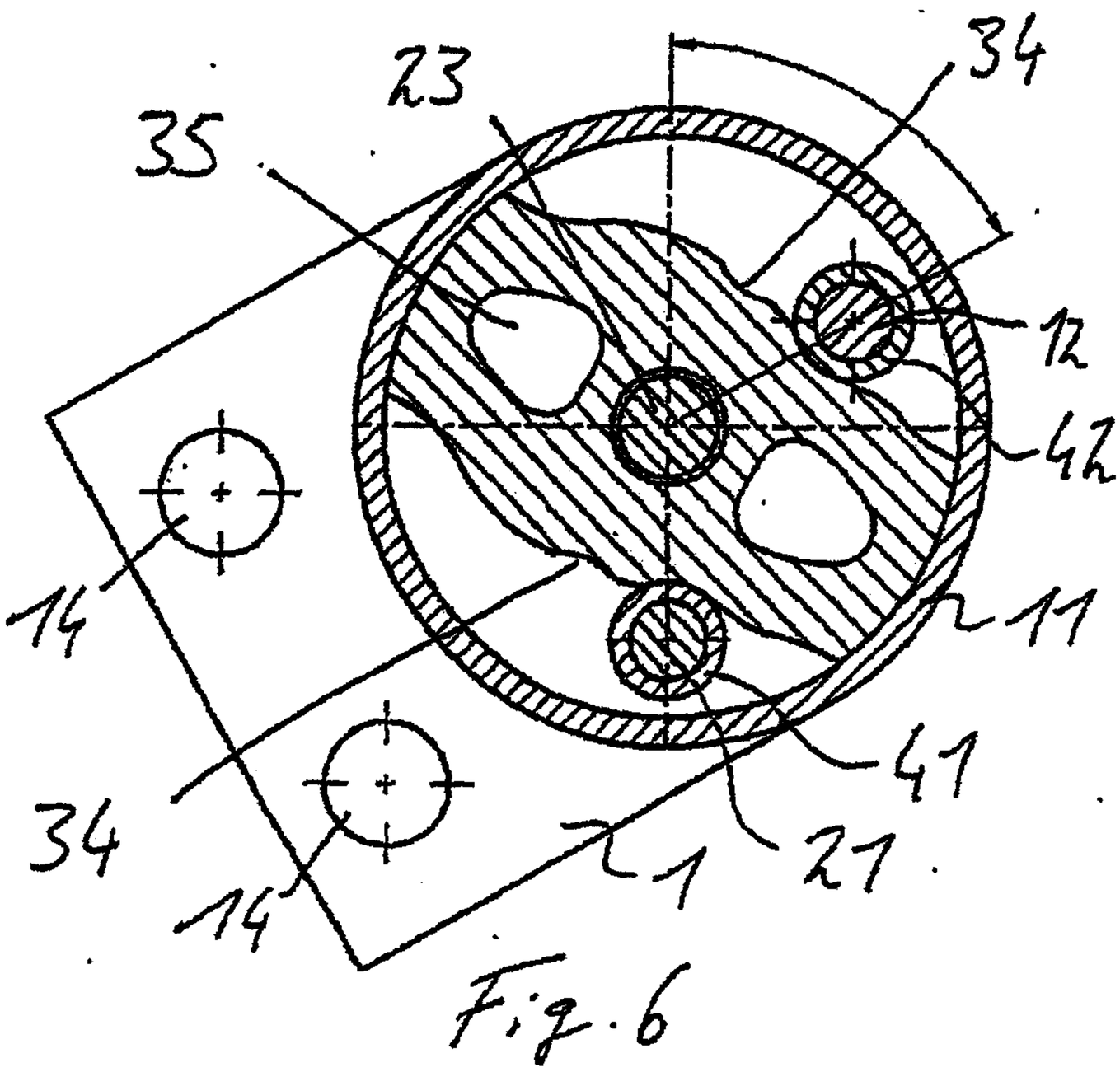

Fig. 6

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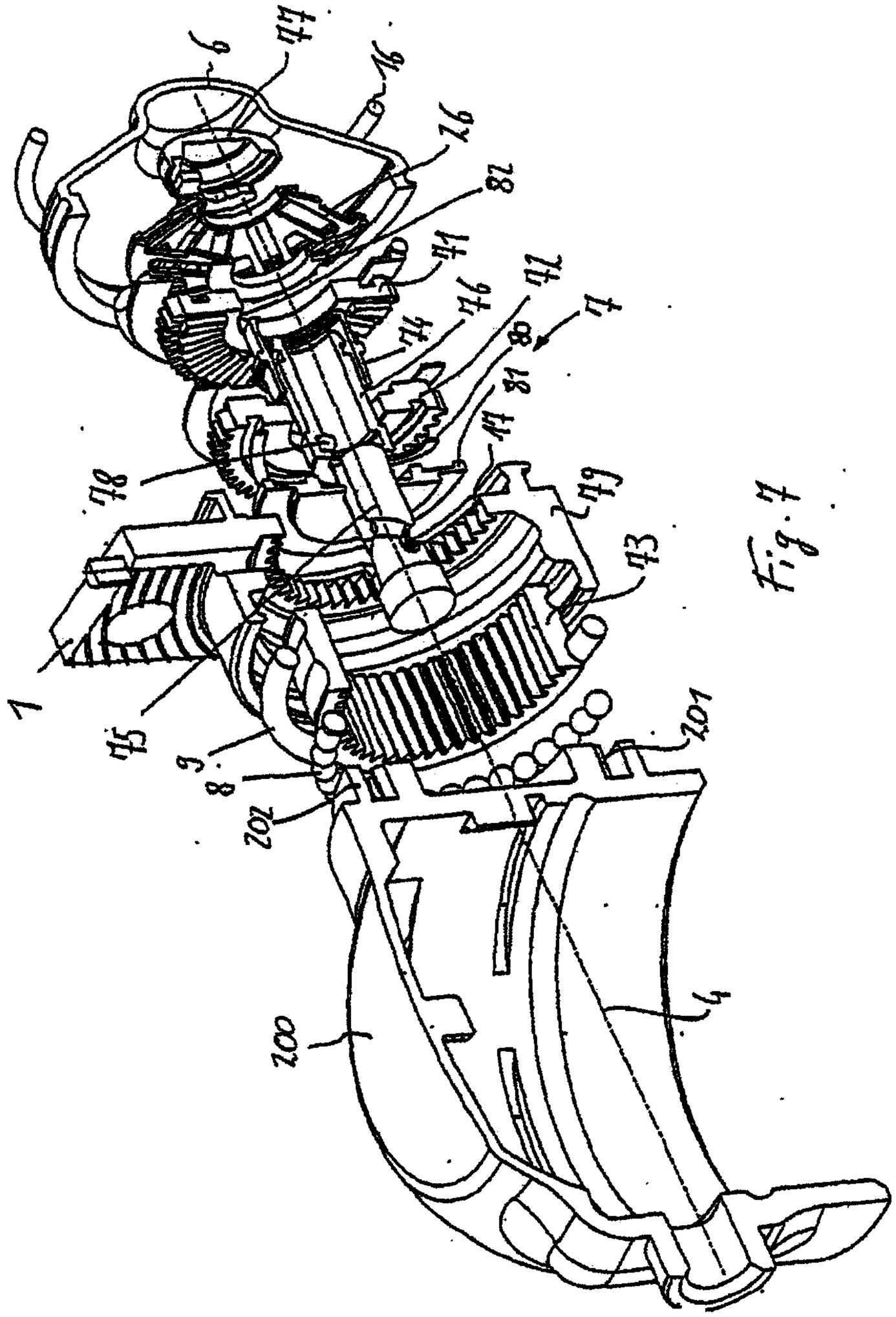


Fig. 4

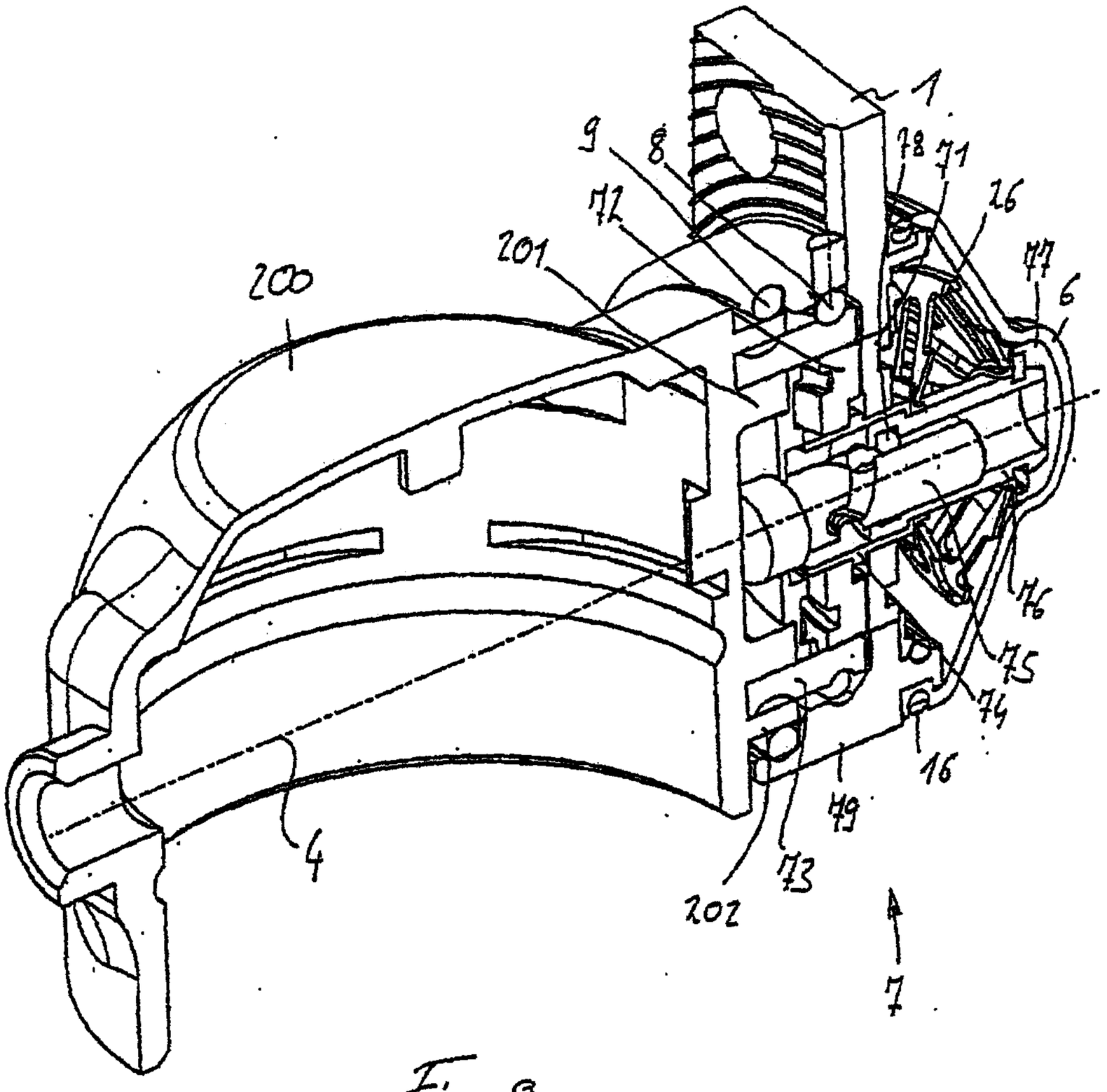
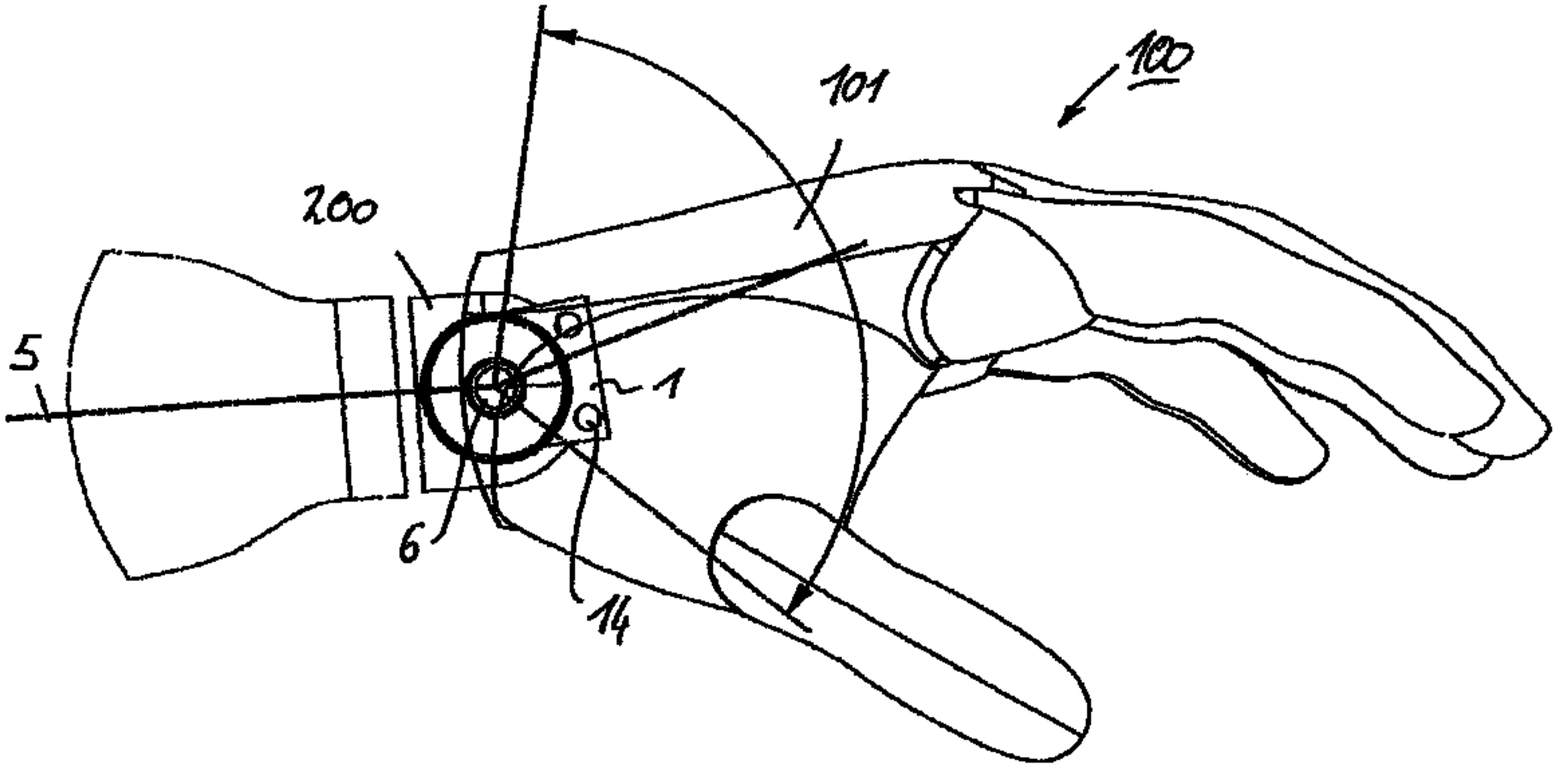


Fig. 8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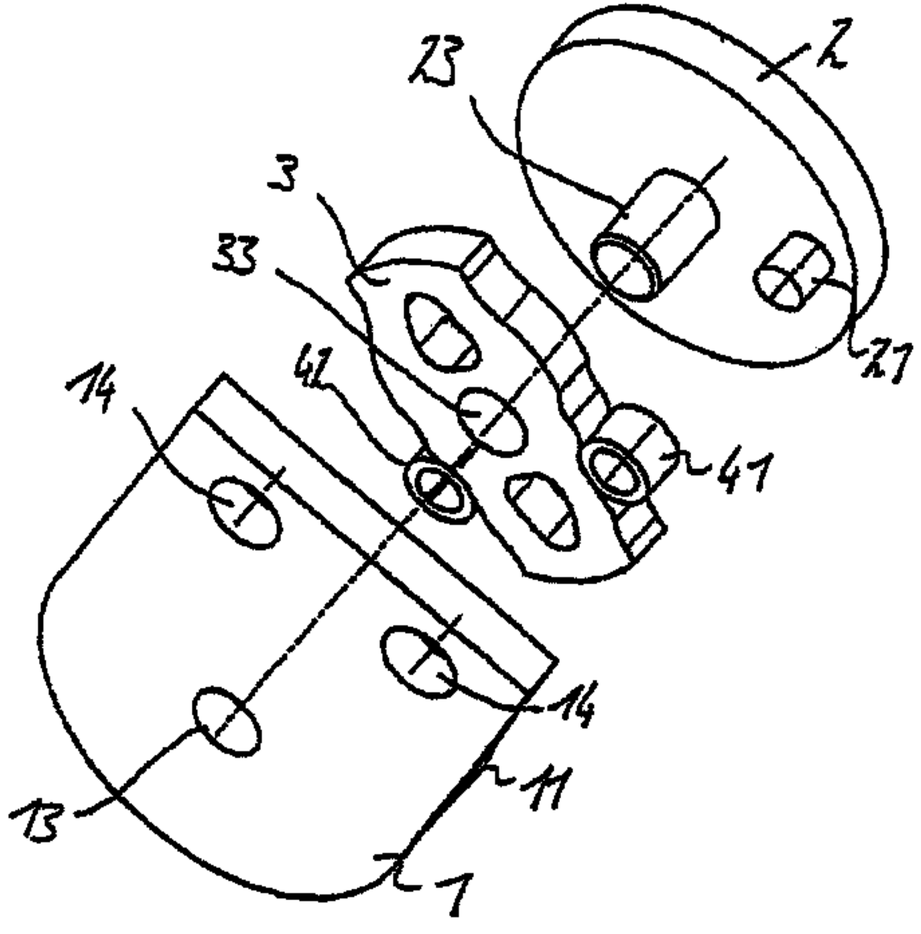
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