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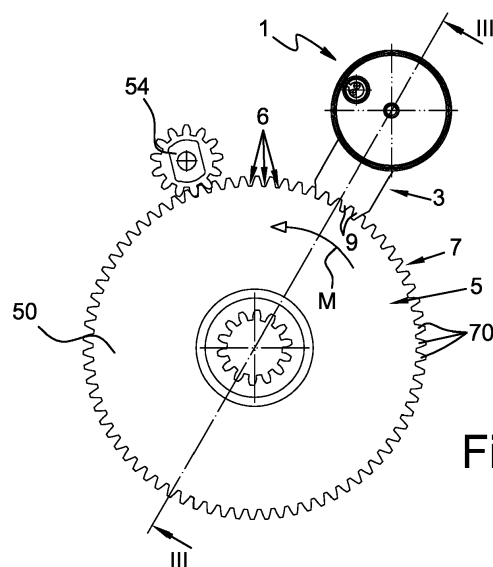
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(54) **LOCKING DEVICE FOR GATES OR THE LIKE**

(57) The present invention relates to a locking device (1) for gates or the like, comprising a locking body (3) configured to reversibly lock a movable element (5), which is cinematically connected to a gate or the like in order to operate the closing and the opening thereof. The movable element (5) comprises at least one locking seat (6) and is adapted to move along a movement direction (M). The locking body (3) comprises at least one locking tooth (9) configured to engage the locking seat (6) of the movable element (5). The locking device (1) further comprises an actuator (11) movable along an acting direction (A). The actuator (11) and the locking body (3) are cinematically connected to one another by means of at least one arm (13), hinged at its own ends to the locking body (3) and to the actuator (11), respectively. The movement of the actuator (11) along the acting direction (A) implies the progressive inclination (a) of the arm (13) with respect to a direction orthogonal (O) to the acting direction (A). The movement of the movable element (5) along the movement direction (M) is prevented by the locking body (3) as long as the inclination (a) of the arm (13) is lower than an unlocking inclination ( $\gamma$ ) starting from which a thrust exerted by the locking seat (6) of the movable element (5) against the locking tooth (9) of the locking body (3) is sufficient to push the locking tooth (9) out of the locking seat (6) and to allow the movement of the movable element (5) along the movement direction (M).



**Fig. 1**

## Description

**[0001]** The present invention relates to a locking device for gates or the like and to a closing and opening system for gates or the like comprising such a locking device.

**[0002]** Currently, the closing and opening systems for gates or the like comprise actuators capable of automatically closing and opening the gate or door. However, it is important that the gate is appropriately locked in the stop position, i.e. in the open or closed position, or also in an intermediate position between the open and closed positions.

**[0003]** In order to lock the gate or the door in the stop position it is known to use the irreversibility of the movement provided by the reduction units present in the closing and opening system itself. Such reduction units can, for example, comprise reduction gear with axial screw or worm screw systems, and generally have a transmission efficiency of less than 50%, since the tangent of the screw propeller is lower than the friction coefficient between the components in relative movement. The irreversibility of the movement is ensured by such an efficiency of less than 50%. This known solution, however, has the following drawbacks: the energy efficiency is low, the reduction ratio is high for constructive factors, in the case of reversal of motion there is an immediate blockage of the residual speed with considerable strains of the mechanical components.

**[0004]** Another system of the known type for locking the gate or door in the stop position provides a lock by friction between two abutment elements, one of which is associated with the gate. Such a friction locking system, however, requires considerable maneuvering efforts and requires robust structures and high operating energies, which are not always compatible with the types of structures present in the commonly used closing and opening systems.

**[0005]** Another system of the known type also provides an interference lock, defined for example by a latch or a prong which is inserted in a corresponding seat provided in the gate, or in any case in a movable element cinematically connected to the gate. The main drawback of this type of lock consists in that the latch or the prong are not always free to exit, if necessary, from the seat present in the gate or in the relative movable element because the gate, or the movable element, basically press laterally against the latch or the prong. In fact it is very probable that the side of the seat presses against the latch, preventing, due to the considerable frictional force generated, the correct extraction of the latch from the seat, if not against a considerable extraction force.

**[0006]** The object of the present invention is to provide a locking device for gates or the like which overcomes the drawbacks of the known solutions.

**[0007]** Another object of the present invention is to provide a locking device that is reversible, that is to say, that always allows unlocking, if necessary, the gate or door.

**[0008]** Another object of the present invention is to pro-

vide a locking device for gates or the like that is particularly simple, functional and cost-effective.

**[0009]** Another object of the invention is to provide a locking device that is capable of giving the greatest assurances of reliability and safety in use.

**[0010]** These objects according to the present invention are achieved by implementing a locking device for gates or the like as described in claim 1.

**[0011]** Further features are described in the dependent claims.

**[0012]** Further features and advantages will appear more clearly from the description of a preferred but non-exclusive embodiment of a locking device for gates or the like, shown by way of an indicative and nonlimiting example with the aid of the accompanying drawings, in which:

Figure 1 is an elevation view of an embodiment of a locking device, according to the invention, associated with a crown of a gate closing system, shown in a locked position;

figure 2 is an elevation view of the locking device of figure 1, shown in an unlocked position;

figure 3 is a lateral sectional view of the locking device shown in figure 1;

figure 4 is a lateral sectional view of the locking device shown in figure 2;

figure 5 is a perspective view of the locking device shown in figure 1, with some external elements removed;

figure 6 is a perspective view of the locking device shown in figure 2, with some external elements removed;

figure 7 is a lateral view of the locking device as shown in figure 5;

figure 8 is a lateral view of the locking device as shown in figure 6;

figures 9 to 12 schematically illustrate the operation of the locking device, according to the invention, in three successive operating steps;

figure 13 shows an enlarged detail of figure 1.

**[0013]** With reference to the above figures, the locking device for gates or the like is denoted as a whole with reference numeral 1.

**[0014]** According to the present invention, the locking device 1 for gates or the like comprises a locking body 3 configured to reversibly lock a movable element 5, which is cinematically connected to a gate or the like in order to operate the closing and the opening thereof. The movable element 5 comprises at least one locking seat 6 and is adapted to move along a movement direction M. The locking body 3 comprises at least one locking tooth 9 configured to engage the locking seat 6 of the movable element 5. The locking device 1 further comprises an actuator 11 movable along an acting direction A. The actuator 11 and the locking body 3 are cinematically connected to one another by means of at least one arm 13,

hinged at its own ends to the locking body 3 and to the actuator 11, respectively. The movement of the actuator 11 along the acting direction A implies the progressive inclination  $\alpha$  of the arm 13 with respect to a direction orthogonal O to the acting direction A. The movement of the movable element 5 along the movement direction M is prevented by the locking body 3 as long as the inclination  $\alpha$  of the arm 13 is lower than an unlocking inclination  $\gamma$  starting from which a thrust exerted by the locking seat 6 of the movable element 5 against the locking tooth 9 of the locking body 3 is sufficient to push the locking tooth 9 out of the locking seat 6 and to allow the movement of the movable element 5 along the movement direction M.

**[0015]** The locking seat 6 may be a recess formed in the movable element 5, or a plurality of recesses formed in the movable element 5. Preferably, such a recess comprises inclined lateral walls configured to interact with corresponding inclined walls of the locking tooth 9.

**[0016]** Advantageously, the locking seat is defined by a toothing 7 comprising a plurality of teeth 70, wherein the locking tooth 9 is configured to engage such a toothing 7.

**[0017]** As shown in figures 1 to 8 and 13, the movable element 5 can be a crown 50 belonging to a motorised closing system of the gate.

**[0018]** In this case, the movement direction M is defined by the direction of rotation of the crown 50 about its axis and corresponds to a line tangent to the circumference centered in the axis of the crown 50 itself and passing through the contact points between the crown 50 and the locking body 3.

**[0019]** Instead, as shown in figures 9 to 12, the movable element 5 can be a rack 52 belonging to a motorised closing system of the gate. In this case, the rack 52 moves along a straight movement direction M.

**[0020]** Figures 9 to 12 schematically illustrate the operation of the locking device 1. In figure 9, the arm 13 is aligned with the orthogonal direction O. In such a configuration, the movement of the movable element 5 is prevented because the locking tooth 9 is not allowed to slide out of the toothing 7 of the movable element 5.

**[0021]** The progressive actuation of the actuator 11, as illustrated in figure 10, implies the progressive inclination of the arm 13 with respect to the orthogonal direction O by a gradually increasing angle  $\alpha$ . However, as long as such an angle of inclination  $\alpha$  is less than an unlocking angle  $\gamma$ , the movement of the mobile element 5 is still prevented because the locking tooth 9 is not allowed to slide out of the toothing 7 of the movable element 5, that is, the thrust exerted by the toothing 7 of the movable element 5 is not sufficient to overcome the constraining and frictional forces which hold the locking tooth 9 in engagement with the toothing 7.

**[0022]** On the other hand, when the angle of inclination  $\alpha$  is equal to and/or greater than the unlocking angle  $\gamma$ , as shown in figure 11, the thrust exerted by the toothing 7 of the movable element 5 is sufficient to overcome the

constraining and frictional forces which hold the locking tooth 9 in engagement with the toothing 7. In this condition, therefore, the locking tooth 9 can slide out of the toothing 7 and therefore the movement of the movable element 5 along the movement direction M is allowed.

**[0023]** The further removal of the actuator 11 along the acting direction A, as shown in figure 12, involves the complete extraction of the locking tooth 9 from the toothing 7.

**[0024]** The behavior described above is reversible since it is always possible to operate the actuator 11 to incline the arm 13 according to an angle of inclination  $\alpha$  smaller or greater than the unlocking angle  $\gamma$  for locking or unlocking the movable element 5.

**[0025]** The locking body 3 may comprise a plurality of locking teeth 9.

**[0026]** Advantageously, the locking tooth 9 has at least one face 15 configured to abut against at least one corresponding face 72 of one of the teeth 70 of the toothing 7. The face 15 of the locking tooth 9 and the face 72 of such a tooth 70 of the toothing 7 have at least one angle of inclination  $\beta$  with respect to a direction OM orthogonal to the movement direction M of the movable element 5 such that the value of the tangent of such an angle of inclination  $\beta$  is greater than the friction coefficient  $\mu$  existing between the face 15 of the locking tooth 9 and the face 72 of such a tooth 70 of the toothing 7.

**[0027]** Advantageously, therefore, the angle of inclination  $\beta$  is greater than the so-called friction angle defined by the sliding of the locking tooth 9 with respect to the toothing 7.

**[0028]** In such a condition, when the locking body 3 is not retained in a locking position of the movable element 5 by the actuator 11, the movement of the movable element 5 is always permitted since the value of the inclination angle  $\beta$ , being greater than the friction angle of the surfaces concerned, is always such as to allow the mutual sliding of such surfaces. In other words, when the locking body 3 is not retained in a locking position of the movable element 5 by the actuator 11, the tangential thrust of the movable element 5 always allows the locking tooth 9 to be pushed out of the toothing 7, thus preventing it from getting caught in such toothing 7.

**[0029]** The unlocking angle  $\gamma$  is in essence an overall equivalent friction angle of the locking device 1 and depends on the frictional forces which are generated between the face 15 of the locking tooth 9 and the face 72 of the teeth 70 of the toothing 7 and between the reciprocally movable components of the actuator 11.

**[0030]** The unlocking angle  $\gamma$  therefore also depends on the geometry of the locking teeth 9 and the teeth 70 of the movable element 5, as well as on the materials and finishes for manufacturing such teeth.

**[0031]** Advantageously, the movement of the actuator 11 along the acting direction A implies the progressive removal of the locking body 3 from the toothing 7.

**[0032]** Advantageously, the locking body 3 is movable between a locking position of the movable element 5 and

a position of complete unlocking of the movable element 5, whereas in the fully unlocked position the locking body 3 is completely extracted from the toothing 7.

**[0033]** As described above, to unlock the movable element 5 it is sufficient for the inclination angle  $\alpha$  of the arm 13 to be greater than the unlocking angle  $\gamma$ . However, in such a condition the toothing 7 of the movable element 5, during its movement along the movement direction M, continues to hit the locking teeth 9 of the locking body 3. The further activation of the actuator 11 implies the progressive increase of the inclination angle  $\alpha$  in addition to the value of the unlocking angle  $\gamma$  and the progressive lifting of the locking body 3 up to a complete unlocking position of the movable element 5, in which no physical contact occurs between the locking body 3 and the movable element 5.

**[0034]** Advantageously, however, the thrust exerted by the toothing 7 of the movable element 5 on the teeth 9 of the locking body 3 at the moment when the inclination angle  $\alpha$  of the arm 13 exceeds the unlocking angle  $\gamma$  is sufficient to push the locking body 3 in the fully unlocked position, assisting the pulling action exerted by the actuator 11.

**[0035]** The teeth 70 of the toothing 7 of the movable element 5 can be teeth having an involute profile or teeth with a trapezoidal profile.

**[0036]** For example, in figures 1 to 8 and 13, the movable element 5 has a toothing 7 with teeth 70 having an involute profile, whereas in figures 9 to 11 the movable element 5 has a toothing 7 with teeth with a trapezoidal profile.

**[0037]** Advantageously, the locking tooth 9 can be configured to mate with involute profile teeth 70 of the toothing 7. In this case, as shown in figure 13, the face 15 of the locking tooth 9 can have a plurality of straight lines tangential to the involute profile of the teeth 70 of the toothing 7, where each of the tangent lines is inclined according to an angle of inclination  $\beta_1$ ,  $\beta_2$  with respect to a direction OM substantially orthogonal to the movement direction M of the movable element 5. Advantageously, the smaller value of the tangent of the angle of inclination  $\beta_1$  among all the angles of inclination  $\beta_1$ ,  $\beta_2$  is greater than the friction coefficient  $\mu$  existing between the face 15 of the locking tooth 9 and the face 72 of the teeth 70 of the toothing 7. In this way, the relative sliding between the locking tooth 9 and the toothing 7, when the locking body 3 is not retained in a locking position of the movable element 5 by the actuator 11, is always permitted.

**[0038]** Advantageously, moreover, as the locking tooth 9 is removed, due to the inclination  $\alpha$  of the arm 13, from the toothing 7, the contact between the face 15 of the locking tooth 9 and the face 72 of the tooth 70 of the toothing 7 occurs at contact points whose tangent  $\beta$  with respect to the direction OM orthogonal to the movement direction M progressively increases. In other words, the smaller inclination angle  $\beta_1$  occurs when the contact between the face 15 and the face 72 is in the proximity of

the foot of the toothing 7, while as the contact moves towards the head of the toothing 7, the inclination angle  $\beta$  increases up to the maximum value  $\beta_2$ . Therefore, the most stringent condition for releasing the movable element 5 is the initial condition, when the locking tooth 9 is still completely inserted in the toothing 7.

**[0039]** Advantageously, the inclination angle  $\beta$  may range between  $15^\circ$  and  $30^\circ$ . Preferably, the angle inclination  $\beta$  is about  $20^\circ$ .

**[0040]** The locking tooth 9 of the locking body 3, as well as the teeth 70 of the toothing 7 of the movable element 5, can have a shape substantially equivalent to that of the teeth of the gear members as described above but, provided that they allow obtaining a mutual interference, can also be defined by grooves and/or holes and by corresponding prongs and/or latches adapted to engage with such grooves and/or holes.

**[0041]** The actuator 11 may comprise a piston 110 movable linearly along the acting direction A within a casing 112, and may comprise a thrust spring 114 configured to maintain the piston 110 in the extracted position with respect to the casing 112, corresponding to the locking position of the movable element 5.

**[0042]** Advantageously, the actuator 11 is of the electromagnetic type, but can also be of the pneumatic, hydraulic or piezoelectric type.

**[0043]** The actuator 11 can also be of the manual type, advantageously usable in emergency conditions.

**[0044]** Advantageously, the casing 112 of the actuator 11 comprises a first guiding portion 116 configured to guide the axial movement of the piston 110, and a second guiding portion 118 configured to guide the extraction movement of the locking body 3.

**[0045]** Advantageously, the locking body 3 is cinematically connected to the actuator 11 by a pair of opposed arms 13.

**[0046]** The piston 110 can have a substantially cylindrical shape and the locking body 3 can advantageously comprise, on its upper face 30, a recess 32 of substantially semi-cylindrical shape configured to receive, in the fully unlocked position, the piston 110.

**[0047]** Advantageously, the lateral faces 34 of the locking body 3 to which the arms 13 are hinged, can each comprise a side recess 36 within which the arms 13 oscillate. In this way the arms 13 are advantageously contained within the volume of the locking body 3, with the exception of their end which is hinged to the actuator 11.

**[0048]** The present invention also relates to a closing and opening system for gates or the like comprising a locking device as described above.

**[0049]** Such a closing and opening system for gates can comprise the movable element 5, in the form of a crown 50 or of a rack 52.

**[0050]** Advantageously, as shown in figures 1 and 2, the crown 50 can be part of the reduction unit of the closing and opening system for gates and can be operated by a pinion 54. The crown 50 can then operate a rotation shaft, coaxial thereto, which transmits the opening and

closing movement to the gate or to the door.

[0051] The locking device according to the invention can also be applied to systems for opening and closing movable elements of types other than gates or doors that need to be locked in a stop position.

[0052] The locking device object of the present invention has the advantage of carrying out an always reversible locking of the gate or door.

[0053] Furthermore, another advantage of the locking device according to the invention consists in that a small sliding force of the actuator and a modest axial movement are sufficient to obtain a complete locking of the gate or of the door.

[0054] Yet another advantage of the locking device according to the invention is that it provides an intrinsically safe locking device with reduced energy consumption.

[0055] Another advantage of the locking device is that it is simple and cost-effective and can be easily operated by a small, economical and safe electromagnet.

[0056] Several changes and variations may be made to the locking device for gates or the like thus conceived, all falling within the invention; moreover, all details can be replaced with technically equivalent elements. In the practice, the materials used as well as the sizes, can be whatever, according to the technical requirements.

## Claims

1. Locking device (1) for gates or the like, comprising a locking body (3) configured to reversibly lock a movable element (5), which is cinematically connected to a gate or the like in order to operate the closing and the opening thereof, said movable element (5) comprising at least one locking seat (6) and being able to move along a movement direction (M), said locking body (3) comprising at least one locking tooth (9), which is configured to engage said locking seat (6) of said movable element (5), said locking device (1) further comprising an actuator (11) which is movable along an acting direction (A), said actuator (11) and said locking body (3) being cinematically connected to one another by means of at least one arm (13), hinged at its own ends to said locking body (3) and to said actuator (11), respectively, the movement of said actuator (11) along said acting direction (A) implying the progressive inclination ( $\alpha$ ) of said arm (13) with respect to a direction orthogonal (O) to said acting direction (A), the movement of said movable element (5) along said movement direction (M) being prevented by said locking body (3) as long as said inclination ( $\alpha$ ) of said arm (13) is lower than an unlocking inclination ( $\gamma$ ) starting from which a thrust exerted by said locking seat (6) of said movable element (5) against said locking tooth (9) of said locking body (3) is sufficient to push said locking tooth (9) out of said locking seat (6) and to allow the movement of said movable element (5) along said

movement direction (M).

2. Locking device (1) according to claim 1, **characterised in that** said locking seat (6) is defined by a toothing (7) which comprises a plurality of teeth (70).
3. Locking device (1) according to claim 2, **characterised in that** said locking tooth (9) has at least one face (15) which is configured to abut against at least one corresponding face (72) of one of said teeth (70) of said toothing (7), said face (15) of said locking tooth (9) and said face (72) of one of said teeth (70) of said toothing (7) having at least an angle of inclination ( $\beta$ ) with respect to a direction orthogonal to said movement direction (M) of said movable element (5), such that the value of the tangent of said angle of inclination ( $\beta$ ) is higher than the friction coefficient ( $\mu$ ) existing between said face (15) of said locking tooth (9) and said face (72) of one of said teeth (70) of said toothing (7).
4. Locking device (1) according to one or more of the preceding claims, **characterised in that** the movement of said actuator (11) along said acting direction (A) causes said locking body (3) to progressively move away from said locking seat (6).
5. Locking device (1) according to one or more of the preceding claims, **characterized in that** said movable element (5) is a crown (50) belonging to a motorised closing system of said gate or the like.
6. Locking device (1) according to one or more of claims 1 to 4, **characterized in that** said movable element (5) is a rack (52) belonging to a motorised closing system of said gate or the like.
7. Locking device (1) according to one or more of the preceding claims, **characterised in that** said locking tooth (9) is configured to couple with involute profile teeth (70) of said toothing (7), said face (15) of said locking tooth (9) having a plurality of lines which are tangent to said involute profile of said teeth (70) of said toothing (7), each of said tangent lines being inclined, according to an angle of inclination ( $\beta_1$ ,  $\beta_2$ ), with respect to a direction substantially orthogonal to said movement direction (M) of said movable element (5), the value of the tangent of the lowest angle of inclination ( $\beta_1$ ) amongst said angles of inclination ( $\beta_1$ ,  $\beta_2$ ) being higher than the friction coefficient ( $\mu$ ) existing between said face (15) of said locking tooth (9) and said face (72) of one of said teeth (70) of said toothing (7).
8. Locking device (1) according to one or more of the preceding claims, **characterised in that** said locking body (3) is movable between a locking position of said movable element (5) and a position of complete

unlocking of said movable element (5), in said position of complete unlocking, said locking body (3) being completely extracted from said locking seat (6).

9. Closing and opening system for gates or the like, comprising a locking device according to one or more of the preceding claims. 5

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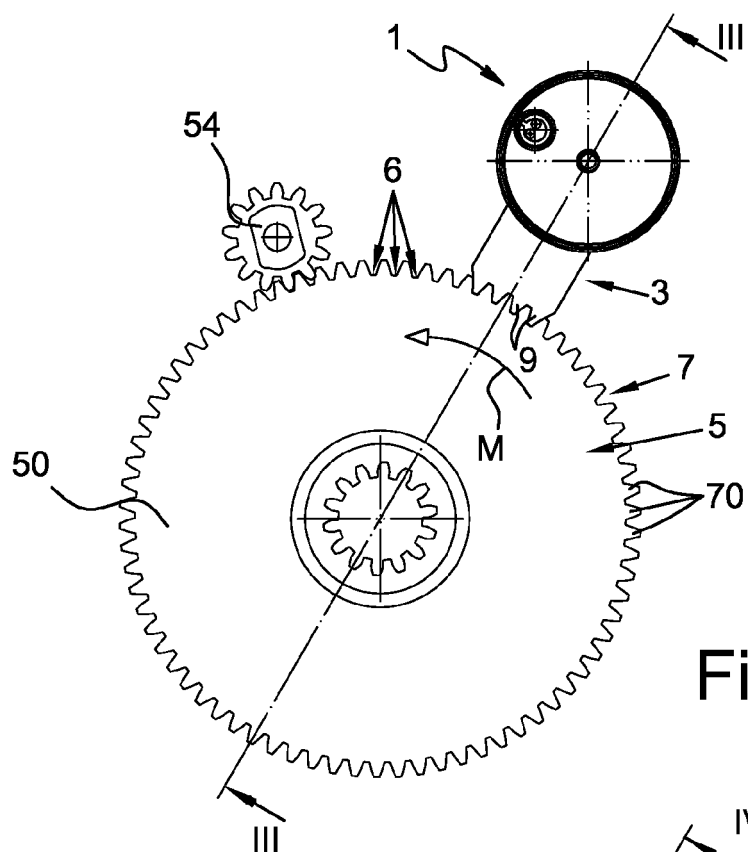
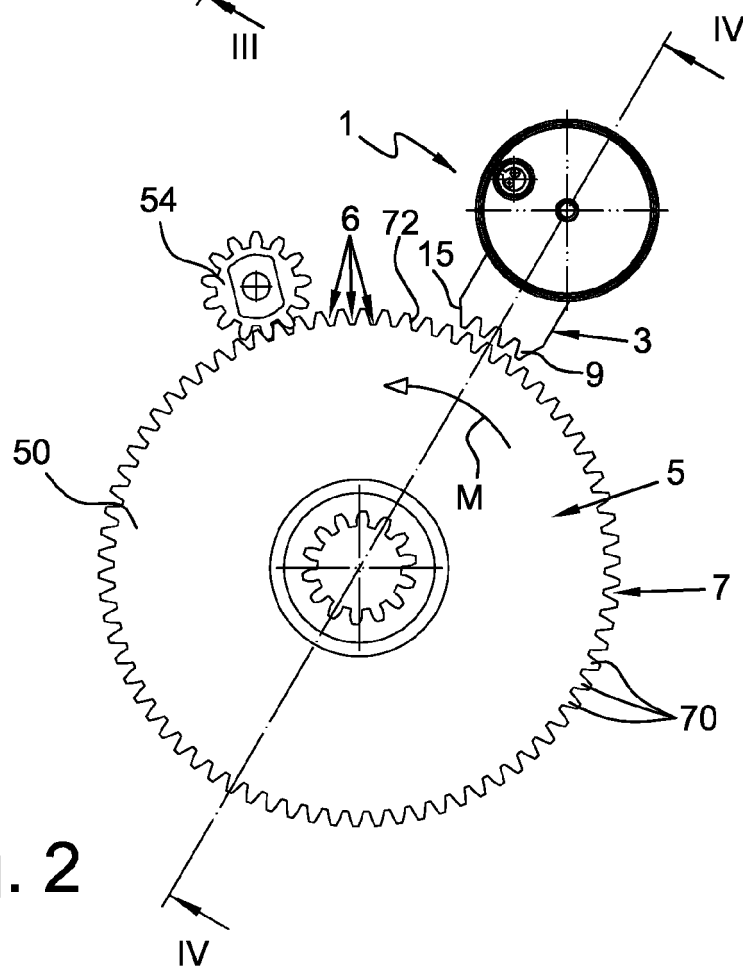


Fig. 1



**Fig. 2**

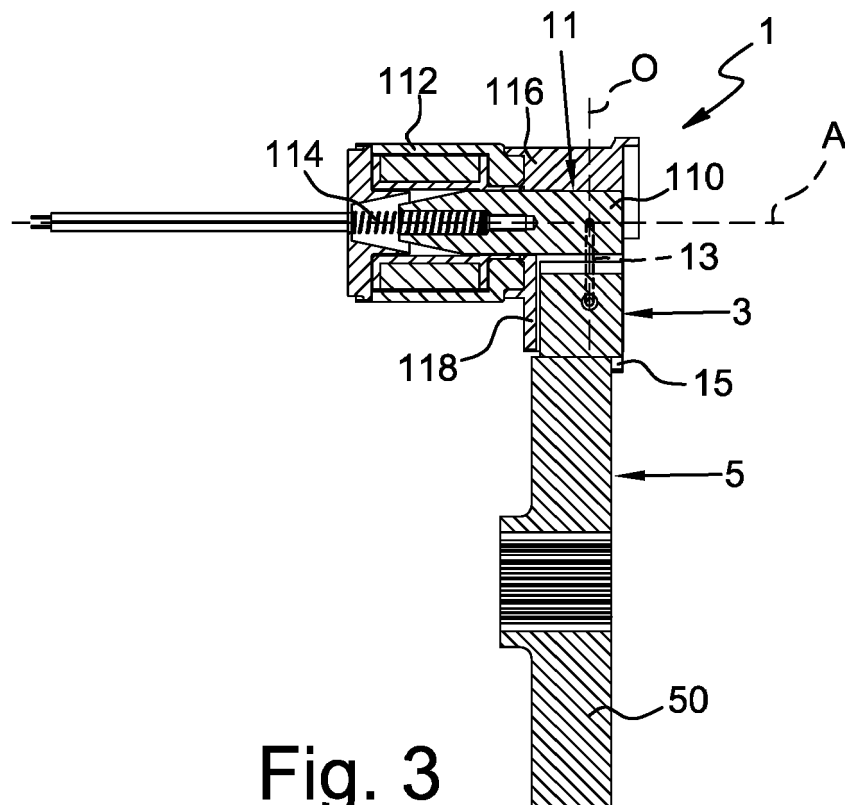


Fig. 3

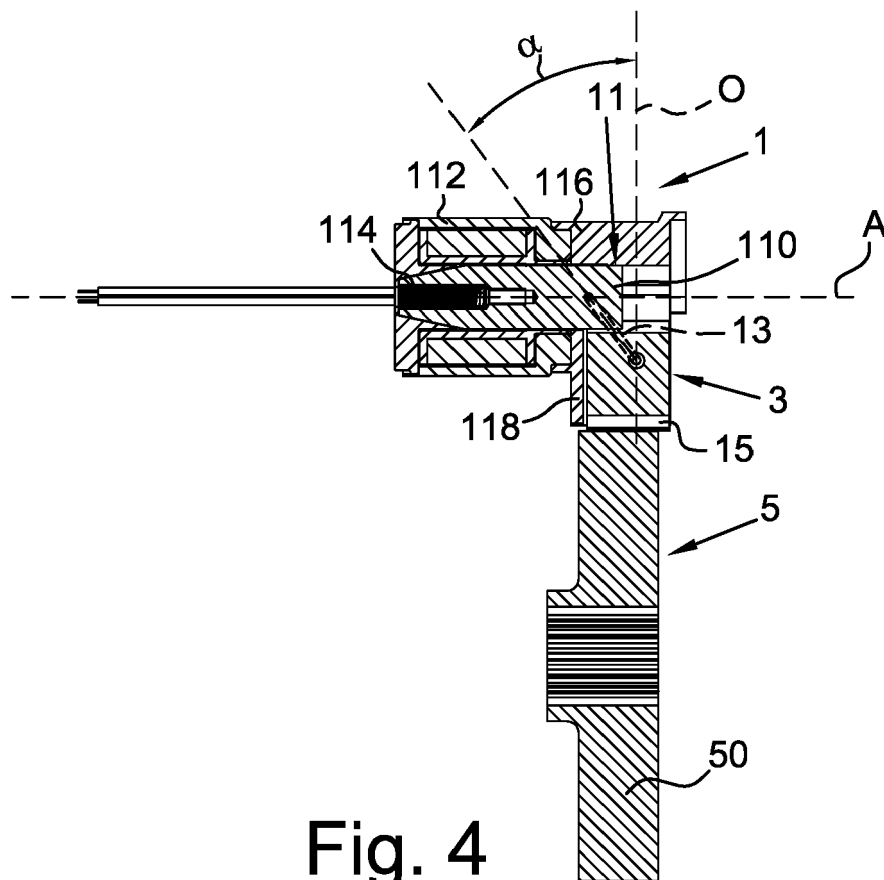
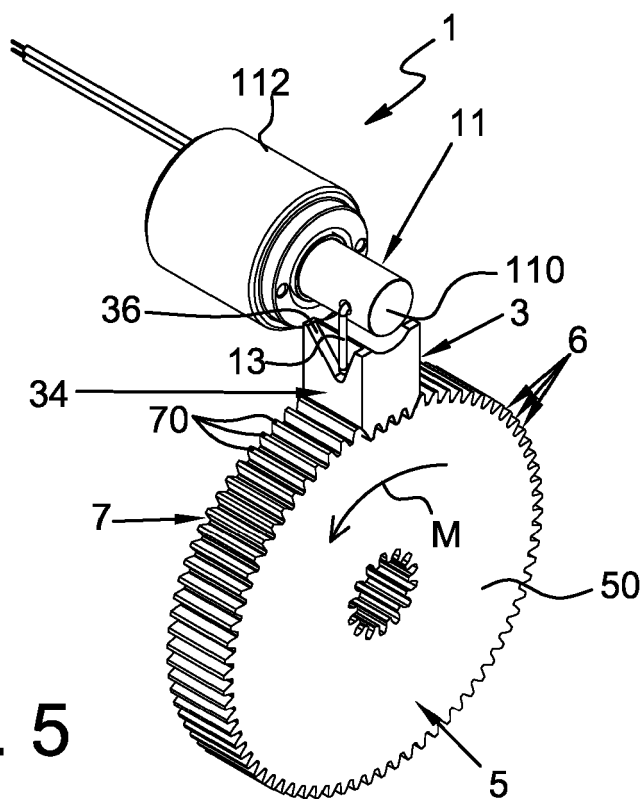
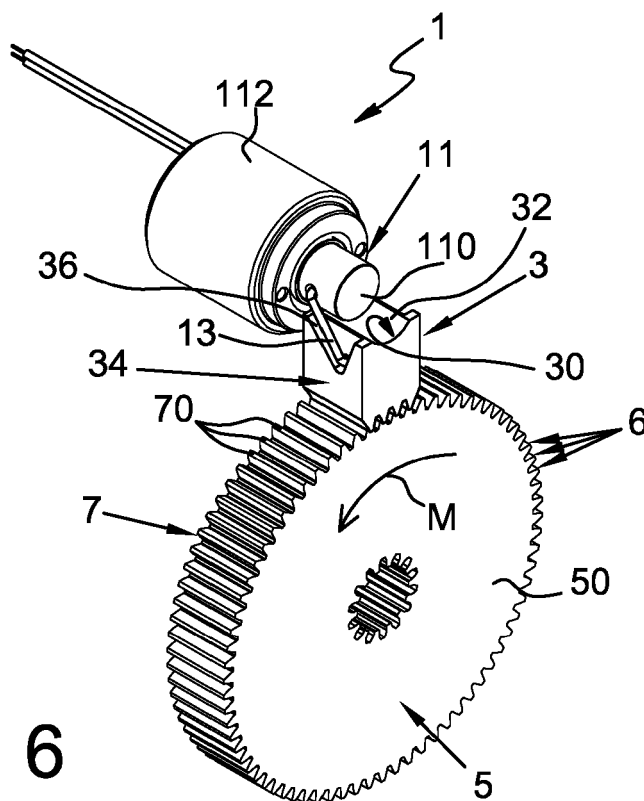


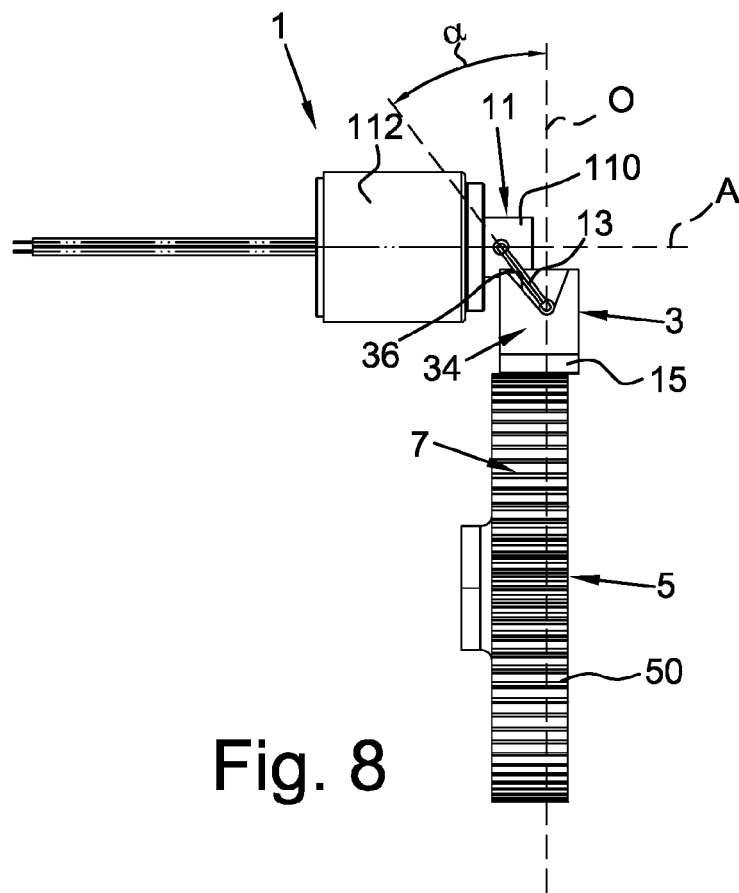
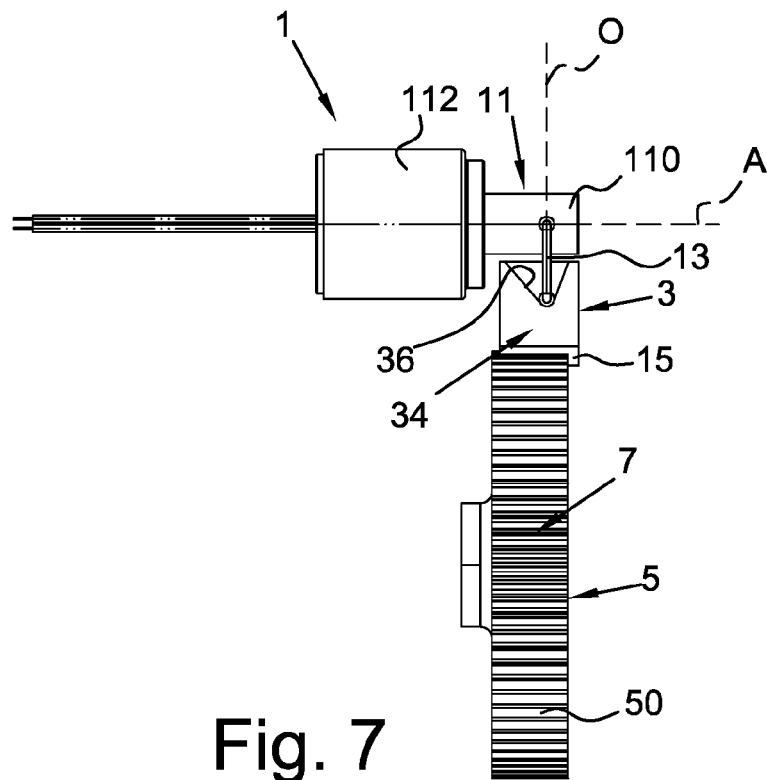
Fig. 4



**Fig. 5**



**Fig. 6**



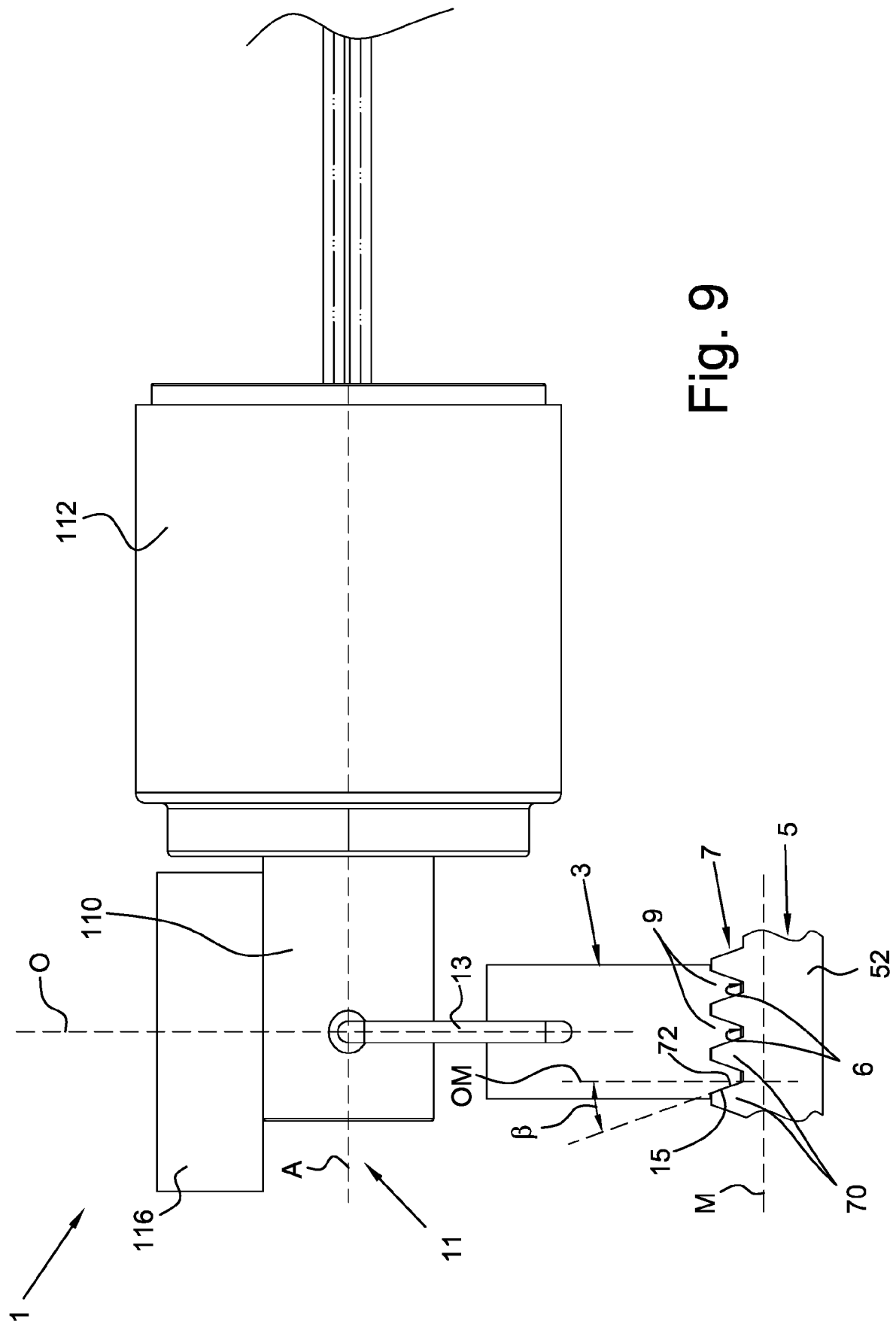
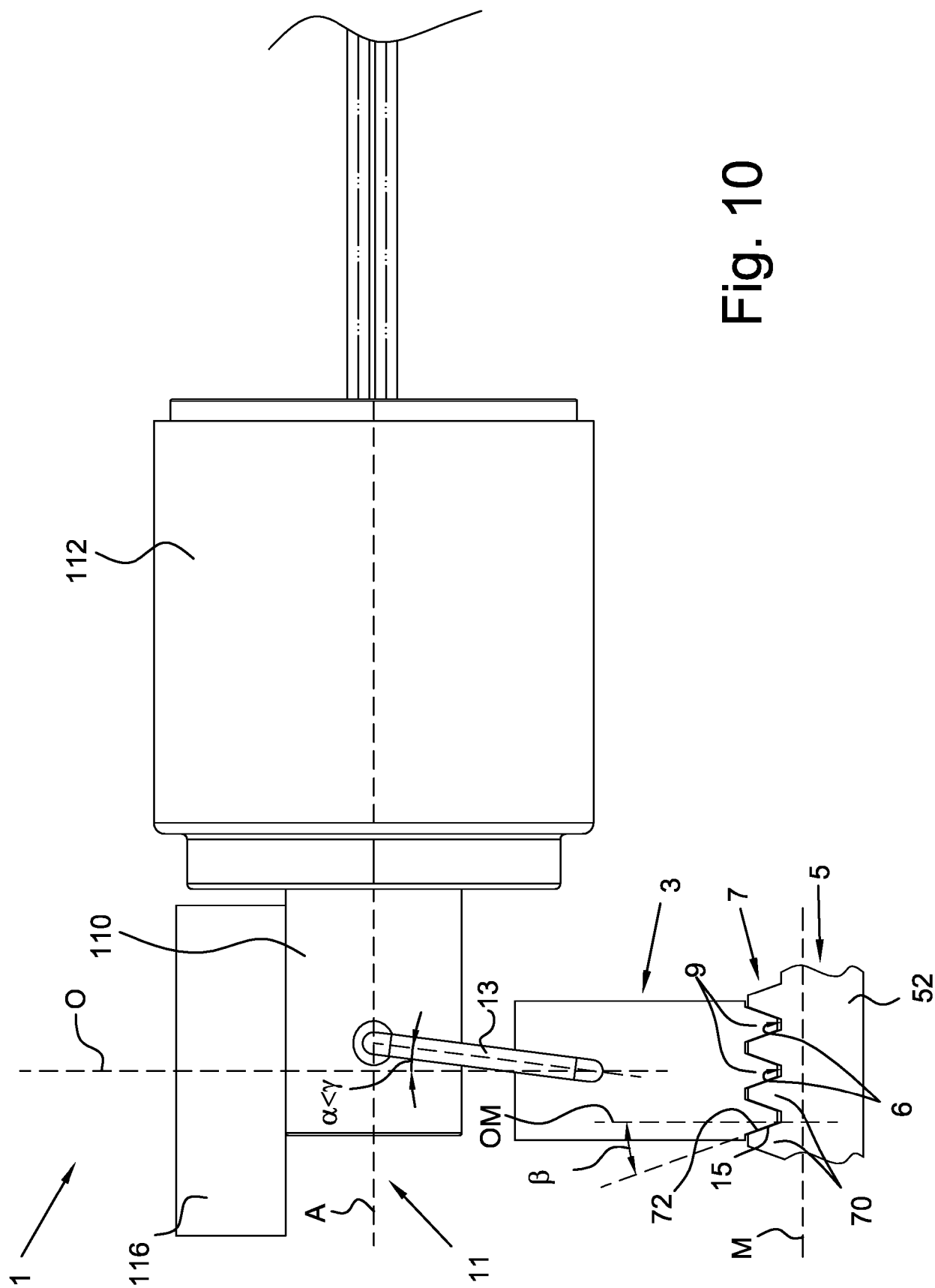
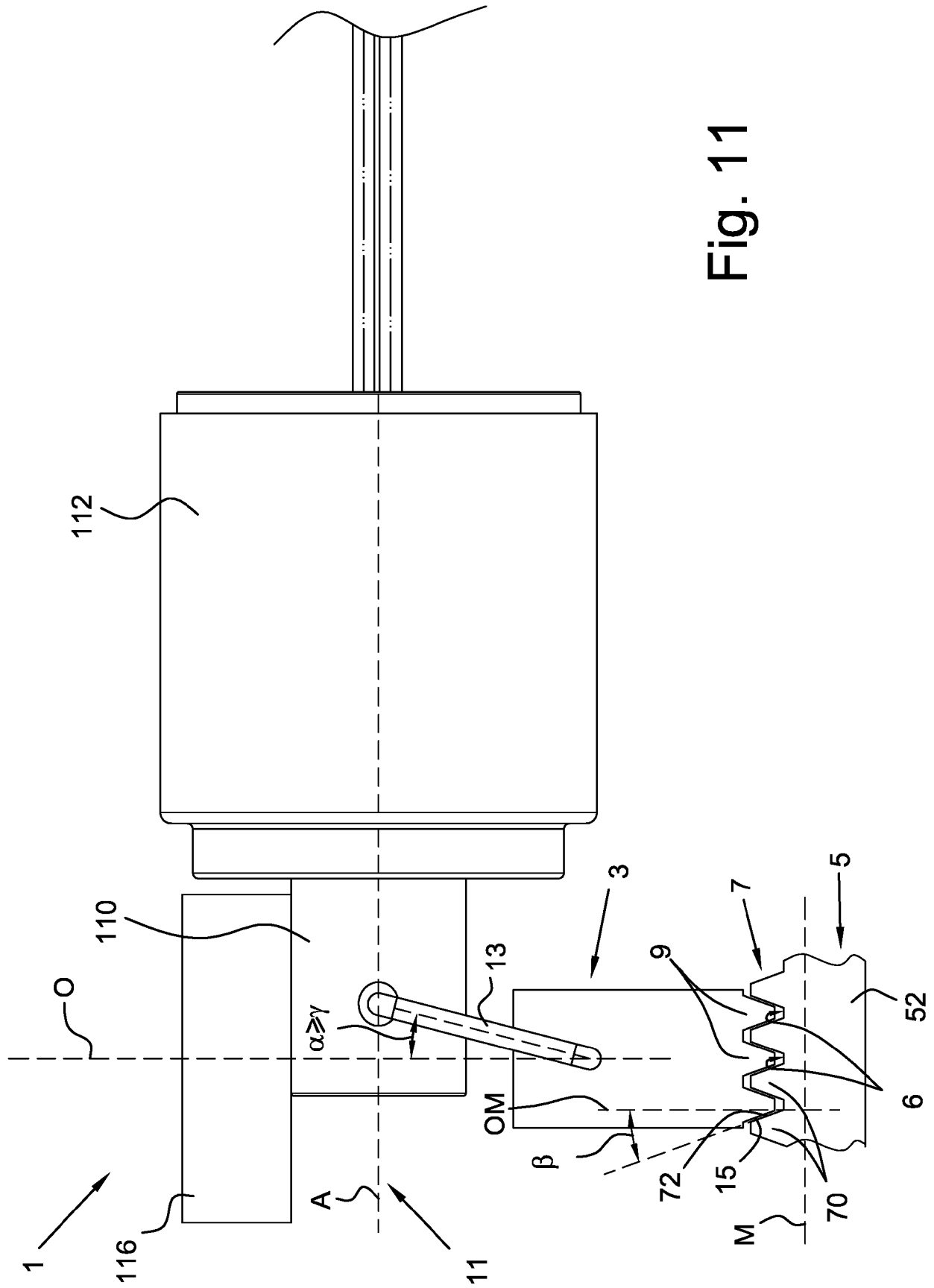


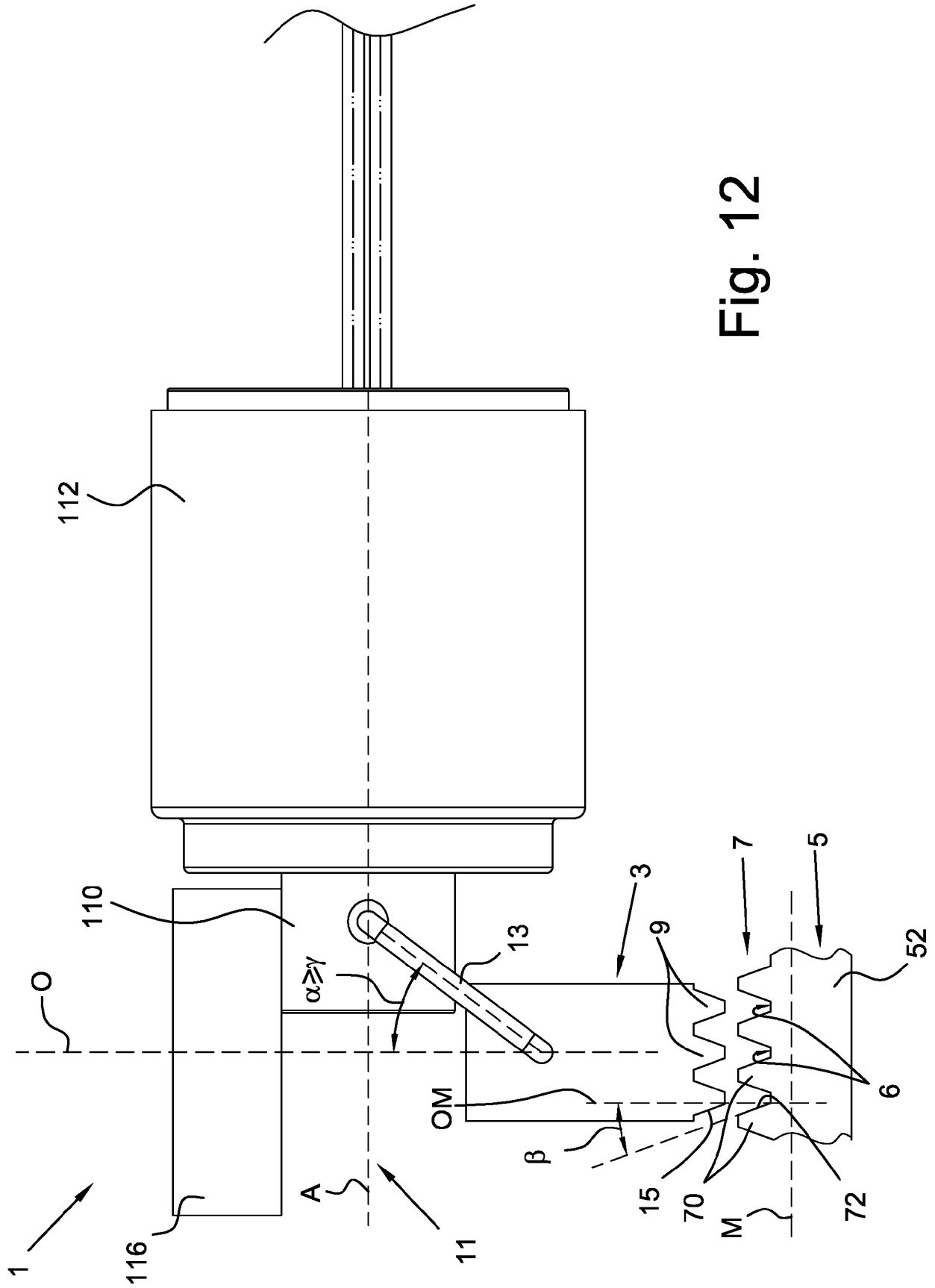
Fig. 9



**Fig. 10**



**Fig. 11**



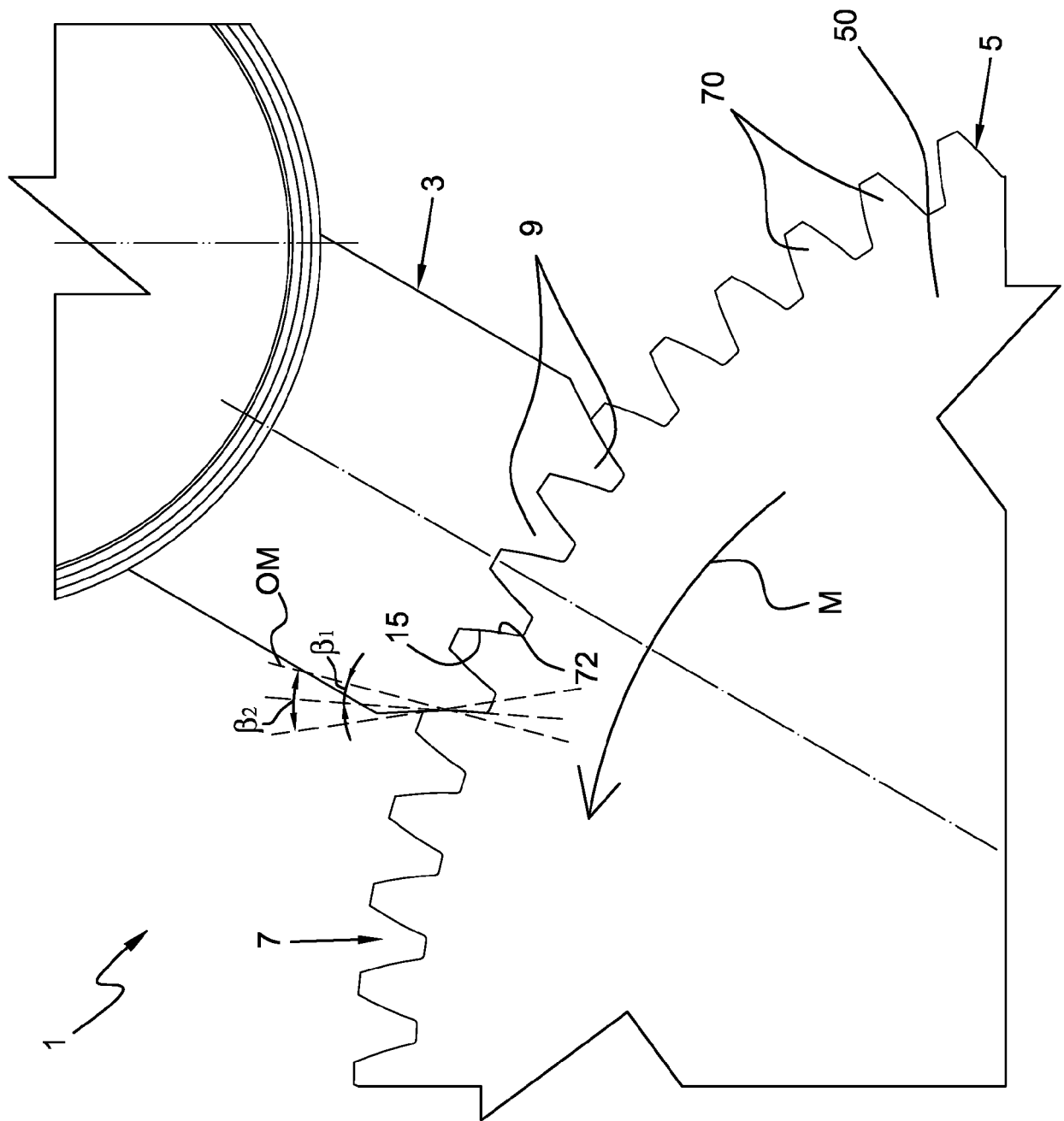


Fig. 13



## EUROPEAN SEARCH REPORT

 Application Number  
 EP 18 15 3394

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                        |                                                 |                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-------------------------------------------------|-----------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages          | Relevant to claim                               | CLASSIFICATION OF THE APPLICATION (IPC) |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | FR 2 688 822 A1 (VIAL JEAN JACQUES [FR])<br>24 September 1993 (1993-09-24)             | 1-6,8,9                                         | INV.                                    |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | * page 6, line 21 - page 7, line 9;<br>figures 2-5 *                                   | 7                                               | E05F15/632<br>E05F15/635                |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | DE 197 00 859 A1 (GEZE GMBH & CO [DE])<br>16 July 1998 (1998-07-16)<br>* figures 1-3 * | 1-9                                             |                                         |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 1 628 346 A (WALTER WHITE WILLIAM)<br>10 May 1927 (1927-05-10)<br>* figure 2 *      | 1-9                                             |                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                        |                                                 | TECHNICAL FIELDS SEARCHED (IPC)         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                        |                                                 | E05F<br>E05B<br>E05D                    |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                        |                                                 |                                         |
| Place of search<br>The Hague                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                        | Date of completion of the search<br>6 July 2018 | Examiner<br>Berote, Marc                |
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