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DRIVE ARRANGEMENT

DRIVE ARRANGEMENT

The present invention relates to a drive arrangement for driving at least one output unit that can be displaced about an axis of rotation or pivot axis.

Such drive arrangements comprise a drive apparatus and an output unit. The drive device is brought into engagement with the output unit in order to transmit a torque to the output unit. Such drive arrangements are often referred to as Maltese cross gears or "Geneva drive".

The document SU1305481 A1 discloses a drive arrangement with the features of the preamble of claim 1.

An object of the present invention is to provide an improved drive arrangement, with which the function of the drive arrangement can be ensured in the long term, for example given reduced precision of the arrangement or given increased contamination.

This object is achieved by a drive arrangement with the features of claim 1.

Further embodiments are specified in the dependent claims.

The drive arrangement according to the invention for driving at least one output unit, displaceable about an axis, comprises at least one drive device, rotatable about an axis of rotation, which has at least one drive member and at least one retaining member. The at least one drive member is disposed with an offset in the radial direction to the at least one retaining member. The drive arrangement further comprises at least one output unit, wherein the output unit has at least one drive recess and at least one retaining recess. The at least one drive member is assigned to the at least one drive recess and engages with the at least one drive recess, in order to drive he drive unit., The at least one retaining member is associated with the at least one retaining recess and engages with the at least one retaining recess, to keep the output unit in a set position. The at least one drive member has a cross section deviating from a circular cross section and is curved at least in sections, and/or the at least one drive recess widens in the radial direction in order to define an entry opening for the at least one drive member.

According to the invention, the drive device and the output unit are designed in such a way that the function of the drive arrangement can be permanently guaranteed. In particular, the torque-transmitting engagement between the at least one drive recess and the at least drive member can be ensured even if there is an increase in the distance between the drive device and the output unit due to manufacturing tolerances, assembly tolerances and/or elastic deformations of the drive device and/or the output unit. In addition, the functionality of the drive arrangement may also be maintained if the drive device and/or the output unit are contaminated. Such an increase in the distance, in particular the radial distance between the drive device and the output unit, may lead to tangential displacement between the drive device and the output unit, which can impair or even prevent the engagement of the at least one drive member in the at least one drive recess. In other words, with the invention the "threading" or the engagement of the at least one drive member in the at least one drive recess can be ensured even if the described increase in the radial distance or tangential displacement between the drive device and the output unit occurs.

By engaging the at least one drive member in the at least one drive recess, the drive device and the output unit are coupled in a torque-transmitting manner such that when a rotary movement of the drive device is carried out, a gradual rotary or adjusting movement of the output unit about its axis of rotation or pivot axis may occur. A continuous rotary movement of the drive device about the axis of rotation can accordingly lead to a gradual rotary or adjusting movement of the output unit. The rotary or adjusting movement of the output unit is always carried out when the at least one drive member is engaged with the at least one drive recess. When the drive device rotates, the at least one drive member may engage in the associated drive recess of the output unit, take the output unit with it and then leave the drive recess again. Between the engagement of the drive member in the drive recess and the leaving of the drive recess, the at least one drive member presses against a wall of the drive recess, as a result of which a torque is exerted on the output unit, which leads to a rotary or adjusting movement of the output unit.

The at least one retaining member always engages in the at least one retaining recess of the output unit when the at least one drive member is not in engagement with the at least one drive recess of the output unit. The at least one retaining member can positively engage in the at least one retaining recess. In this state, the output unit can be held in its set position. The drive arrangement is thus in a locked position. In the locked position, the output unit is prevented from rotating about its axis of rotation or pivot axis. Due to the rotary movement of the drive device having the at least one retaining member, the at least one retaining member initially engages with a portion in the at least one associated retaining recess of the output unit, wherein this section continuously increases due to the rotary movement of the drive device. After a predetermined angle of rotation is executed, the retaining member can leave the at least one retaining recess. As soon as the at least one retaining member even partially engages in the retaining recess, rotation of the output unit about its rotation or pivot axis may be prevented.

If the drive device is driven further, the retaining member and the drive member continue to rotate so that the drive member can be brought into engagement with the next drive recess. For example, the drive member can be rotated by 90° to 270° after leaving a drive recess about the axis of rotation of the drive arrangement in order to engage in the next drive recess. At the same time, the at least one retaining member rotates further in the retaining recess and leaves the retaining recess when or shortly after the drive member engages in the next drive recess. The at least one retaining member thus releases the output unit for the next adjusting step.

The at least one drive member may have a cross section having at least one curved portion that contacts a wall of the at least one drive recess in order to drive the at least one output unit. The at least one drive member may comprise a reduced cross section in the radial direction with respect to the axis of rotation of the drive device.

The cross section of the at least one drive member may have at least one first apex and at least one second apex. The distance between the first apex and the second apex defines the greatest extent of the drive member. The cross section of the at least one drive member may have its greatest extent in a direction transverse to the radial direction of the drive device. Alternatively, the cross section of the at least one drive member may have at least one first edge and at least one second edge, the distance between which defines the greatest extent of the drive member. If two edges are provided on the cross section of the drive member, the cross section of the drive member may comprise two curved portions that extend between the two edges.

If the cross section of the drive member comprises two apexes, the cross section is also curved in the region of the apexes. The cross section of the drive member may thus have a plurality of radii of curvature. The radius of curvature in the region of the apexes may differ from the radius of curvature of the portion between the two apexes.

The cross section of the at least one drive member may comprise at least one third apex and at least one fourth apex. The distance between the third apex and the fourth apex may be smaller than the distance between the first apex or the first edge and the second apex or the second edge.

The third apex and the fourth apex can be in alignment in the radial direction of the drive device. The distance between the first apex and the second apex may be matched to the size of the drive recess in order to achieve a guided movement of the at least one drive member in the drive recess when the output unit is displaced about its rotation or pivot axis.

The distance between the third apex and the fourth apex, which is smaller than the distance between the first apex and the second apex, may compensate for tangential displacements between the drive device and the output unit, which may occur due to tolerances, so that the engagement of the at least one drive member in the associated drive recess may be ensured. The size of a radial clearance between the at least one retaining member and the at least one drive member may be determined, among other things, via the distance between the third or fourth apex, that is to say, via the cross section of the drive member that is reduced in the radial direction, which radial clearance may support the alternate engagement of the drive member and the retaining member in the associated drive recesses and retaining recesses.

The at least one drive recess may widen outward in the radial direction in order to define an entry opening for the at least one drive member. By widening the drive recess outward in the radial direction, the entry opening of the drive recess may be enlarged for the penetration or engagement of the drive member. The distance between two opposite flanks of the at least one drive recess may increase outward in the radial direction. If the at least one drive recess is directed radially inward, the at least one drive recess may widen inward in the radial direction. This applies in particular if the drive device is arranged radially within the output unit.

The axis of rotation of the drive device may run through or along the at least one retaining member. The at least one retaining member has a curved outer surface. The curvature of the outer surface of the retaining member is matched to the curvature of the at least one retaining recess such that the at least one retaining member can penetrate into the at least one retaining recess and rotate in the retaining recess. As soon as the at least one retaining member penetrates into the at least one retaining recess, rotation of the output unit about its rotation or pivot axis may be prevented. The at least one retaining member may have at least in one portion a curvature that is matched to the curvature of the at least one retaining recess. The radius of curvature of the curved portion of the retaining member can be matched to the radius of curvature of the wall of the at least one retaining recess.

The at least one drive member and the at least one retaining member may be connected to one another via at least one connecting member. The connecting member may extend in the radial direction. The connecting member may be disk-shaped or cam-shaped, for example. The at least one connecting member may also be connected to at least one coupling portion, via which the at least one connecting member may be coupled to a drive. The coupling to the drive may be made directly or indirectly via other components.

The at least one drive member and the at least one retaining member may extend parallel to the axis of rotation of the drive device. The drive recesses and the retaining recesses can be developed to correspond to the shape or the cross section of the drive member and the retaining member. The at least one drive member may have an oval or elliptical or lenticular or circular cross section.

Exemplary embodiments of the present invention are described below with reference to the attached figures. They represent:

Figures 1 and 2 perspective views of a tracking system for solar modules according to an embodiment;

Figures 3 to 7 different views of a pivoting unit according to a first embodiment;

Figure 8 an exploded view of the pivoting unit shown in Figures 3 to 7;

Figure 9 an enlarged view of the section marked IX in Figure 8;

Figure 10 a further exploded view of the pivoting unit shown in Figures 3 to 9;

Figure 11 an enlarged view of the section marked XI in Figure 10;

Figures 12 to 14 different views of a drive arch of the pivoting unit shown in Figures 3 to 11;

Figures 15 to 17 different views of a drive device of the pivoting unit shown in Figures 3 to 11;

Figures 18 to 22 different views of a pivoting unit according to a second embodiment of the invention;

Figure 23 an exploded view of the pivoting unit shown in Figures 18 to 22;

Figure 24 an enlarged view of the detail marked in Figure 23 with XXIV;

Figure 25 a further exploded view of the pivoting unit shown in Figures 18 to 23;

Figure 26 an enlarged view of the detail marked in Figure 25 with XXVI;

Figures 27 to 33 different views of a drive device of the pivoting unit shown in Figures 18 to 26;

Figures 34 to 37 perspective views of a pivoting unit according to a third embodiment of the invention in the state of being attached to a post;

Figures 38 to 41 different side views of the pivoting unit according to the third embodiment of the invention in the state of being attached to a post; and

Figure 42 a perspective view of the drive device according to the third embodiment of the invention.

Figure 1 shows a perspective view of a tracking apparatus for solar modules. The tracking apparatus is generally designated with NV. The tracking apparatus NV comprises a plurality of pivoting units 10_1 to 10_5. Each of the pivoting units 10_1 to 10_5 is connected to a post 12 anchored in the ground U. The pivoting units 10_1 to 10_5 are interconnected via the drive shafts 14. The drive shafts 14 are driven by a motor M, disposed on the pivoting unit 10_5 in Figure 1. In this way, several pivoting units 10_1 to 10_5 can be driven with a single drive. The pivoting units 10_1 to 10_5 are also connected to one another via support rails 16 and 18, to which solar modules 20 can be attached with the aid of fastening members. To align the solar modules 20 with the sun, the pivoting units 10_1 to 10_5 are driven via the drive shafts 14, as a result of which the pivoting units 10_1 to 10_5 can pivot the solar modules 20 attached to them.

Figure 2 shows a further perspective view of the tracking apparatus NV, in which the solar modules 20 and the pivoting unit 10_5 arranged on a post 12 and the posts 12 of the further pivoting units 10_1 to 10_4 are shown. Solar modules 20 with different shapes, sizes, orientations and also solar modules 20 of different types of construction can be attached to the tracking apparatus NV, as illustrated in Figure 2 by the differently represented solar modules 20_1 and 20_2.

Figures 3 to 5 show different perspective views of a pivoting unit 10 according to a first embodiment. The pivoting unit 10 comprises a cross member 22, a drive arch 24 attached to the cross member 22 and a support member 26.

The cross member 22 and the support member 26 are pivotally connected to each other. A pivot axis S extends through the cross member 22 and the support member 26. The pivot axis S extends through the pivot point SP formed at the connection point between the cross member 22 and the support member 26.

The drive arch 24 is connected to the cross member 22 via fastening means 28 such as screws or bolts. At the ends of the cross member 22, connecting members 30 can be seen. The cross member 22 can be connected to the support rails 16 and 18 shown in Figure 1 via the connecting members 30.

The support member 26 can be connected with its end 32 opposite the pivot axis S to a post 12 which can be anchored in or on the ground (see Figure 1). Fastening members 34 and 36 are also attached to the end 32 of the support member 26. A drive device 38 is connected to the support member 26 via the fastening members 34 and 36. The drive device 38 serves to pivot into a new pivot position and to hold the drive arch 24 in a set position. The drive arch can be pivoted gradually. For this purpose, the drive device 38 engages with a drive contour 40 on the drive arch 24. The drive contour 40 is formed on the outside of the drive arch 24 in the radial direction. The drive device 38 and the drive arc 24 form a drive arrangement.

Figures 6 and 7 show two views of the pivoting unit 10 from opposite viewing directions. Figures 6 and 7 show the cross member 22, the drive arch 24 and the support member 26. In the starting position and/or the mounting position of the pivoting unit 10, i.e., the cross member 22 has not been pivoted relative to the support member 26 about the pivot point SP, the support member 26 extends perpendicular to the cross member 22. The pivot point SP is formed in the middle of the cross member 22. At the ends of the cross member 22, the connecting members 30 are shown, which serve to connect the cross member 22 to the support rails 16 and 18 (see Figure 1).

At the end 32 of the support member 26, which is opposite the pivot point SP, the fastening members 34 and 36 are connected to the support member 26. The drive device 38 is rotatably mounted on the fastening members 34 and 36. The fastening members 34 and 36 hold the drive device 38 on the support member 26. The drive device 38 is in engagement with the drive contour 40 on the drive arch 24. The drive contour 40 comprises two different types of recesses. The drive contour 40 comprises drive recesses 42 and retaining recesses 44 which are arranged alternately in the direction of the circumference of the drive arch 24. When the drive device 38 engages in the drive recesses 42, the drive arch 24 and the cross member 22 connected to it are moved. If the drive device 38 engages in the retaining recesses 44, the drive arch 24 and the cross member 22 connected to it can be held in its set position. The drive device 38 can also change its position in engagement with one of the retaining recesses 44 in order to be able to engage in the next drive recess 42. No torsional load is transmitted to the drive shaft 14. The drive contour 40 and the drive device 38 will be discussed in more detail later in this description.

Figure 8 shows an exploded perspective view of the pivoting unit 10. In Figure 8, the cross member 22, the drive arch 24, the support member 26, the drive device 38 and the two fastening members 34 and 36 are shown.

Figure 9 shows an enlarged view of the detail marked IX in Figure 8. Figure 9 shows the end 32 of the support member 26, the two fastening members 34 and 36 and a section of the drive arch 24.

The fastening members 34 and 36 each comprise two fastening sections 46 and 48. The fastening sections 46 and 48 are angled to the main body of the fastening members 34 and 36. Each fastening section 46 and 48 has an opening 50, 52. The openings 50, 52 can only be seen in Figure 9 on the fastening member 36. With these fastening sections 46 and 48, the fastening members 34 and 36 are connected to the support member 26.

The fastening members 34 and 36 each comprise a bearing opening 54 and 56 in which the drive device 38 can be stored. Bearing bushes 58 and 60 are provided for mounting the drive device 38 in the openings 54 and 56 and are received in the openings 54 and 56. The drive device 38 comprises two coupling members 62 and 64. The coupling members 62 and 64 are rod-shaped. The coupling members 62 and 64 can be received in sections in the openings 54, 56 or in the bearing bushes 58, 60, arranged in the openings 54, 56. The coupling members 62 and 64 each comprise a coupling section 66, 68 and a bearing section 70. The coupling sections 66 and 68 are provided with a cross section which is suitable for coupling to a drive shaft 14 (see Figure 1). The drive section 72 of the drive device 38, in which the drive member 74 is provided, is formed between the coupling members 62 and 64. The drive member 74 engages in the drive contour 40 of the drive arch 24. In the drive section 72, a retaining member is provided, which is not shown in Figure 9. The retaining member will be discussed in detail later in this description.

The pivoting unit 10 comprises a guide member 76, which forms a guide device for the radial guidance of the drive arch 24. The drive arch 24 can be supported in the radial direction on the guide member 76. The guide member 76 thus prevents the drive arch 24 from being released from engagement with the drive device 38 in the radial direction. The guide member 76 is mounted on a spacer and/or bearing member 78. The bearing member 78 is arranged on a screw which extends between the fastening members 34 and 36. The drive arch 24 runs between the two fastening members 34 and 36. The fasteners 34 and 36 are connected to each other by screws. In order to establish and maintain a predetermined distance between the two fastening members 34 and 36, the spacers 78 are provided, through which the screws extend.

Figure 10 shows an exploded perspective view of the pivoting unit 10. Figure 10 shows the cross member 22, the drive arch 24, the support member 26, the drive device 38 and the two fastening members 34 and 36.

Figure 11 shows an enlarged view of the detail marked XI in Figure 10. Figure 11 shows the drive device 38, which is in engagement with the drive contour 40 of the drive arch 24, the fastening members 34 and 36 and the end 32 of the support member 26.

The drive device 38 comprises two coupling members 62 and 64, which extend from the drive section 72 in the opposite direction. The bearing sections 70 of the coupling members 62 and 64 adjoin at the drive section 72 in the direction of the axis of rotation D. Coupling sections 66 and 68, with their cross section developed for coupling to a drive shaft 14, follow bearing sections 70 in the direction of axis of rotation D. In the assembled state of the pivoting unit 10, the coupling members 62 and 64 extend through the openings 54 and 56 and through the bearing bushes 58 and 60, arranged in the openings 54 and 56.

Figures 12 to 14 show different views of the drive arch 24. The drive arch 24 is composed of two partial arcs 80 and 82, which are connected to an arcuate base member 84. The partial arcs 80 and 82 can be welded to the base member 84, as can be seen from the weld seams 86 shown. Viewed in cross section, the drive arch 24 has an essentially T-shaped cross section through the base member 84. Starting from this base member 84, the partial arcs 80, 82 extend in the radial direction.

The partial arcs 80, 82 each comprise two openings 88, via which the drive arch 24 can be connected to the cross member 22.

The drive contour 40 comprises drive recesses 42 and retaining recesses 44. The drive recesses 42 and the retaining recesses 44 are arranged alternately in the circumferential direction of the drive arch 24. The drive recesses 42 are radial incisions in the drive arch 24. The drive recesses 42 can also be referred to as slot-shaped. The sections of the drive arch 24 formed between the drive recesses 42 and/or the incisions are provided with retaining recesses 44. The retaining recesses 44 are curved and/or arched. The retaining recesses 44 are essentially semicircular. The drive recesses 42 extend further into the drive arch 24 in the radial direction than the retaining recesses 44. The retaining recesses 44 can be curved or arched. The retaining recesses 44 are essentially semicircular. The drive recesses 42 extend further in the radial direction into the drive arch 24 than the retaining recesses 44.

Figure 15 shows a perspective view of the drive device 38. The drive device 38 is rotatable about the axis of rotation D, which corresponds to the longitudinal axis of the drive device 38. The drive device 38 comprises a drive section 72 and two coupling members 62 and 64. The coupling members 62 and 64 each have a bearing section 70 and a coupling section 66 and 68. The coupling sections 66 and 68 have a cross section which is suitable for coupling to a drive shaft 14 (see Figure 1). This cross section is formed by flattening 66_1, 66_2 and 68_1, 68_2 in the area of the coupling sections 66 and 68. The coupling sections 66 and 68 can be received, for example, in a drive shaft 14 with a recess which is complementary to the cross section of the coupling sections 66 and 68. Starting from the drive section 72, the coupling members 62 and 64 extend in the opposite direction.

In addition to the drive member 74, the drive section 72 comprises two connecting members 90 and 92 which connect the coupling members 62 and 64 to the drive member 74. The connecting members 90 and 92 can be formed in one piece with the coupling members 62 and 64. The connecting members 90 and 92 are cam-shaped. The drive section 72 also comprises a retaining member 94. The drive member 74 and the retaining member 94 extend between the twi connecting members 90 and 92. The retaining member 94 is formed in the shape of a semi-circle and arranged coaxially with the coupling members 62 and 64. The drive member 74 is arranged eccentrically. The longitudinal axis M of the drive member 74 extends parallel but offset in the radial direction to the axis of rotation D of the drive device 38. The drive member 74 can be rod-shaped. The drive member 74 can be rod-shaped. The drive member 74 is received in openings 96 in the connecting members 90 and 92.

Figure 16 shows a front view of the drive device 38. The bearing sections 70 of the coupling members 62 and 64 have a circular cross section. At the transition between the bearing sections 70 and the coupling sections 66 and 68 with their flats 66_1, 66_2 and 68_1, 68_2 a step can be seen. The drive member 74 and the retaining member 94 extend between the two connecting members 90 and 92. The drive member 74 is arranged eccentrically. The drive member 74 extends offset in the radial direction parallel to the axis of rotation D. A free space 98 can be seen between the drive member 74 and the retaining member 94. The retaining member 94 has a semicircular outer contour, the outer surface of which in this embodiment extends on the same radius as the outer peripheral surfaces of the bearing sections 70 of the coupling members 62 and 64 about the axis of rotation D of the drive device 38.

Figure 17 shows a side view of the drive device 38, in which the coupling member 64, the connecting member 92 and the drive member 74 are shown. The connecting member 92 is cam-shaped. An opening 96 is formed in the connecting member 92, in which the drive member 74 is received.

Figures 18 to 33 described below show a pivoting unit 10 according to a second embodiment. The same reference numerals as in the first embodiment are used for features or components being similar or having an equivalent effect. To avoid repetitions, the differences between the two embodiments are described in detail below. Components and features that have already been described in detail with regard to the first embodiment are not described again in detail. The description of these components and features also applies analogously to the second embodiment.

Figures 18 to 22 show different views of a pivoting unit 10 according to the second embodiment. The pivoting unit 10 comprises a cross member 22, a drive arch 24 attached to the cross member 22 and a support member 26. The drive arch 24 is connected to the cross member 22 via fastening means 28. At the ends of the cross member 22 connecting members 30 are attached, via which the cross member 22 can be connected to the support rails 16 and 18 (Figure 1).

In contrast to the first embodiment, the support member 26 according to the second embodiment does not have a C-shaped cross section, but is rectangular in cross section. A pivot axis S extends through the pivot point SP formed at the connection point between the cross member 22 and the support member 26.

Furthermore, it can already be seen in Figures 18 to 22 that the drive device 38 according to the second embodiment differs from the drive device of the first embodiment. The drive device 38 and in particular the differences between the latter and the drive device according to the first embodiment will be discussed in detail in the further course of the description.

Figure 23 shows an exploded perspective view of the pivoting unit 10. Figure 23 shows the cross member 22, the drive arch 24, the support member 26, the drive device 38 and the two fastening members 34 and 36.

Figure 24 shows an enlarged view of the detail identified by XXIV in Figure 23. Figure 24 shows the end 32 of the support member 26, the two fastening members 34 and 36 and a section of the drive arch 24.

The drive device 38 comprises two coupling members 62 and 64. The coupling members 62 and 64 each comprise a coupling section 66, 68 and a bearing section 70, wherein only the bearing section 70 is recognizable on the coupling member 64 in Figure 24. The coupling sections 66 and 68 comprise projections 66_1, 66_2, 66_3, 66_4 and 68_1, 68_2, 68_3, 68_4 extending in the radial direction, via which the drive device 38 can be coupled with a correspondingly developed drive shaft 14 (see Figure 1), wherein 66_3 and 66_4 are not visible in Figure 24. The coupling sections 66 and 68 are each connected to the bearing sections 70 via a rod-shaped section 100. The drive section 72 of the drive device 38 is provided between the coupling members 62 and 64, in which the drive member 74 and the retaining member 94 are formed. The drive member 74 and the retaining member 94 alternately engage in the drive contour 40 of the drive arch 24.

Figure 25 shows a further perspective exploded view of the pivoting unit 10. In Figure 25, the cross member 22, the drive arch 24, the support member 26, the drive device 38 and the two fastening members 34 and 36 are shown.

Figure 26 shows an enlarged view of the detail marked XXVI in Figure 25. Figure 26 shows the drive device 38, which is in engagement with the drive contour 40 of the drive arch 24, the fastening members 34 and 36 and the end 32 of the support member 26.

The drive device 38 comprises two coupling members 62 and 64, which extend from the drive section 72 in the opposite direction. The bearing sections 70 of the coupling members 62 and 64 are connected to the drive section 72 in the direction of the axis of rotation D. The bearing sections 70 are followed in the direction of the axis of rotation D by the connecting sections 100 which connect the bearing sections 70 to the coupling sections 66 and 68. The coupling sections 66 and 68 form the termination of the drive device 38 in the axial direction. In the assembled state of the pivoting unit 10, the coupling members 62 and 64 extend through the openings 54 and 56 and through the bearing bushes 58 and 60 arranged in the openings 54 and 56.

Figure 27 shows a perspective view of the drive device 38. The drive device 38 is rotatable about the axis of rotation D, which corresponds to the longitudinal axis of the drive device 38. The drive device 38 comprises a drive section 72 and two coupling members 62 and 64. The coupling members 62 and 64 each have a bearing section 70 and a coupling section 66 and 68. The coupling sections 66 and 68 are connected to the bearing sections 70 via the connecting sections 100. The coupling sections 66 and 68 comprise the projections 66_1, 66_2, 66_3, 66_4 and 68_1, 68_2, 68_3, 68_4 projecting in the radial direction. The coupling sections 66 and 68 with their projections 66_1, 66_2, 66_3, 66_4 and 68_1, 68_2, 68_3, 68_4 with a drive shaft 14 (see Figure 1) are coupled to transmit torque. The coupling sections 66 and 68 and a section of the drive shaft 14 (see Figure 1) can be developed to be complementary. The coupling sections 66 and 68 and the corresponding portion of a drive shaft 14 can be complementary so that they can be engaged with each other. The coupling sections 66 and 68 and/or the section of the drive shaft 14 can be developed in such a way that assembly-related distance tolerances between adjacent pivoting units 10 and/or posts 12 arranged next to one another are compensated to a limited extent. For example, the coupling members 66 and 68 and the drive shaft can be developed in such a way that they are in engagement with one another in the direction of the pivot axis to allow a displacement relative to one another in order to be able to compensate for the tolerances mentioned.

The drive section 72 comprises two connecting members 90 and 92. The connecting members 90 and 92 can be formed in one piece with the coupling members 62 and 64 and/or the drive member 74 and/or the retaining member 94. The connecting members 90 and 92 are disk-shaped.

Figure 28 shows a front view of the drive device 38. The drive member 74 and the retaining member 94 extend between the disk-shaped connecting members 90 and 92. The connecting member 74 is arranged eccentrically. The retaining member 94 comprises a semicircular

outer contour. The drive device 38 is rotatable about the axis of rotation D. The axis of rotation D extends through the centre point of the semicircular outer contour of the retaining member 94. A free space 98 can be seen between the drive member 74 and the retaining member 94. The retaining member 94 is developed in cross section in the form of a circular sector with a semicircular outer contour (hereinafter referred to as "semicircular sector shape") and is arranged coaxially with the coupling members 62 and

64. The drive member 74 is arranged eccentrically. The longitudinal axis M of the drive member 74 extends parallel but offset in the radial direction to the axis of rotation D of the drive device 38.

The coupling sections 66 and 68 comprise the projections 66_1, 66_2, 66_3, 66_4 and 68_1, 68_2, 68_3, 68_4 which projects in the radial direction, which can couple the drive device 38 to a drive shaft 14 (see Figure 1) in a torque-transmitting manner. The projections 66_4 and 68_4 are not shown in Figure 28 (see Figure 27). The explanations below also apply analogously to the projections 66_4 and 68_4, which are not shown in Figure 28. The projections 66_1, 66_2, 66_3 and 68_1, 68_2, $68_3$are spherical to compensate for angular misalignments between the drive device 38 and the drive shaft 14. For this purpose, the projections 66_1, 66_2, 66_3 and 68_1, 68_2, 68_3 comprise a curved radial outer surface 102. The outer surface 102 is curved in the direction of the axis of rotation D. The curvature is illustrated by the line LS_1 shown in Figure 28 which extends parallel to the axis of rotation D. Furthermore, the projections 66_1, 66_2, 66_3 and 68_1, 68_2, 68_3 have side surfaces 104 which are curved and extend in the radial direction. The side surfaces 104 extend in the radial direction between the outer surface 102 and the foot 106 of the respective projection 66_1, 66_2, 66_3 and 68_1, 68_2, 68_3. For reasons of clarity, the foot 106 of the projections 66_1, 66_2, 66_3 and 68_1, 68_2, 68_3 is only provided in Figure 28 at the projections 66_1 and 68_1 with a reference symbol. The side surface 104 is curved in the direction of the axis of rotation D, as indicated by the line LS_2 shown on one of the side surfaces 104 in Figure 28. The line LS_2 extends parallel to the axis of rotation D. Due to the curvature of the radial outer surfaces 102 and the curved side surfaces 104 of the projections 66_1, 66_2, 66_3, 66_4 and 68_1, 68_2, 68_3, 68_4 angular misalignments between the drive device 38 and the drive shaft 14 can be compensated for.

Figure 29 shows a side view of the drive device 38, in which the coupling member 64, its coupling section 68 and the connecting member 92 are shown. The connecting member 92 is disk-shaped. The coupling section 68 comprises the projections 68_1, 68_2, 68_3, 68_4 projecting in the radial direction. The projections 68_1, 68_2, 68_3, 68_4 are offset by 90° to each other.

Figure 30 corresponds to the front view of the drive device 38 according to Figure 28, with the difference that the section line XXXI-XXXI is shown. Figure 31 shows a sectional view along the section line XXXI-XXXI in Figure 30. Figure 31 shows the disk-shaped connecting member 92, the drive member 74 and the retaining member 94. The retaining member 94 is semicircular in cross-section.

The drive member 74 comprises a cross section that deviates from a circular cross section and is arched at least in sections. The cross section of the drive member 74 is reduced in the radial direction with respect to the axis of rotation D compared to a circular cross section. The cross section of the drive member 74 can be described as oval or elliptical. As indicated in Figures 31 and 32, the cross section of the drive member 74 has four vertices S_1, S_2, S_3 and S_4. Between the vertices S_1 and S_2 , the drive member 74 has its greatest extent in a direction transverse to the radial direction. In other words, the distance between the vertices S_1 and S_2 defines the greatest extent of the drive member 74. The vertices S_3 and S_4 are aligned in the radial direction. The distance between the vertices S_3 and S_4 is smaller than the distance between the vertices S_1 and S_2. The smaller distance between the vertices S_3 and S_4 lying in alignment in the radial direction makes it clear that the cross section of the drive member 74 is reduced in the radial direction.

Due to the reduced cross section of the drive member 74 in the radial direction, the engagement of the drive member 74 in one of the drive recesses 42 can be ensured, so that the function of the pivoting unit 10 can be ensured permanently. With the cross section of the drive member 74 being reduced in the radial direction, the drive member 74 can engage securely in the corresponding drive recess 42 even when the radial distance between the drive device 38 and the drive arch has increased. In particular, tolerance fluctuations within the pivoting unit 10 can be compensated for. Should the radial distance between the drive device 38 and the drive arch 24 increase due to tolerance fluctuations and/or elastic deformation, the oval cross section of the drive member 74 enables the drive member 74 to engage securely in the drive contour 40 of the drive arch 24 even in this case.

Furthermore, the distance between the opposite flanks of the drive recesses 42 (see for example Figures 24 and 26) can increase in the radial direction. The drive recesses 42 expand in the radial direction. This also ensures the safe “threading” and/or the secure engagement of the drive member 74 in one of the drive recesses 42 even with an increased radial distance between the drive device 38 and that of the drive arch 24.

Figure 32 corresponds to Figure 31, wherein the section line XXXIII-XXXIII is shown in Figure 32. Figure 33 shows a sectional view along the section line XXXIII-XXXIII in

Figure 32. The drive section 72 has two connecting members 90 and 92. The connecting members 90 and 92, the drive member 74 and the retaining member 94 can be formed in one piece. The drive member 74 and the retaining member 94 extend between the disk-shaped connecting members 90 and 92. The drive member 74 is arranged offset in the radial direction to the retaining member 94, so that the free space 98 is formed.

Figures 34 to 42 described below show a pivoting unit 10 according to a third embodiment. The same reference numerals as in the first two embodiments are used for features or components being similar or having an equivalent effect. To avoid repetitions, the differences between the third embodiment and the previous embodiments are described in detail below. Components and features that have already been described in detail with respect to the first and/or the second embodiment are not described again in detail. The description of these components and features also applies analogously to the third embodiment.

Figure 34 shows a perspective view of a pivoting unit 10 according to a third embodiment in the state of being attached to a post 12. The pivoting unit 10 comprises a cross member 22, a drive arch 24 attached to it and two support members 26_1 and 26_2 . The drive device 38 is only recognizable in outlines in Figure 34. The pivoting unit 10 is connected, via the support members 26_1 and 26_2 to the post 12. The ends 32 of the support members 26_1 and 26_2 form a connecting section via which the support members 26_1 and 26_2 are connected to one another and to the post 12. The posts 12, according to this embodiment, have an H-shaped cross section. The support members 26_1 and 26_2 are supported on the post 12 by means of spacers which cannot be seen in Figure 34.

Figure 35 shows a further perspective view of a pivoting unit 10 according to a third embodiment in the state of being attached to a post 12. The essential difference from the illustration according to Figure 34 can be seen in the cross section of the post 12. According to Figure 35, the post has a C-shaped cross section and does not have a H-shaped cross section like the post 12 according to Figure 34. The support member 26_2 is supported on the post 12 via a spacer 108. The support member 26_1 abuts to the post 12. As mentioned, spacers are also provided in Figure 34, which are arranged on both sides of the post 12 and are of the same size. These spacers are not shown in Figure 34.

Figure 36 shows an enlarged perspective view of the pivoting unit 10, wherein the support member 26_1 has been hidden. The H-shaped cross section of the post 12 can be clearly seen in Figure 36. The H-shaped cross section of the post 12 is composed of a cross leg 12_1 and two side legs 12_2 and 12_3, which are connected to one another via the cross leg 12_1. A spacer 110 rests on the cross leg 12_1 on both sides. The spacers 110, the support member 26_2 and also the support member 26_1, not shown in Figure 36, are connected via connecting members 112 and 114 to the post 12. For this purpose, the cross leg 12_1 of the post 12 comprises a plurality of openings 116, which are recognizable in outlines in Figure 36 above the spacer 110. The openings 116 are formed in an end section 12_4 of the post 12, which is used for connection to the pivoting unit 10. The end section 12_4 forms a connecting section for connecting the post 12 to the support members 26_1 and 26_2.

The cross member 22 comprises a U-shaped or hat-shaped cross section. The drive arch 24 is fastened to the cross leg of the U-shape. The drive arch 24 comprises the drive contour 40. The drive contour 40 is composed of a plurality of drive recesses 42 and a plurality of retaining recesses 44 which are arranged alternately in the circumferential direction of the drive arch 24. The drive device 38 engages with the drive contour 40 of the drive arch 24 via its drive section 72.

The coupling section 66 of the coupling member 62 can be seen in Figure 36. The coupling section 66 comprises a recess 665, which has a hexagonal cross section. The same applies to the coupling section 68 of the coupling member 64, which, however, is not shown in Figure 36 (see Figure 42). The drive arch 24 can be supported on the guide member 76 in the radial direction via its base member 84. The guide member 76 is developed in the form of a radial stop with a circular cross section.

Figure 37 shows an enlarged section of a side view, in which, in addition to the support member 26_1 , the spacer 110 has also been hidden. In Figure 37, the openings 116 and 118 on the cross leg 12_1 of the post 12 can be seen. The openings 116 and 118 are formed in an end section 12_4 of the post 12, which is used for connection to the pivoting unit 10. The end section 124 forms a connecting section for connection to the support members 26_1 and 26_2. The end section 124 of the post 12 is connected to the end 32 forming a connecting section (not shown in Figure 37, see Figures 34 and 35) of the support members 26_1 and 26_2. For reasons of clarity, only three openings 116 and/or 118 are designated. The openings 116 and 118 are offset from one another in the vertical direction. The connecting members 112 and 114 shown in Figure 36 can be inserted into one or more of the openings 116, 118 in order to create a connection between the support members 26_1 (not shown in Figure 37) and 26_2, the spacers 110 (not shown in Figure 37) and the post 12. A number of openings 116, 118 are available for establishing the connection between the post 12 and the support members 26_1 (not shown) and 26_2 . By suitable selection of the openings 116, 118, which are to be used to establish a connection between the support members $26_{1($ not shown in Figure 37) and 26_2 and the post 12, offsets in the horizontal direction and the vertical direction can be compensated for. Such offsets can occur, in particular, when a pivoting unit 10 is connected to a further pivoting unit (see Figure 1) or a drive with assembly tolerances and unevenness in the terrain, or when adjacent posts or pivoting units are not in alignment.

Figure 37 also shows the coupling section 66 of the coupling member 62. The coupling section 66 comprises a recess 665, which has a hexagonal cross section. An adapter or directly a drive shaft (see Figure 1) with a section or projection with a hexagonal cross section can be inserted into the recess 665 of the coupling section 66 and drive the drive device 38. The same applies to the coupling section 68 of the coupling member 64 not shown in Figure 37 (see Figure 42).

Figure 38 shows a section of a side view of the pivoting unit 10 in the state of being attached to a post 12. The post 12 has an H-shaped cross section. The drive device 38 extends between the two support members 26_1 and 26_2. The support members 26_1 and 26_2 each comprise a bearing point 120 and 122, on which the drive device 38 is mounted with its bearing sections not shown in Figure 38. The bearing points 120 and 122 are developed in the form of bearing flanges which are connected to the support members 26_1 and 26_2. The bearing flanges and/or the bearing points 120 and 122 receive the bearing sections (not shown) of the drive device 38 in sections. The bearings 120 and 122 can have plain bearings.

Figure 39 shows an enlarged section of the view according to Figure 38. The drive device 38 is mounted with its bearing sections, not shown in Figure 39, in the bearing points 120, 122 on the support members 26_1 and 26_2. The drive arch 24 likewise runs between the two support members 26_1 and 26_2. The drive arch 24 can be supported via its base section 84 on the guide member 76, which is developed in the form of a radial stop with a circular cross section. In particular, the drive contour 40 of the drive arch 24 runs between the two connecting members 90 and 92 of the drive device 38. The drive member 74 and the retaining member 94, which cannot be seen in Figure 39, also extend between the connecting members 90 and 92. The retaining member 94, which cannot be seen in Figure 39, is in the position of the drive device 38 shown in Figure 39 in engagement with the drive contour 40 and in particular in engagement with a retaining recess 44 (see Figure 37). In Figures 38 and 39, the post 12 is located essentially in the middle between the two support members 26_1 and 26_2.

Figure 40 shows a section of a side view of the pivoting unit 10 in the state of being attached to the post 12. In contrast to Figures 38 and 39, the post 12 here has a C-shaped cross section. The support member 26_2 is supported on the post 12 via a spacer 108, wherein the side leg 123 of the C-shaped post 12 is recognizable in Figure 40. The end 32 (not recognizable) of the support member 26_1 is received in the C-profile of the post 12 and, like the support member 26_2, is connected to the end section 124 of the post 12.

Figure 41 shows an enlarged section of the view according to Figure 40. The support member 26_2 is supported on the post 12 via the spacer 108. The support member 26_1, the spacer 108 and the support member 26_2 are connected to one another and to the post 12 by means of connecting members (not shown in Figure 41).

Furthermore, Figure 41 shows the bearing points 120 and 122 provided on the support members 26_1 and 26_2, at which the drive device 38 is mounted. The drive unit 38 extends between the support members 26_1 and 26_2 and is accommodated with its bearing sections (not shown) in the bearing projections 120, 122.

Figure 42 shows a perspective view of the drive device 38. The drive device 38 comprises coupling members 62 and 64, between which a drive section 72 is arranged. The connecting members 90 and 92 connect the coupling members 62 and 64 to the drive member 74 and the retaining member 94. The drive member 74 and the retaining member 94 extend between the connecting members 90 and 92 and are spaced apart from one another by the free space 98.

The coupling members 62 and 64 each comprise a bearing section 70 with which the drive device 38 can be received in the bearing points 120 and 122 (see Figures 38 to 41). The coupling section 66 can be seen on the coupling member 62 radially inward of the bearing sections 70. The coupling section 66 comprises a recess 665. The recess 665 has a hexagonal cross section. A hexagonal projection of a drive shaft 14, an adapter or a drive can be inserted into the coupling section 66 in order to couple the drive device 38 to a drive in a torque-transmitting manner (see Figures 1 and 2). The coupling member 64 also comprises such a coupling section 68 with a recess, which, however, is not shown in Figure 42.

The function of the pivoting unit 10 is explained below. The pivoting unit 10 can be driven via a drive shaft 14 shown in Figure 1 or a drive. For this purpose, the drive shaft 14 can be coupled to the drive device 38 via one of the coupling members 62 or 64 in a torque-transmitting manner. The drive device 38 is mounted rotatably about the axis of rotation D (see Figures 9, 11, 15, 16, 24, 26 to 28, 31, 32 and 42) in the fastening members 34 and 36 and/or in the bearing points 120 and 122. The axis of rotation D of the drive device 38 extends essentially parallel to the pivot axis S. A drive shaft 14 connected to the drive device 38 can also extend essentially parallel to the pivot axis S.

The drive torque transmitted to the drive device 38 via one of the coupling members 62 and 64 sets the drive device 38 in rotation. The drive member 74 thereby rotates on a circular path with a predetermined radial distance about the axis of rotation D. The drive device 38 is coupled via its drive member 74 to the drive arch 24 in a torque-transmitting manner, so that the drive arch 24 may be gradually pivoted about the pivot axis S by a rotary movement of the drive device 38 about the axis of rotation. The drive member 74 can engage in one of the drive recesses 42 through the rotary movement carried out by the drive device 38, take the drive arch 24 with it and leave the corresponding drive recess 42. In this way, an adjusting step about the pivot axis S is carried out and the drive arch 24 with the cross member 22 attached to it is transferred into a new pivot position. Between the engagement in the drive recess 42 and the leaving of the drive recess 42, the drive member 74 presses against a flank of the drive recess 42. As a result, a torque is transmitted to the drive arch 24 so that the adjusting step of the drive arch 24 and the cross member 22 about the pivot axis S is carried out.

Due to the movement of the drive member 74 and the drive arch 24, the retaining member 94 of the drive device 38 engages with a retaining recess 44. The retaining member 94 engages in a retaining recess 44 adjacent to the drive recess 42, which has just left the drive member 74. The retaining member 94 can rotate in the corresponding retaining recess 44. The retaining member 94 engages with a first section of its cross section in the retaining recess 44, wherein this section increases continuously due to the rotary movement of the drive device 38 with the retaining member 94. The engagement of the retaining member 94 in the retaining recess 44 prevents rotation and/or pivoting of the cross member 22 and the drive arch 24 attached to it about the pivot axis S. The drive device 38 and the drive arch 24 are thus in a locked position. If the drive device 38 is driven further in this state, the retaining member 94 leaves the retaining recess 44 again and releases the drive arch 24 for an adjusting step initiated by the drive member 74.

The retaining member 94, when it is in engagement with a retaining recess 44, can prevent a relative rotation between the drive arch 24 and the cross member 22 connected thereto and the respective support member 26, 26_1, 26_2 in the state of being attached to at least one post 12. As soon as the retaining member 94 also engages with a (partial) section in a retaining recess 44, rotation of the drive arch 24 about the pivot axis S is prevented, i.e., a complete inclusion of the cross section of the retaining member 94 in a retaining recess 44 is not required in order to prevent rotation of the drive arch 24. Due to the alternating arrangement of the drive recesses 42 and the retaining recess 44, an adjustment step of the drive arch 24 initiated by the drive member 74 or a holding step can alternately be carried out in which the drive arch 24 can be held in a blocking position via the retaining member 94. The retaining member 94 can prevent an undesired adjusting of the pivoting unit 10 about the pivot axis S without a torsional moment being transmitted to the drive shaft 14 and/or the drive.

However, if the drive arch 24 and the cross member 22 connected to it are to be pivoted further, the drive device 38 is driven further until the drive member 74 engages in the next drive recess 42 and a further adjustment step is carried out. If the drive arch 24 and the cross member 22 connected to it are to be locked in the set position, the drive device 38 is stopped in the locked position. In this position, the retaining member 94 is at least partially engaged with a retaining recess 44.

The connecting members 90 and 92 form a guide for the drive arch 24 in the direction of the axis of rotation D and/or the pivot axis S, which extend parallel to one another. For this purpose, the connecting members 90 and 92 enclose the drive arch 24 between them. Because of the connecting members 90 and 92, the drive arch 24 cannot bypass the drive member 74 and also not the retaining member 94 in the axial direction. The drive arch 24 is thus held in engagement with the drive member 74 and the retaining member 94 by the connecting members 90 and 92. The structure of the pivoting unit 10 can be considerably simplified by the guide function provided by the connecting members 90 and 92.

The pivoting unit 10 can also considerably simplify the assembly of a tracking apparatus NV. The pivoting unit 10 can be preassembled. The preassembled pivoting unit 10 can then be connected as an independent unit to posts 12 already anchored in the floor. The posts 12 are connected to the end 32 of the respective support member 26, 26_1, 26_2. This completes the assembly of the pivoting unit 10 on the post 12. If several pivoting units 10 (see Figure 1) are to be provided, these pivoting units 10 are brought into alignment with one another in accordance with the pivot axis S and connected to one another via the drive shafts 14 and the frame members and/or support rails 16 and 18. Each coupling member 62 and 64 of the drive device 38 can be connected via a drive shaft 14 to a further pivoting unit 10 or a drive and/or motor. The ends of the drive shafts 14 and/or corresponding adapters and/or the coupling members of the drive device 38 are configured such that both misalignments between the drive device 38 and the drive shaft 14 and distance tolerances between the drive device 38 in the direction of the pivot axis S can be compensated for.

Patenttivaatimukset

1. Käyttölaitteisto (38, 24), jossa on:

ainakin yksi pyörimisakselin (D) ympäri pyöritettävä käyttölaite (38), joka käsittää ainakin yhden käyttöelementin (74) ja ainakin yhden pidätyselementin (94), jolloin ainakin yksi käyttöelementti (74) on sijoitettu radiaalisessa suunnassa epäkeskisesti ainakin yhteen pidätyselementtiin (94) nähden, ja

ainakin yksi akselin (S) ympäri pyöritettävä tai käännettävä voimanottoyksikkö (24), jolloin voimanottoyksikkö (24) käsittää ainakin yhden käyttösyvennyksen (42) ja ainakin yhden pidätyssyvennyksen (44),

jolloin ainakin yksi käyttöelementti (74) on kohdistettu ainakin yhteen käyttösyvennykseen (42) ja tarttuu ainakin yhteen käyttösyvennykseen (42) voimanottoyksikön (24) käyttämiseksi, ja

jolloin ainakin yksi pidätyselementti (94) on kohdistettu ainakin yhteen pidätyssyvennykseen (44) ja tarttuu ainakin yhteen pidätyssyvennykseen (44) voimanottoyksikön (24) pidättämiseksi asetetussa asennossa,

jolloin ainakin yksi käyttöelementti (74) käsittää ympyrän poikkileikkauksesta poikkeavan ja ainakin osuuksittain kaarevan poikkileikkauksen, jolloin ainakin yksi käyttöelementti (74) käsittää pyörimisakseliin (D) nähden ympyrän poikkileikkaukseen verrattuna radiaalisessa suunnassa pienentyneen poikkileikkauksen,

jolloin ainakin yhden käyttöelementin (74) poikkileikkaus käsittää ainakin ensimmäisen lakipisteen (S_1) ja ainakin toisen lakipisteen (S_2), joiden etäisyys toisiinsa määrittää käyttöelementin (74) suurimman ulottuvuuden, tai jolloin ainakin yhden käyttöelementin (74) poikkileikkaus käsittää ainakin ensimmäisen reunan ja ainakin toisen reunan, joiden etäisyys toisiinsa määrittää käyttöelementin (74) suurimman ulottuvuuden,

t u n n e t t u siitä, että

ainakin yhden käyttöelementin (74) poikkileikkaus käsittää ainakin kolmannen lakipisteen (S_3) ja neljännen lakipisteen (S_4), joiden etäisyys toisiinsa on pienempi kuin ensimmäisen lakipisteen (S_1) tai ensimmäisen reunan ja toisen lakipisteen (S_2) tai toisen reunan välinen etäisyys.

2. Patenttivaatimuksen 1 mukainen käyttölaitteisto (38, 24), jossa ainakin yksi käyttösyvennys (42) laajenee radiaalisessa suunnassa ulospäin tai sisäänpäin sisääntuloaukon määrittämiseksi ainakin yhdelle käyttöelementille (74).

3. Jonkin edellisen patenttivaatimuksen mukainen käyttölaitteisto (38, 24), jossa käyttölaitteen (38) pyörimisakseli (D) kulkee ainakin yhden pidätyselementin (94) läpi tai sitä pitkin.

4. Jonkin edellisen patenttivaatimuksen mukainen käyttölaitteisto (38, 24), jossa ainakin yksi pidätyselementti (94) käsittää ainakin yhdessä osuudessa kaarevuuden, joka on sovitettu ainakin yhden pidätyssyvennyksen (94) kaarevuuteen.

5. Jonkin edellisen patenttivaatimuksen mukainen käyttölaitteisto (38, 24), jossa ainakin yksi käyttöelementti (74) ja ainakin yksi pidätyselementti (94) on yhdistetty keskenään ainakin yhden liitoselementin (90, 92) kautta.

6. Jonkin edellisen patenttivaatimuksen mukainen käyttölaitteisto (38, 24), jossa ainakin yksi käyttöelementti (74) ja ainakin yksi pidätyselementti (94) ulottuvat olennaisesti yhdensuuntaisesti käyttölaitteen (38) pyörimisakseliin (D) nähden.

7. Jonkin edellisen patenttivaatimuksen mukainen käyttölaitteisto (38, 24), jossa ainakin yksi käyttöelementti (74) käsittää soikean tai ellipsimäisen tai linssimäisen poikkileikkauksen.

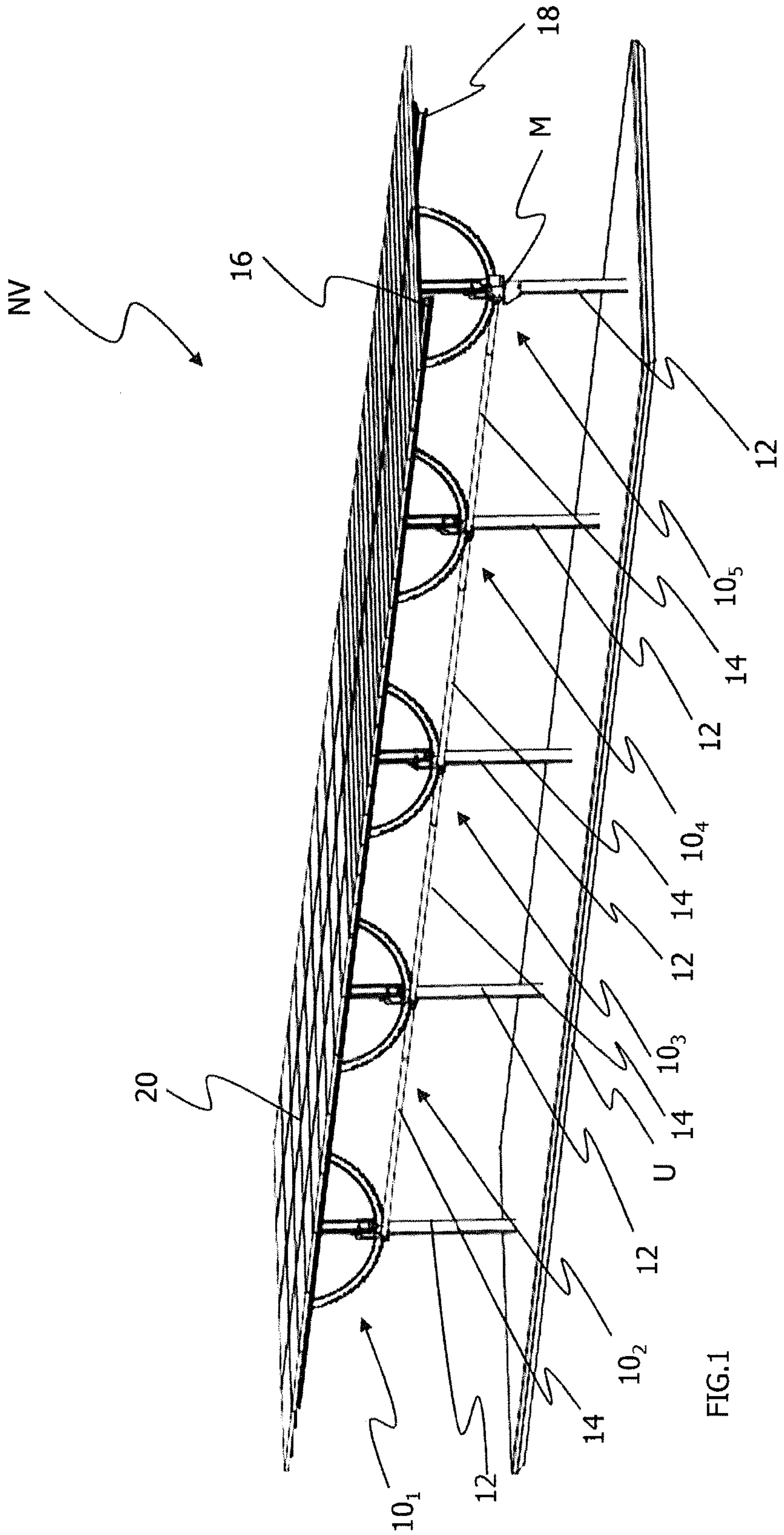

FIG.1

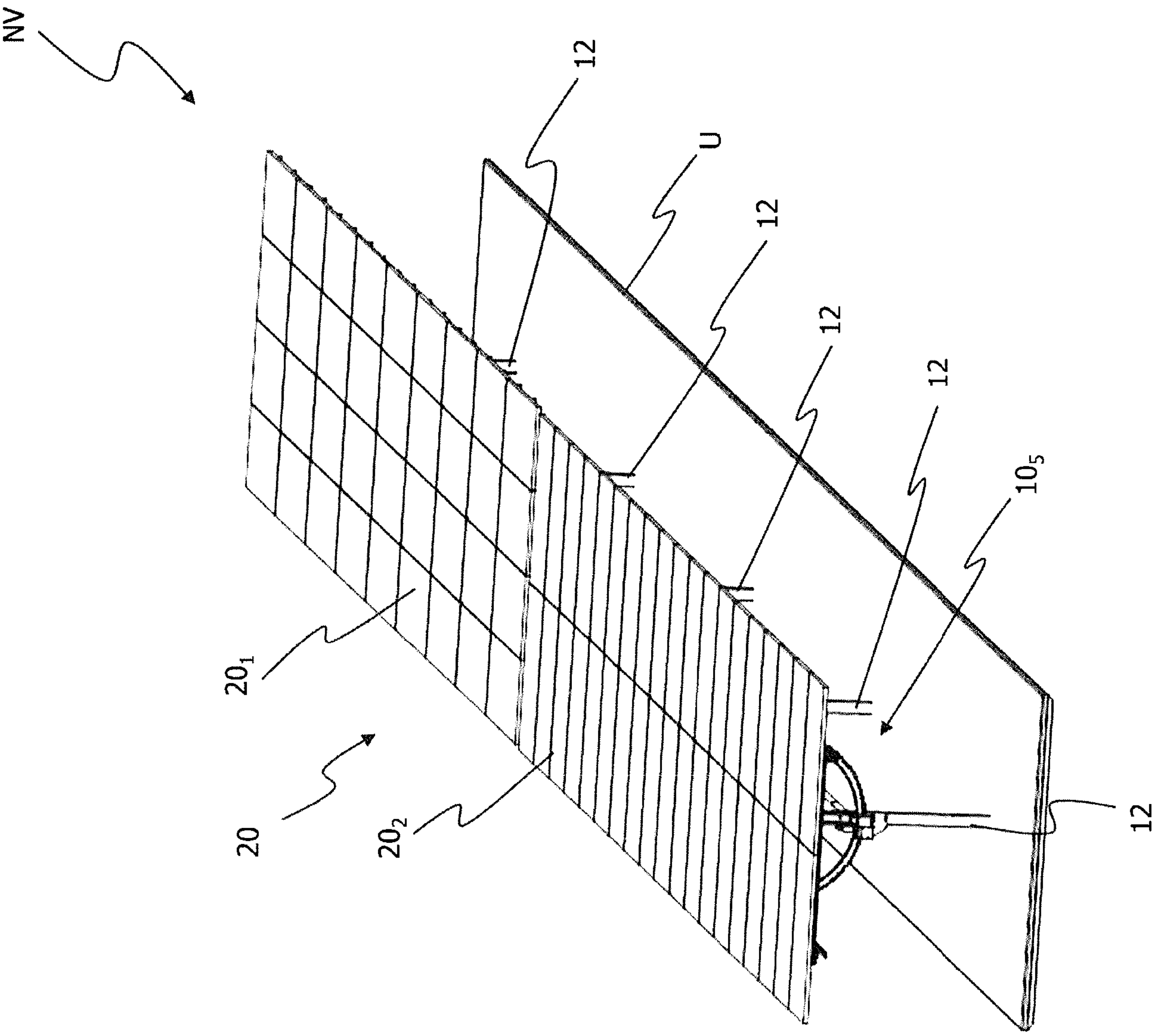

FIG.2

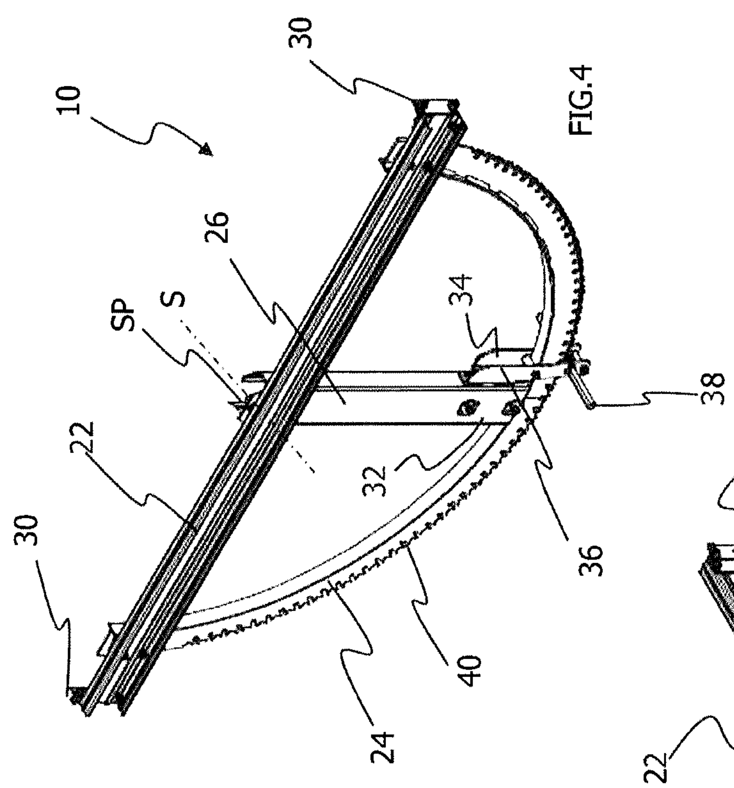

FIG.4

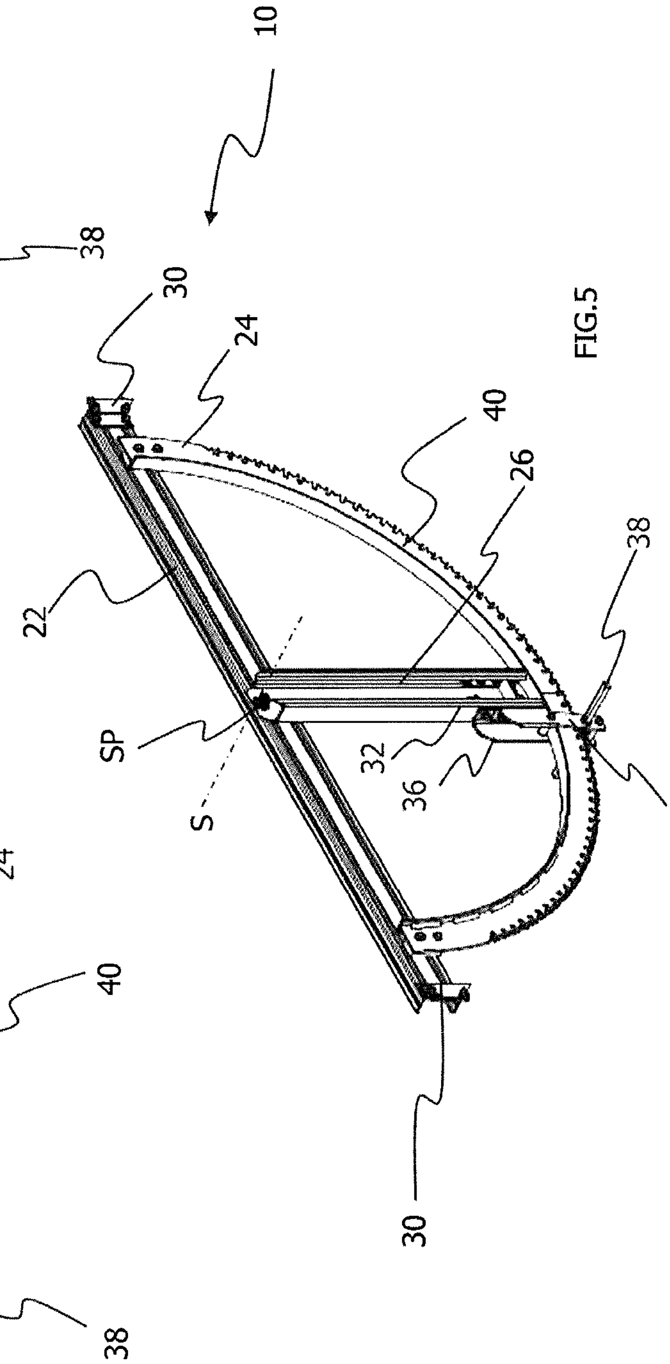

FIG.5

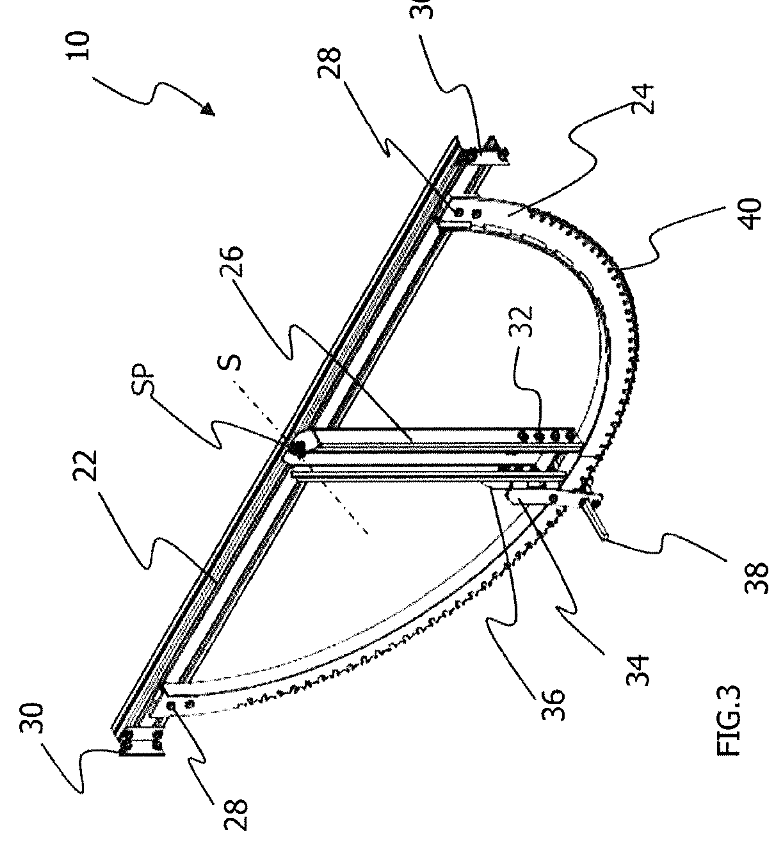

FIG.3

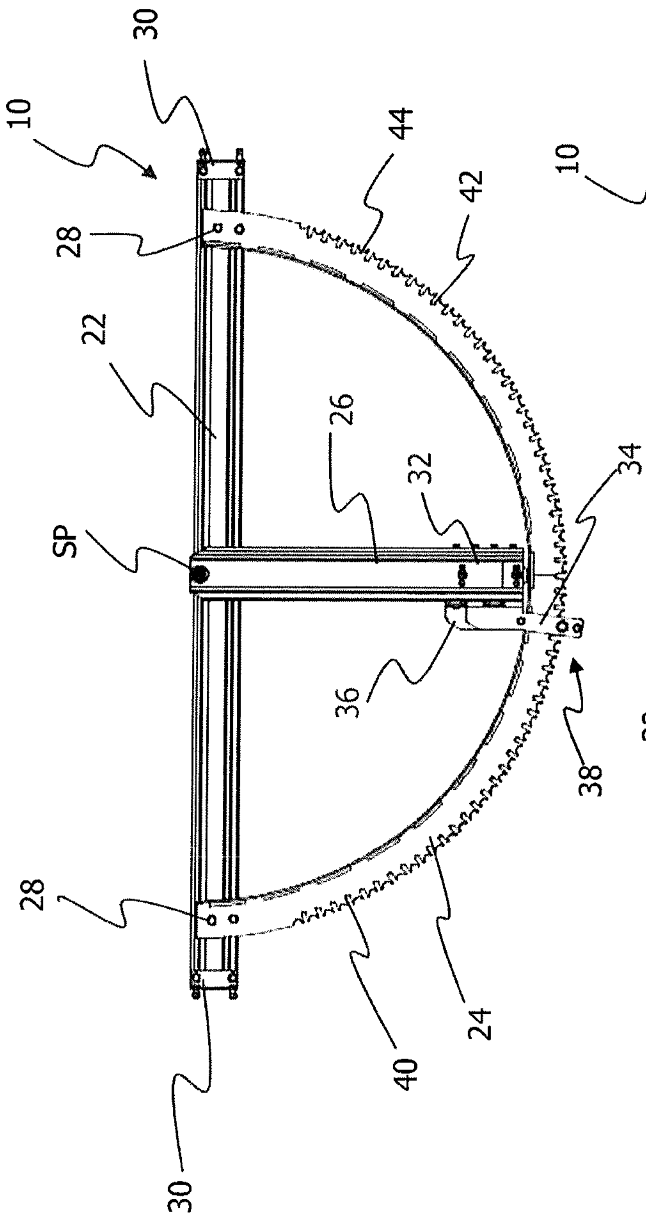
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FIG.6

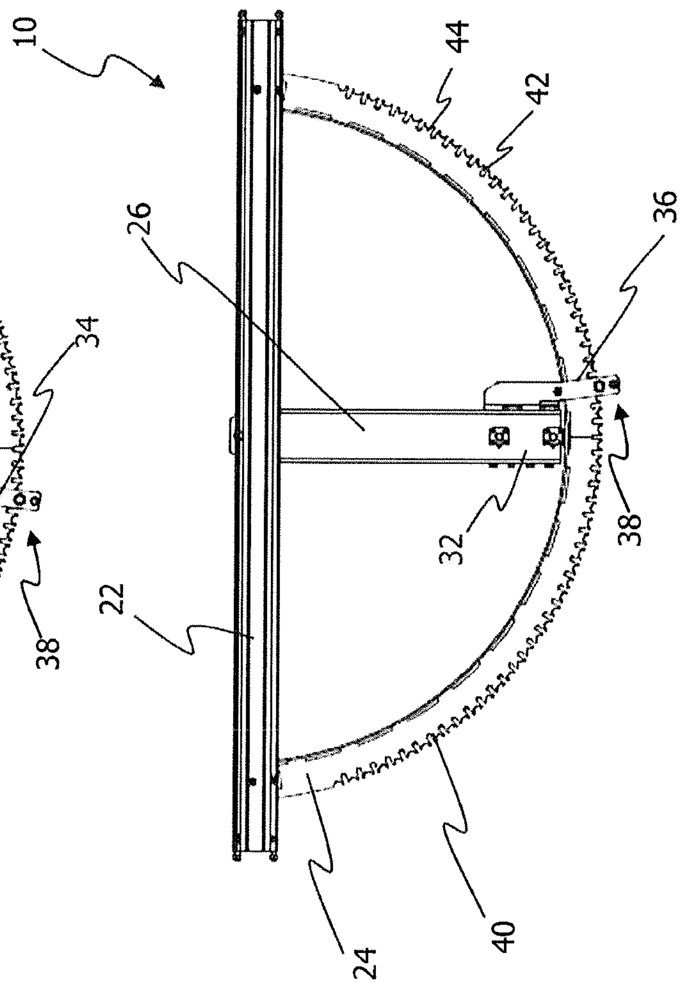
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FIG.7

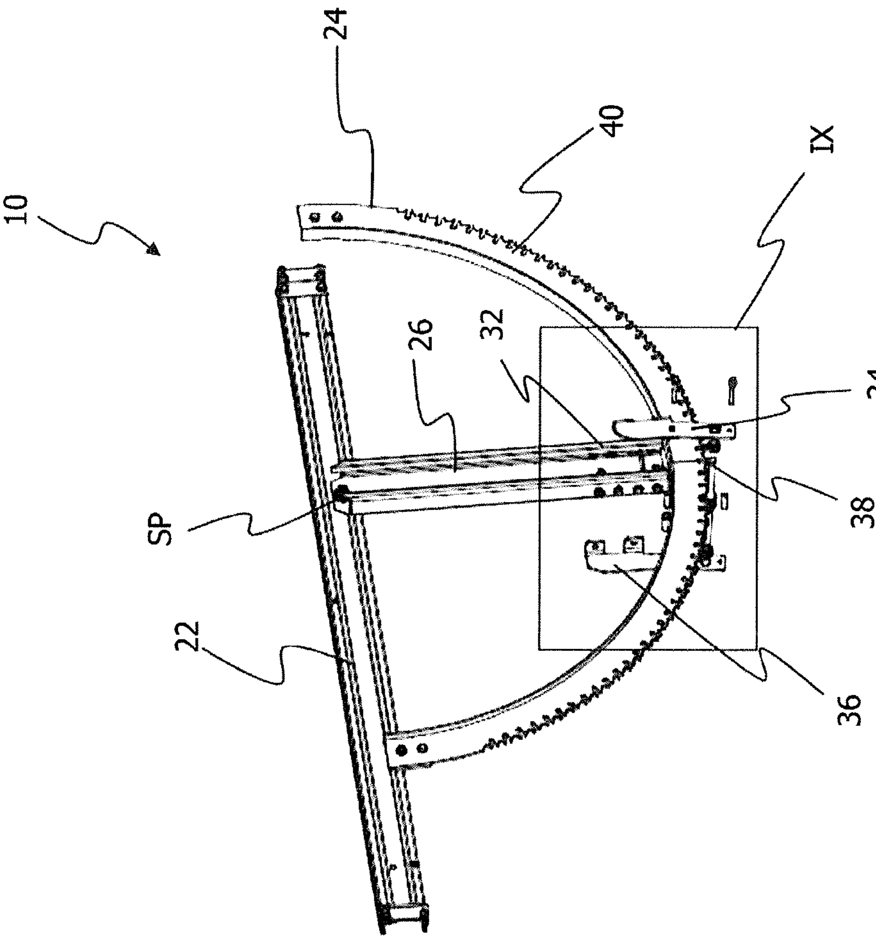

FIG.8

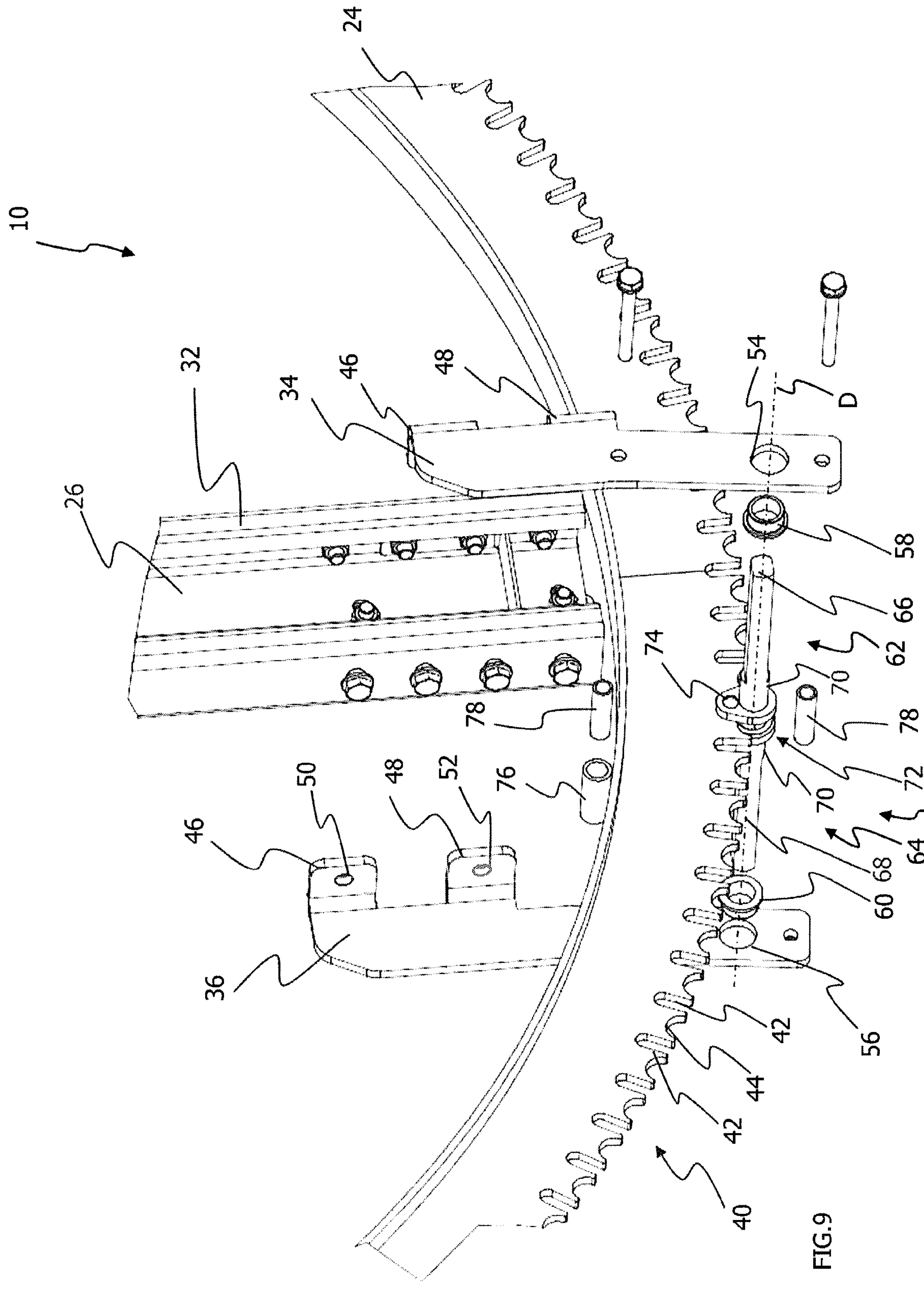
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FIG.9

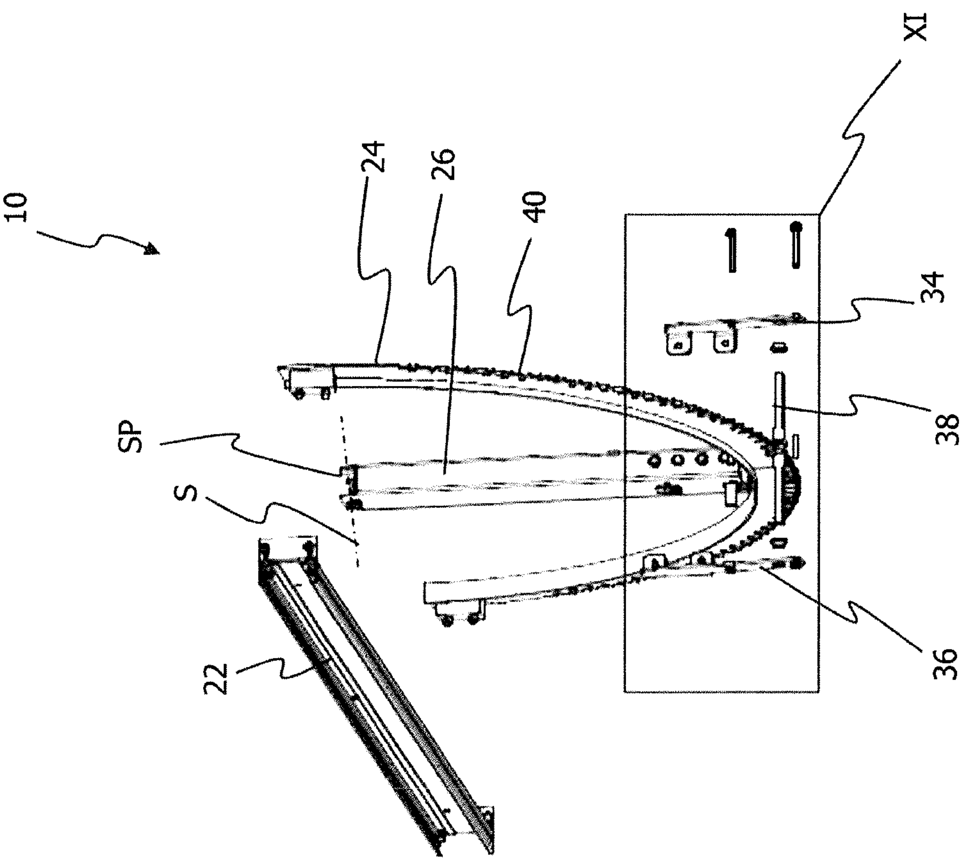

FIG.10

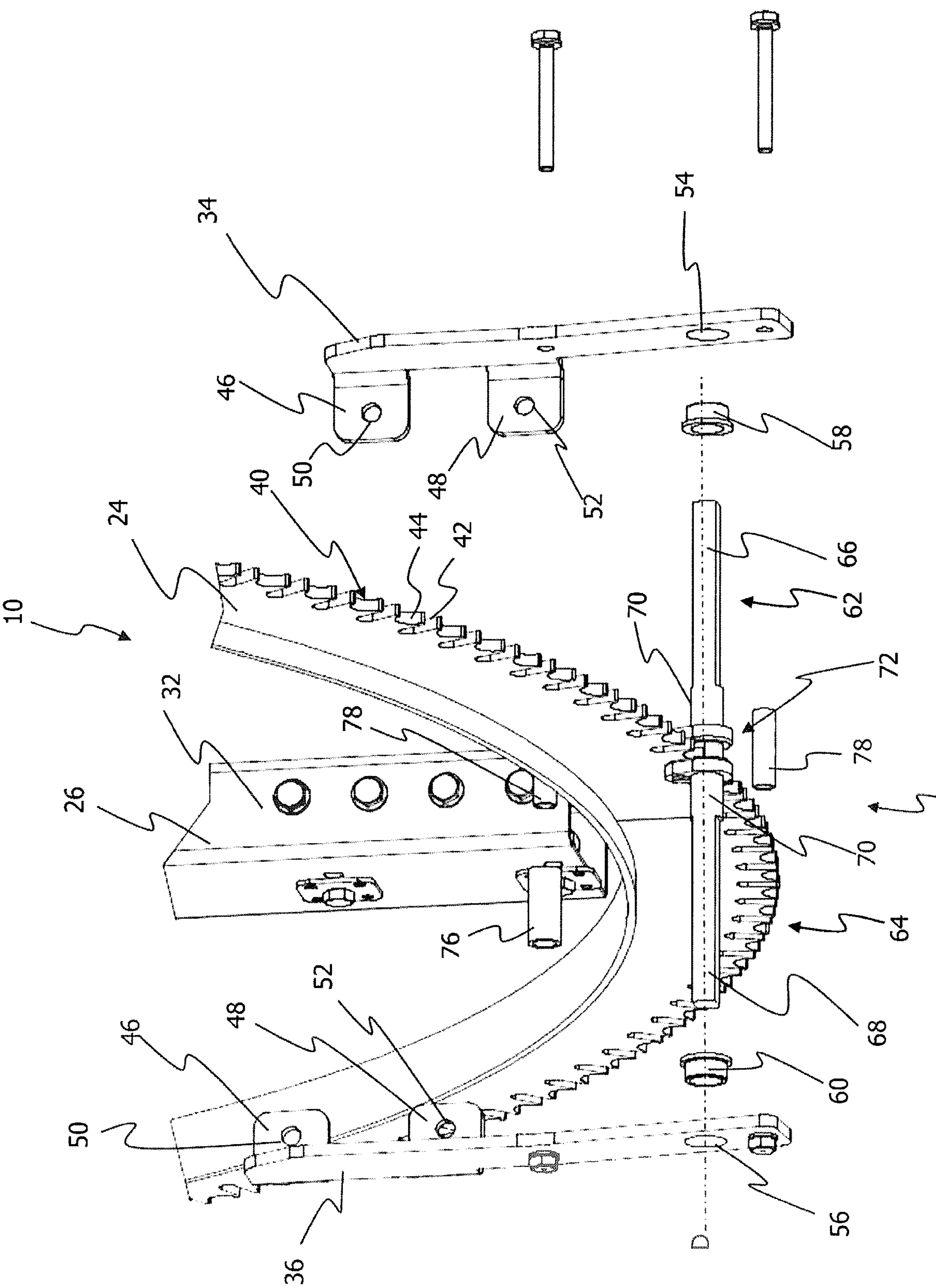
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FIG.11

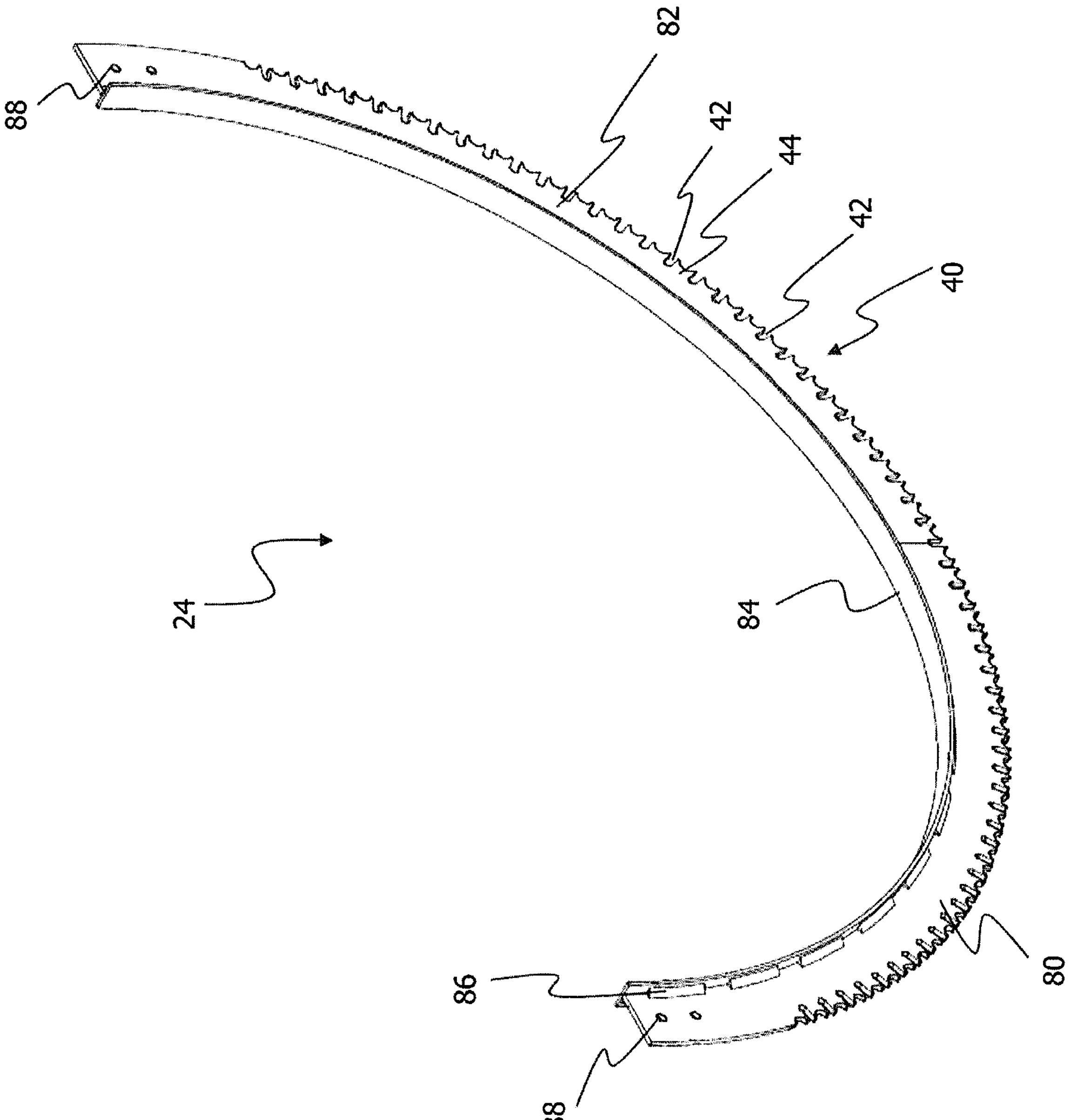


FIG.12

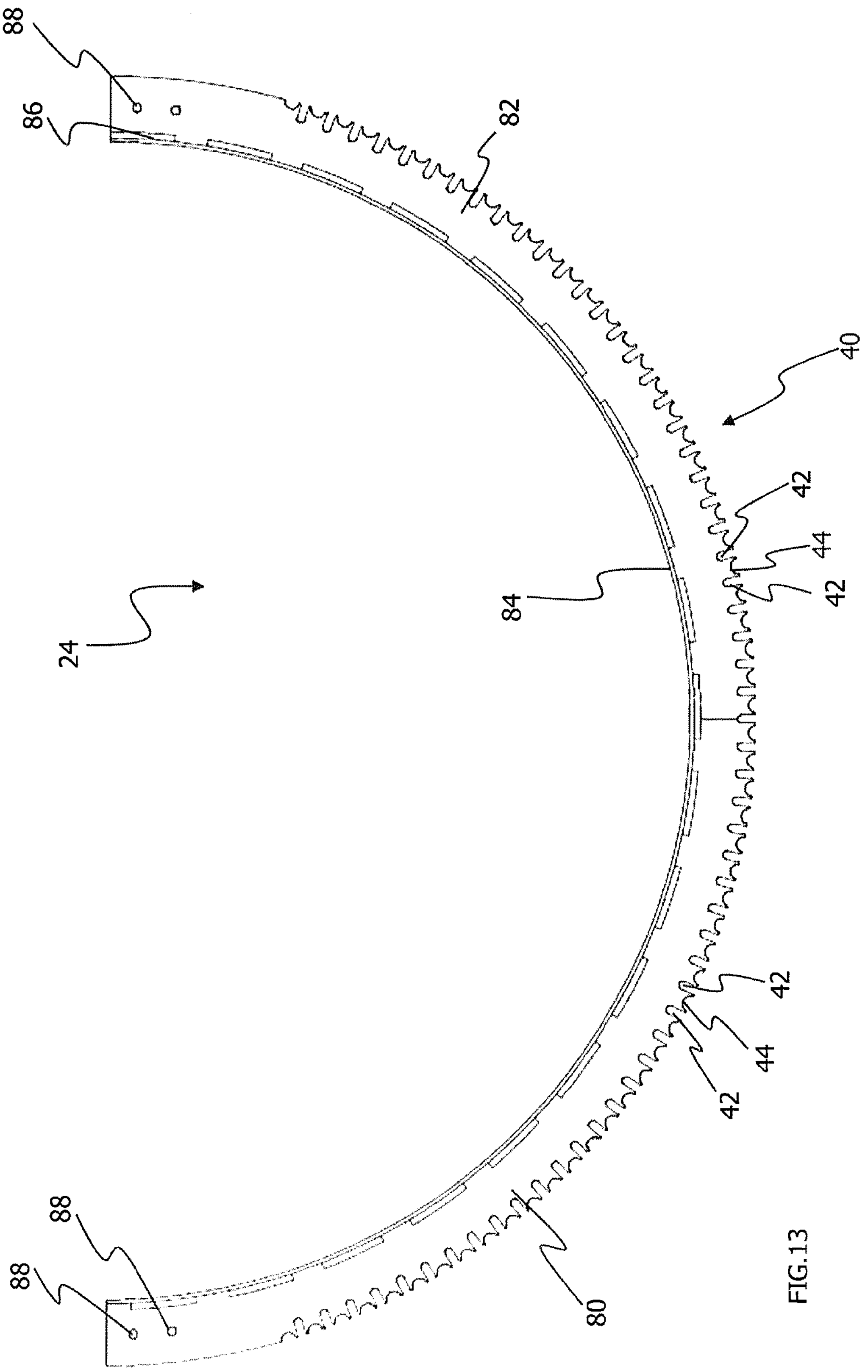


FIG.13

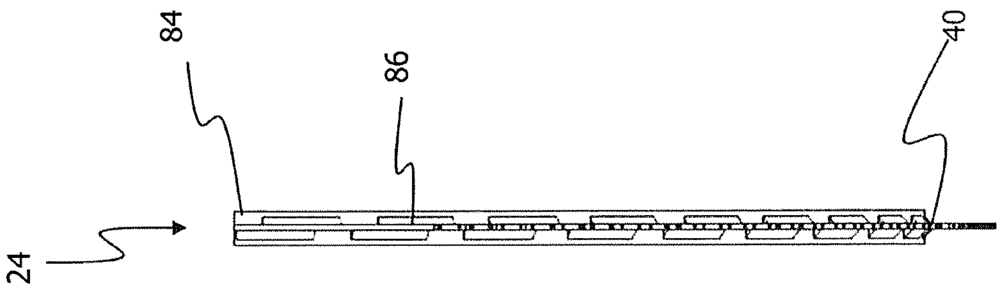


FIG.14

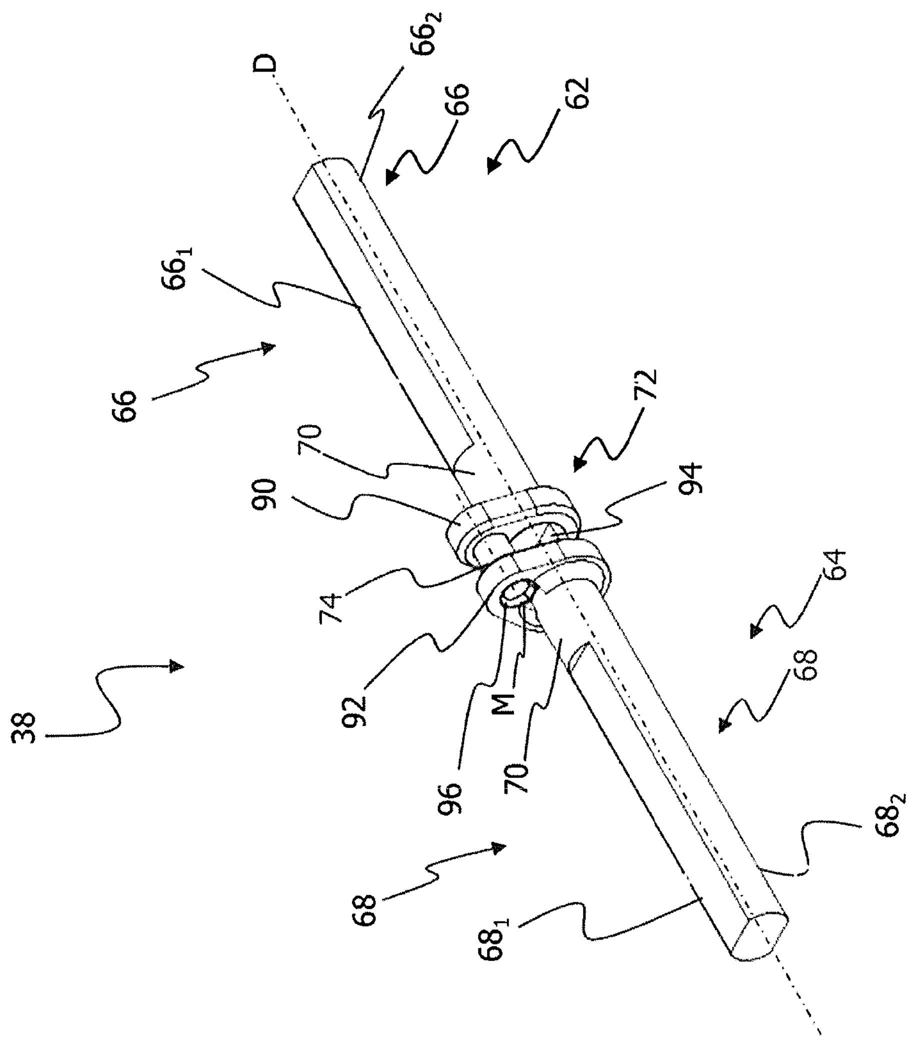


FIG.15

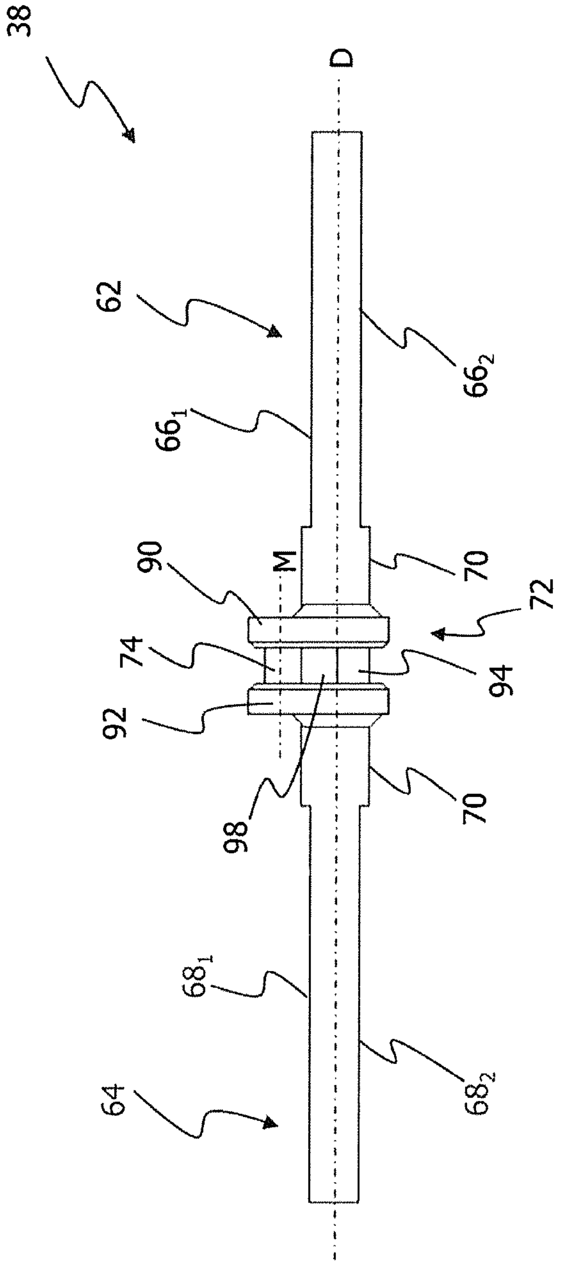

38
D
62
66_2
66_1
M
90
70
72
74
94
92
70
98
68_1
68_2
64

FIG.16

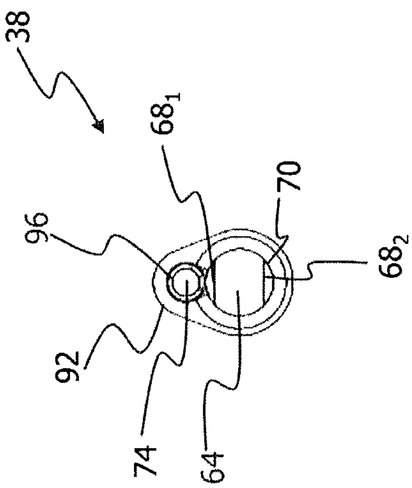

38
68_1
70
96
68_2
92
74
64

FIG.17

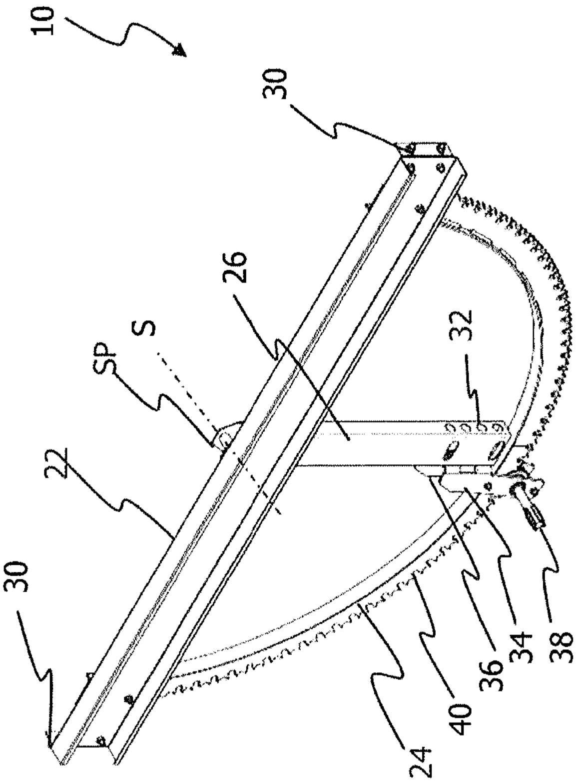


FIG.19

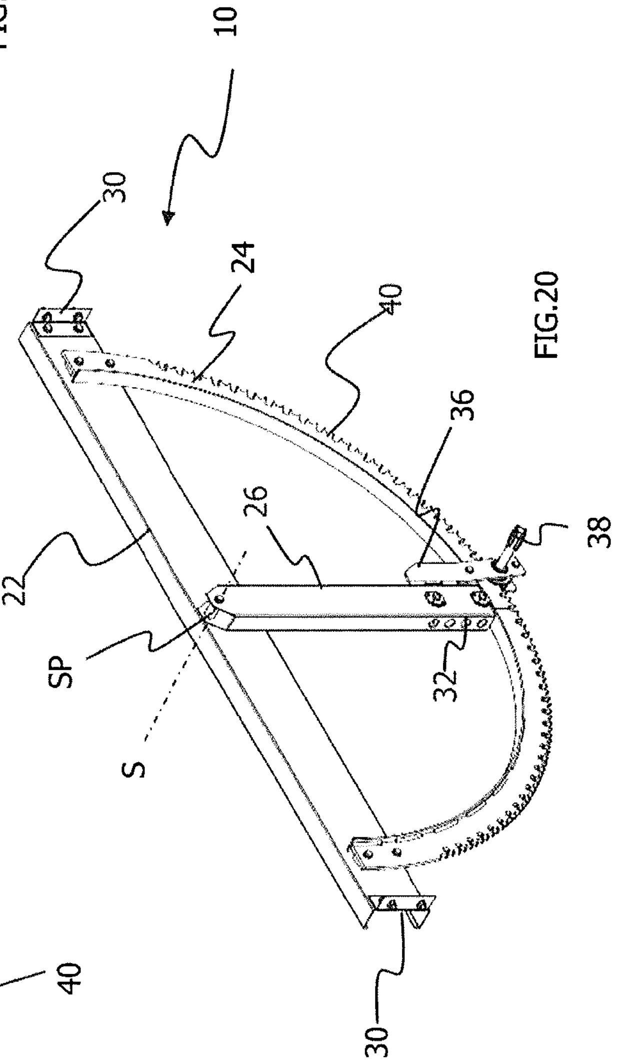


FIG.20

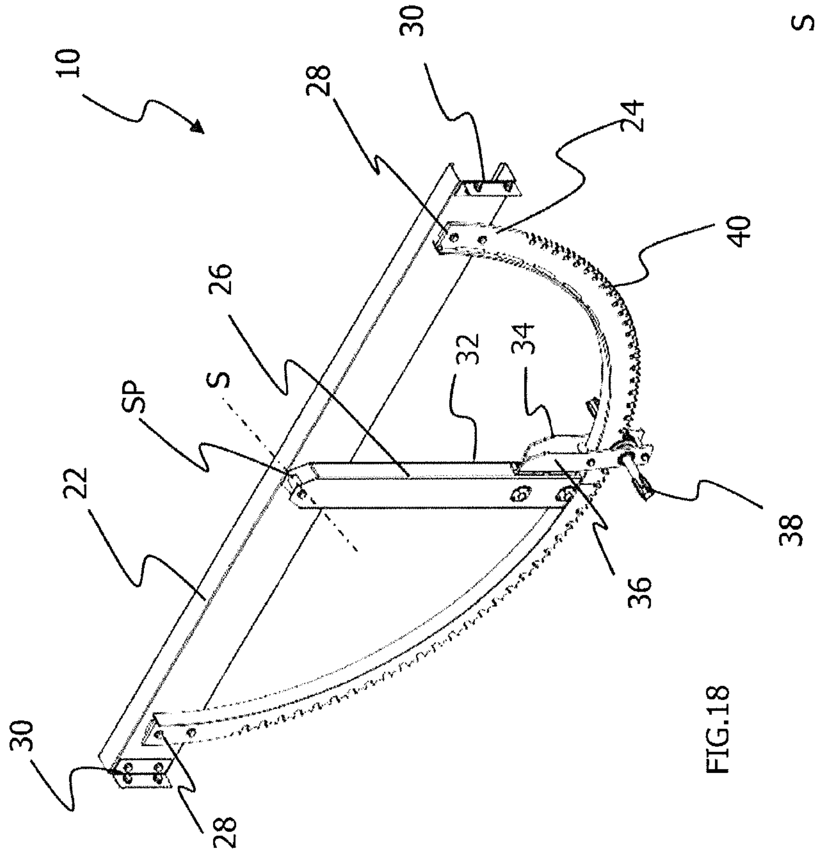


FIG.18

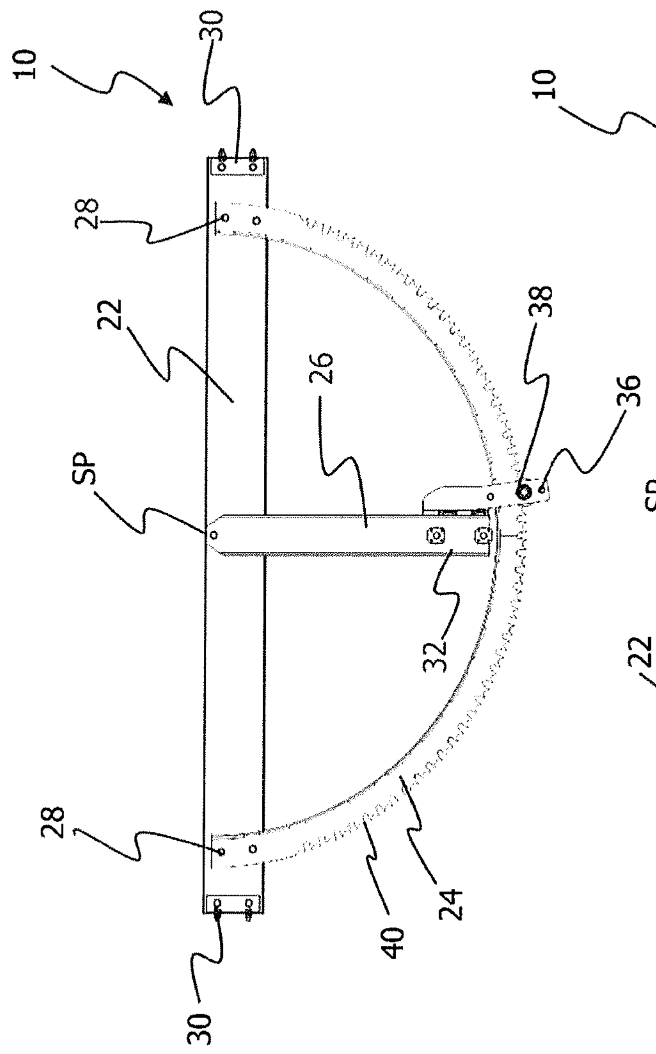


FIG.21

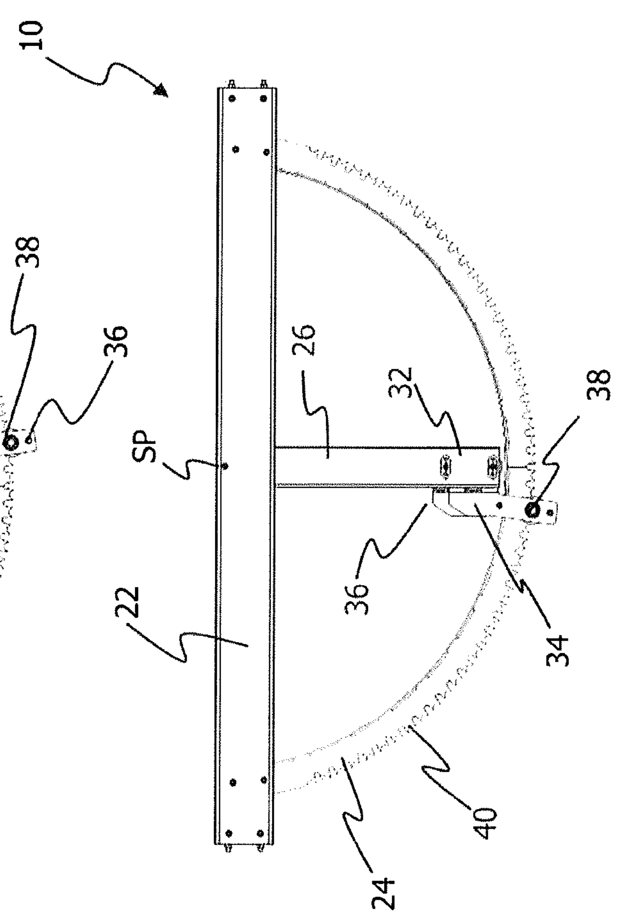


FIG.22

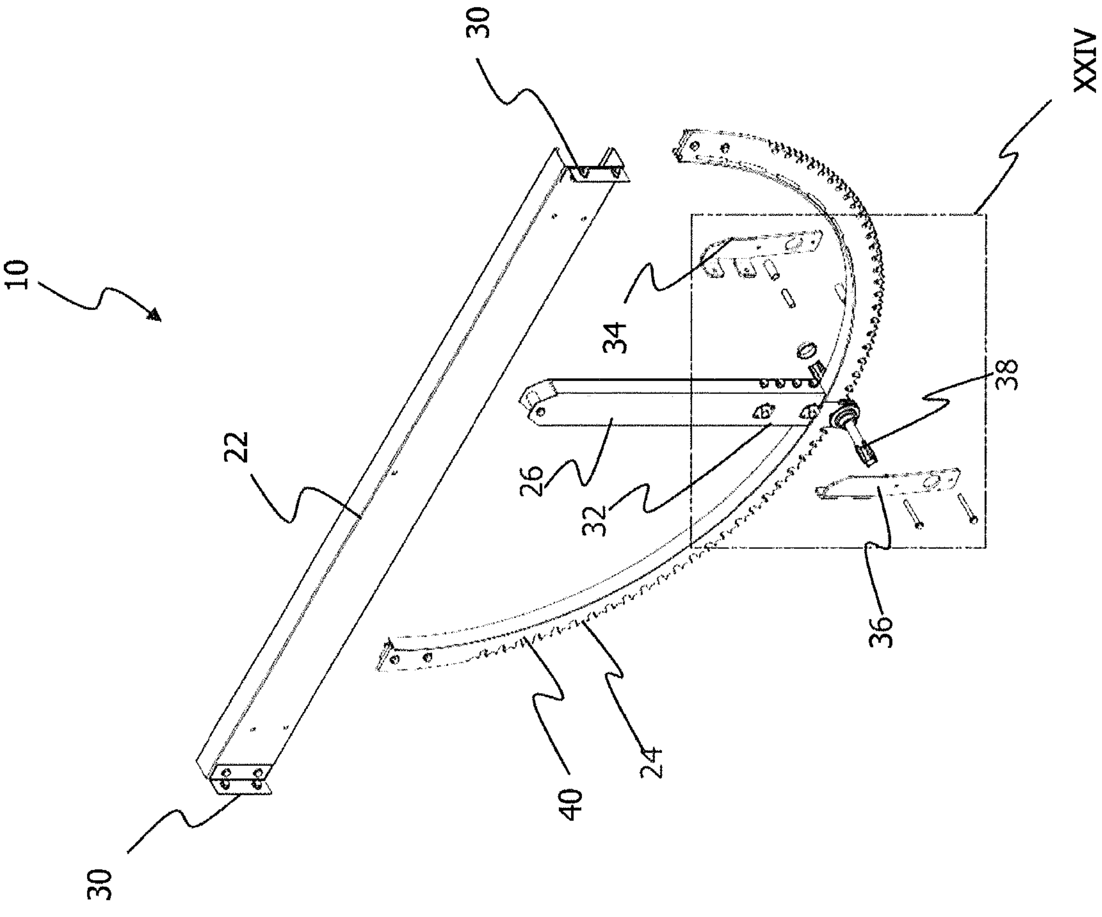
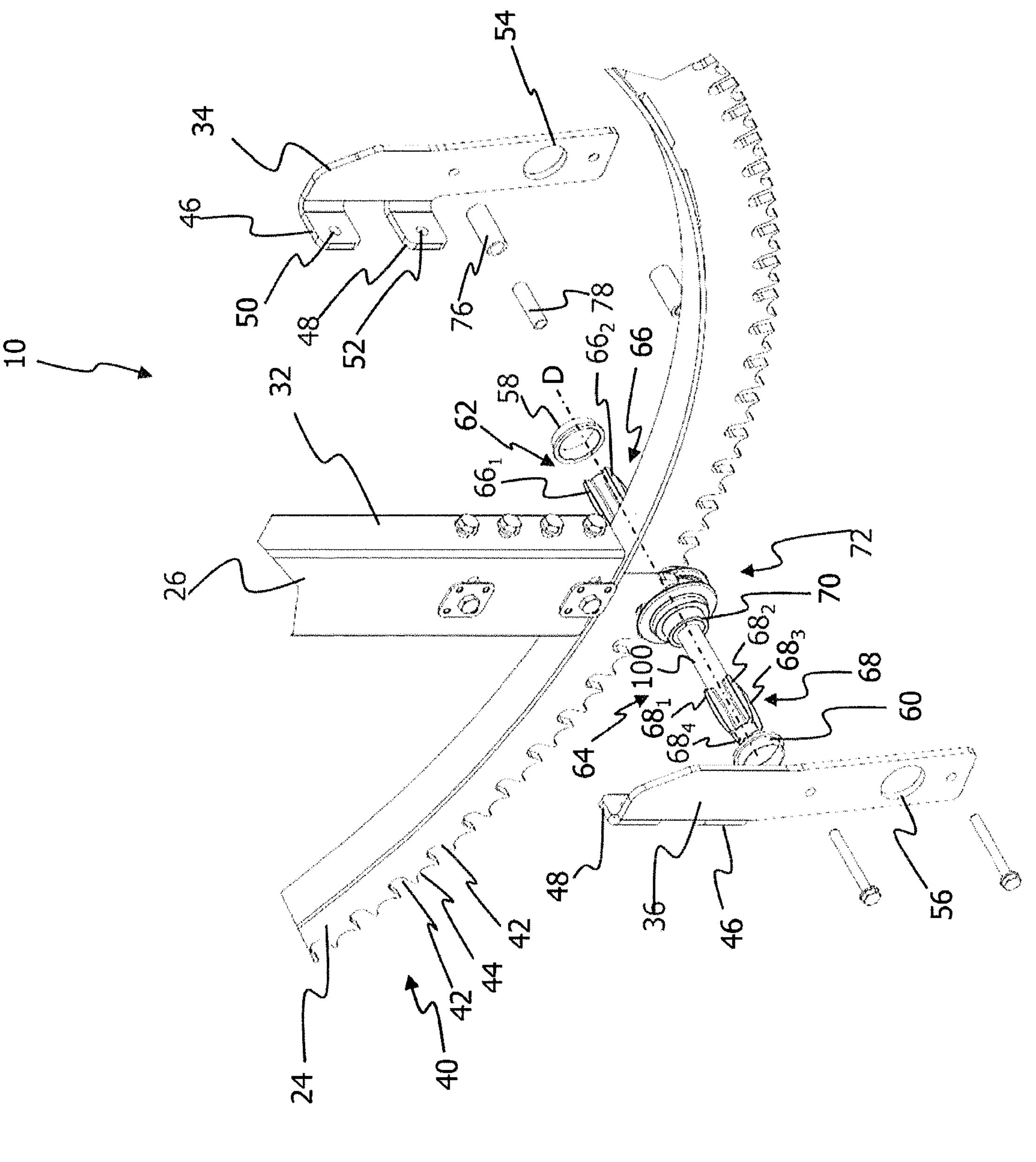


FIG.23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62
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66_1
66_2
66
68_1
68_2
68_3
68_4
68
70
72
76
78
100
D

FIG.24

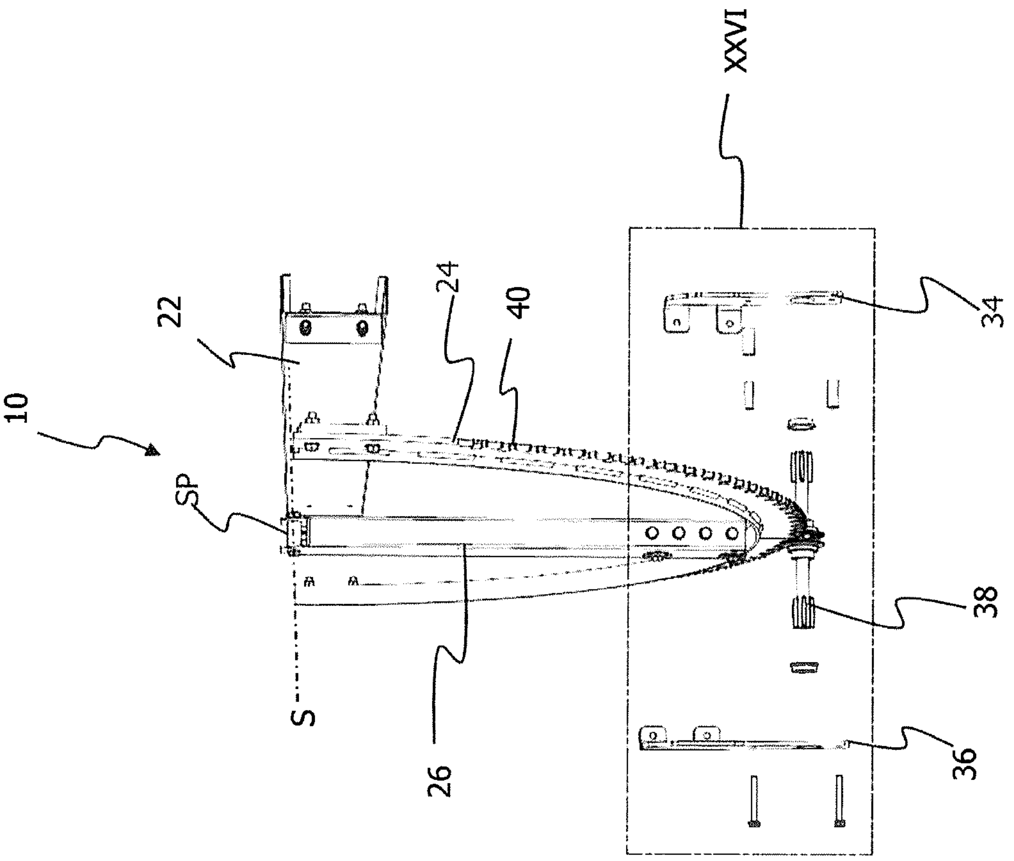
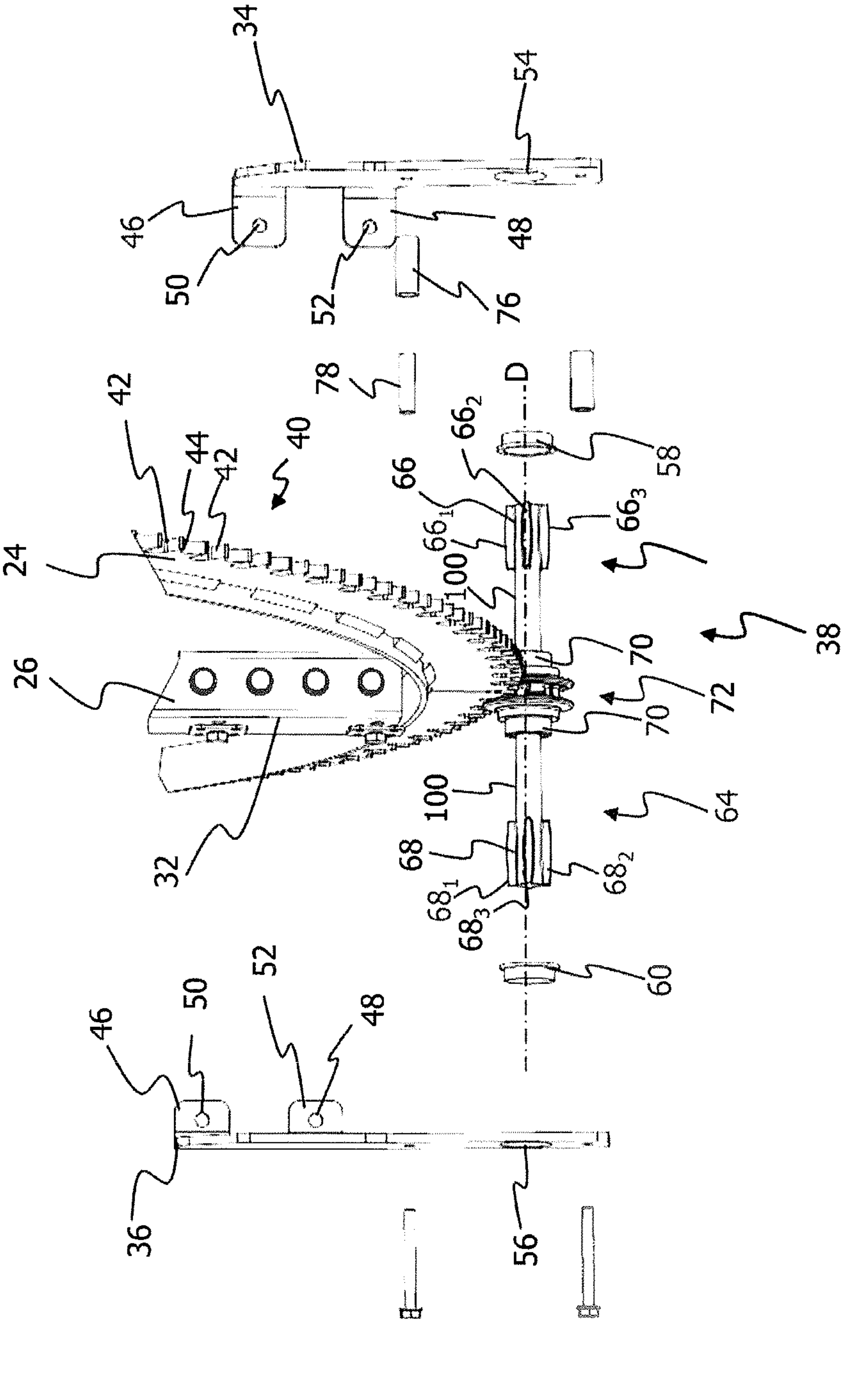


FIG.25



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76
78
D
42
44
42
40
24
26
32
66
66_2
66_1
66_3
58
100
70
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70
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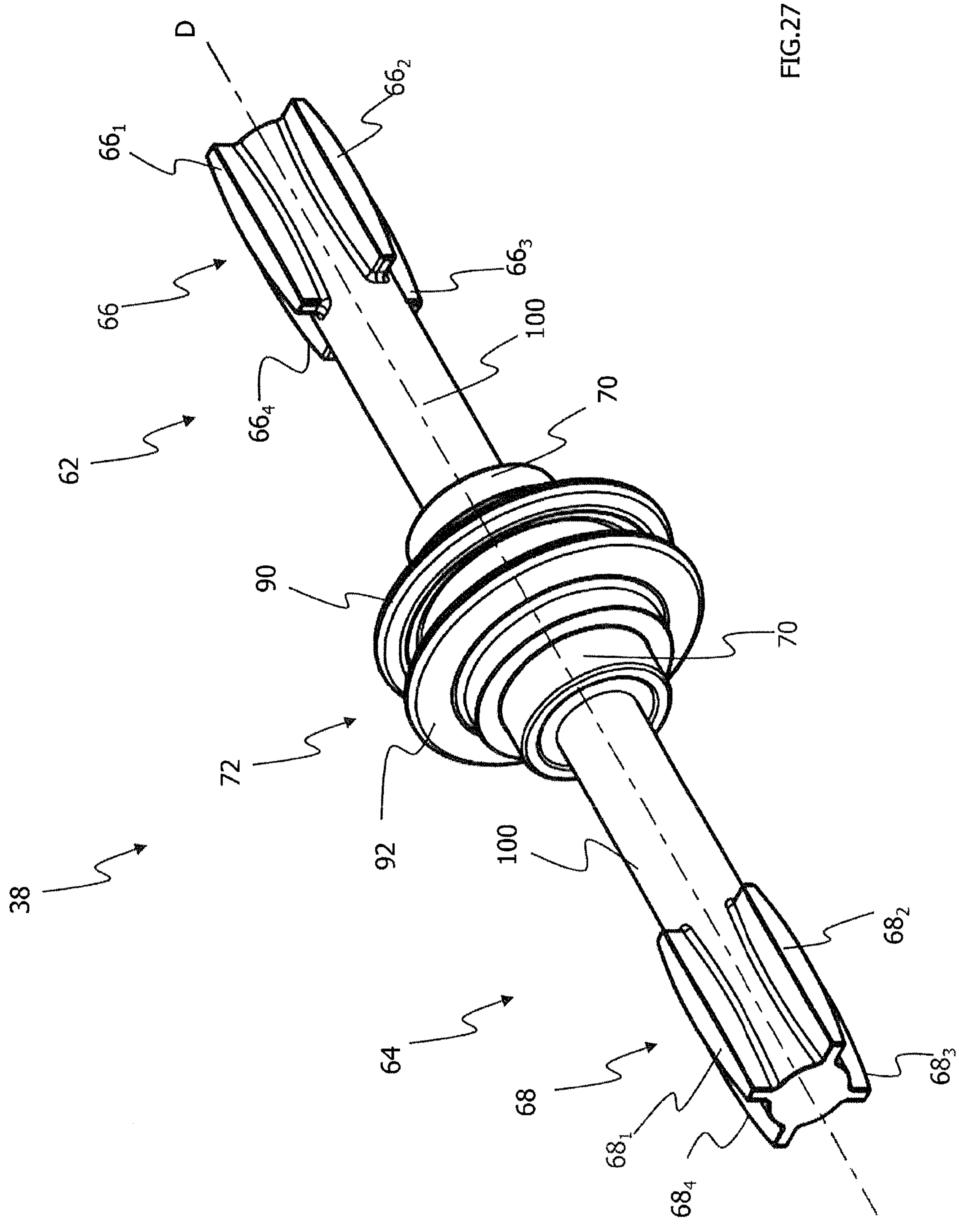
100
64
68
68_1
68_2
68_3
60
46
50
52
48
36
56

FIG.26


D
66_1
66_2
66_3
66_4
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100
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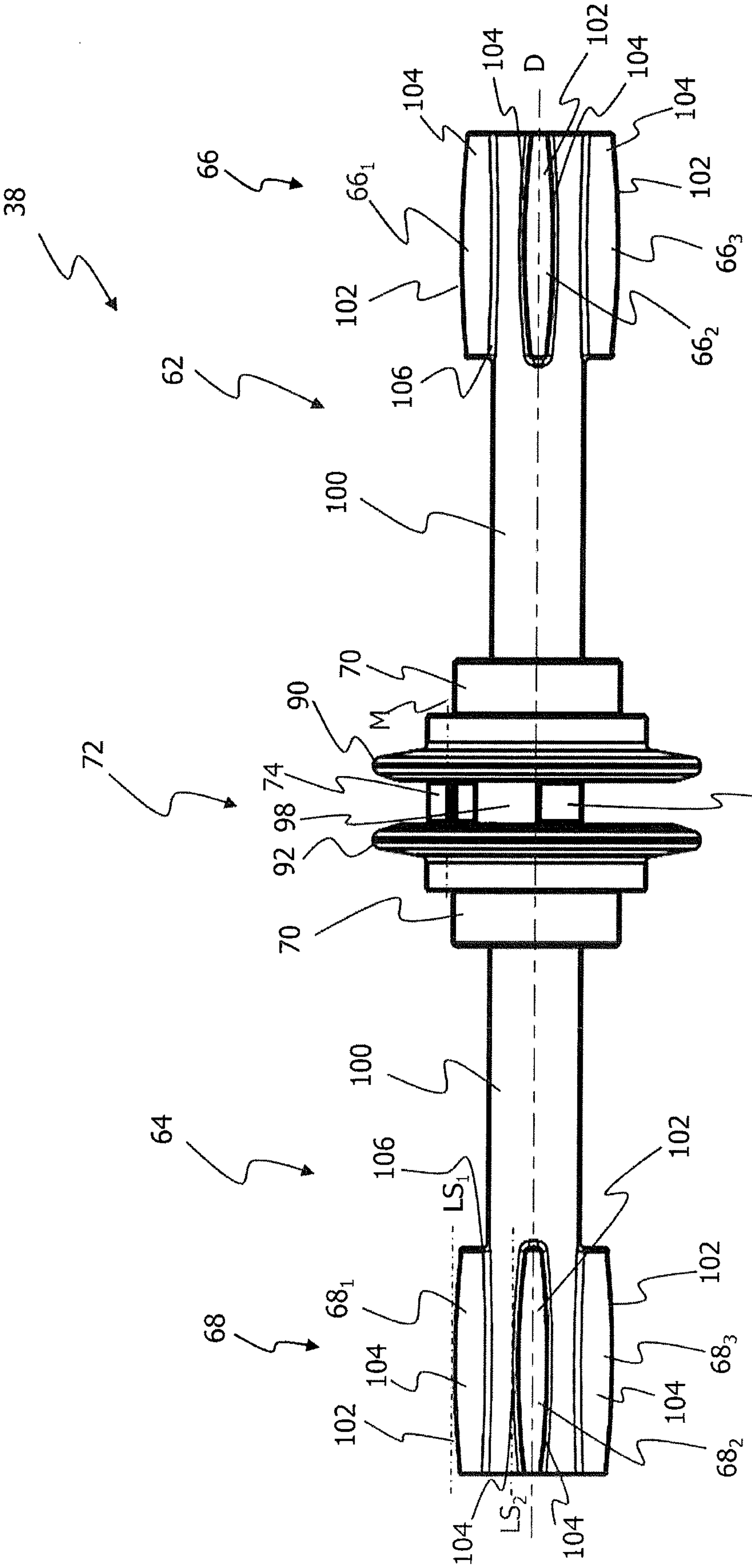
90
70
72
92
100
38
68_2
64
68
68_3
68_1
68_4

FIG.27


38
66
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104
D
102
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104
102
66_3
66_2
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106
62
100
70
M
90
72
74
98
92
94
70
100
64
106
LS_1
102
102
68_1
68
68_3
104
104
102
68_2
104
LS_2
104

FIG.28

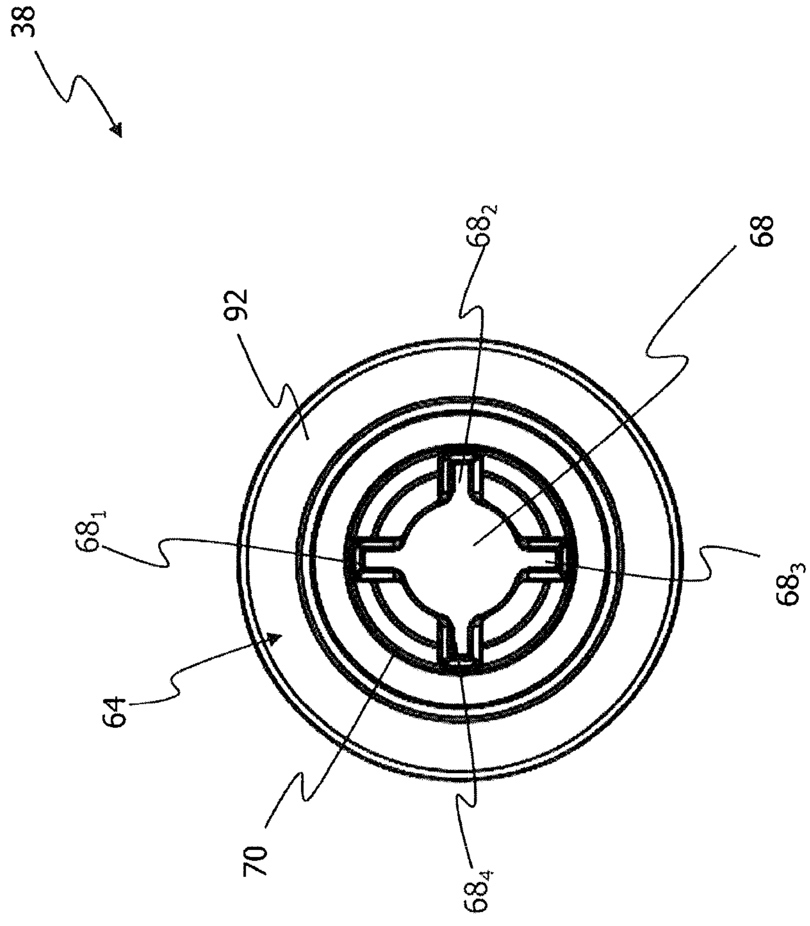
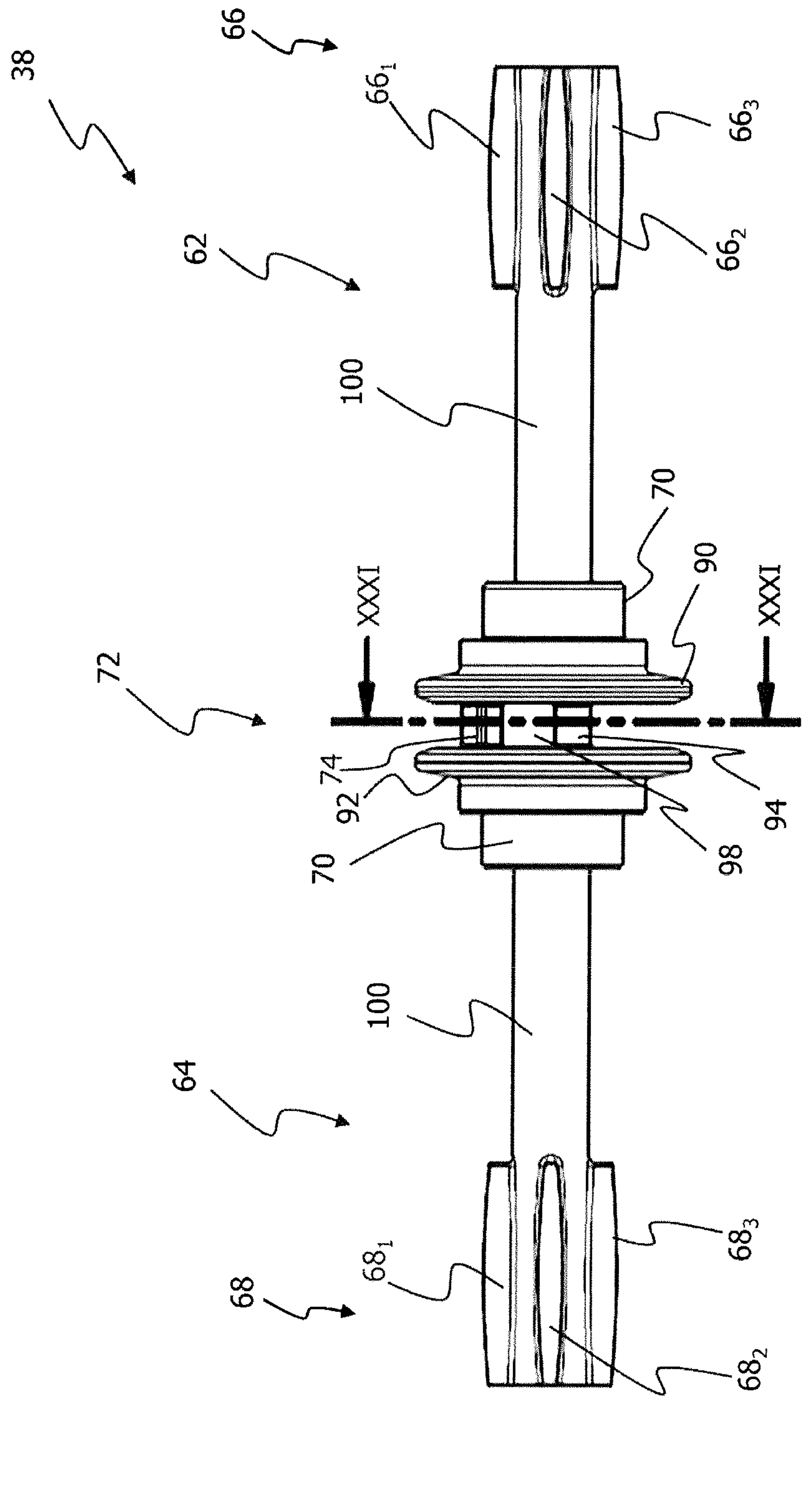


FIG.29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66_3
66_2
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100
70
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XXXI
XXXI
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74
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70
100
64
68_1
68_3
68
68_2

FIG.30

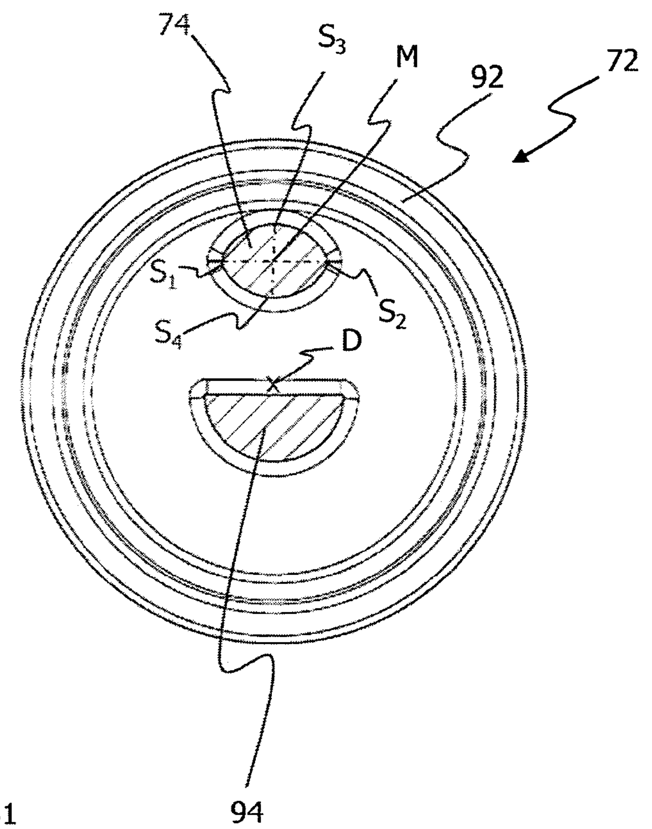


FIG.31

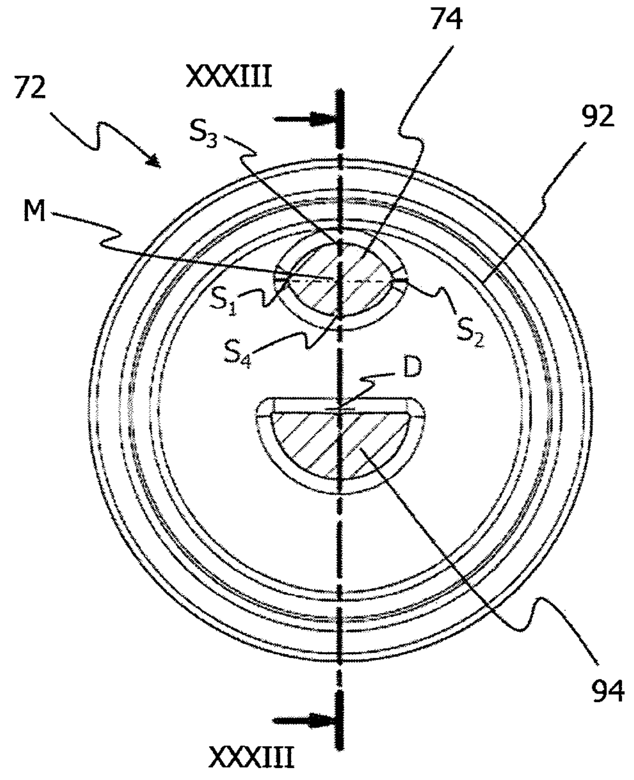


FIG.32

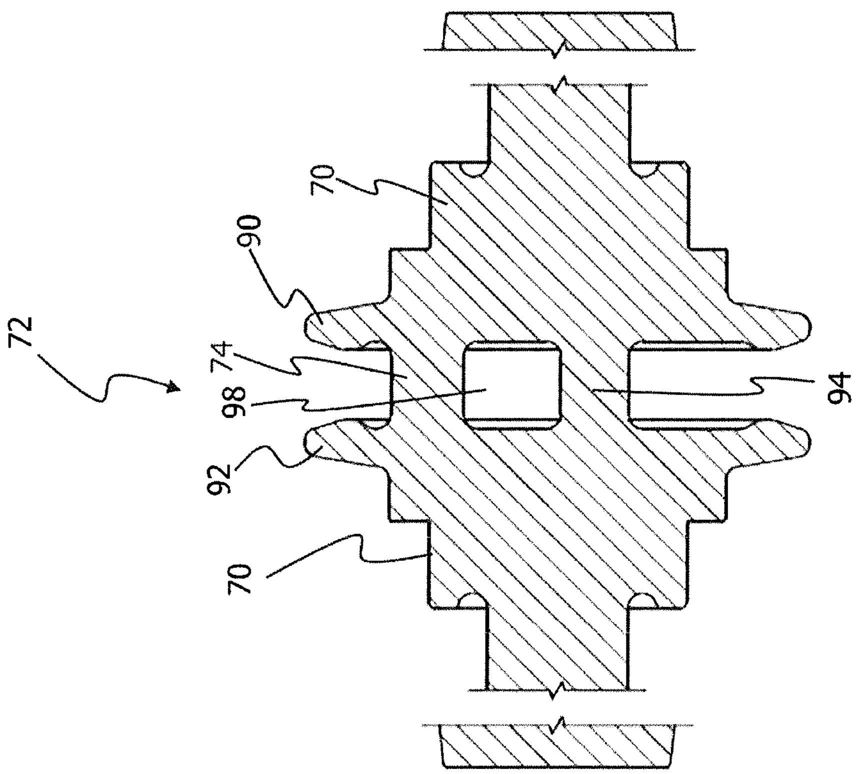


FIG.33

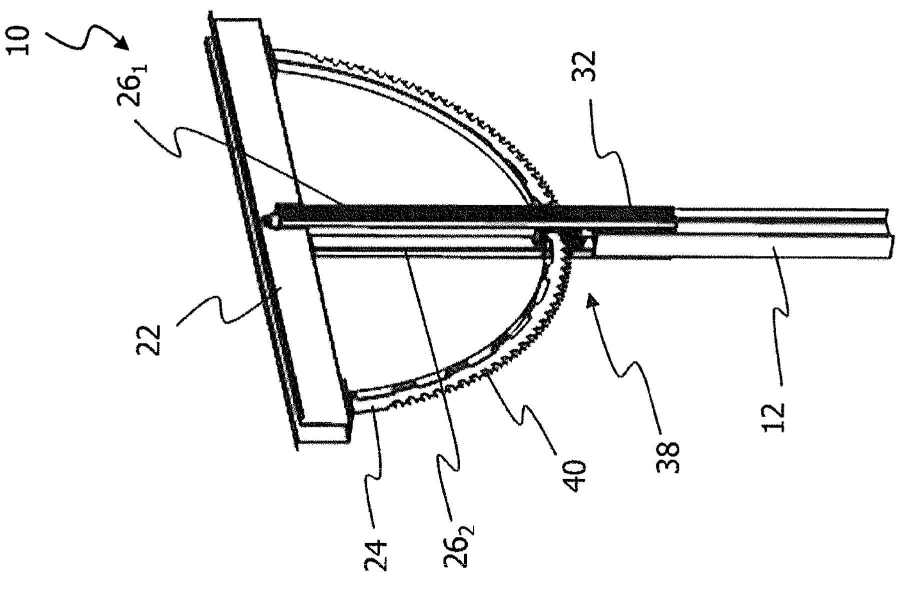


FIG.34

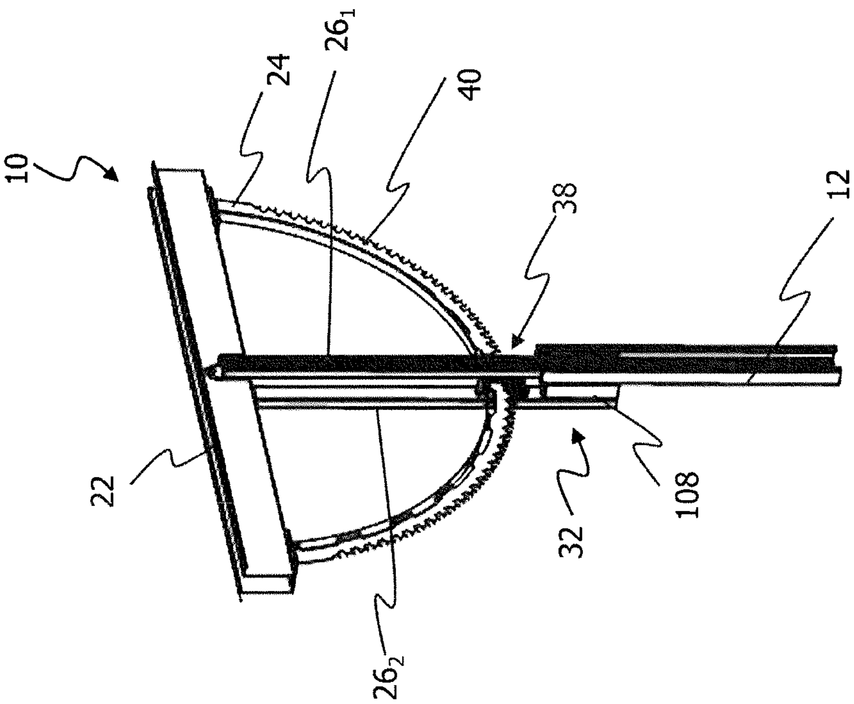
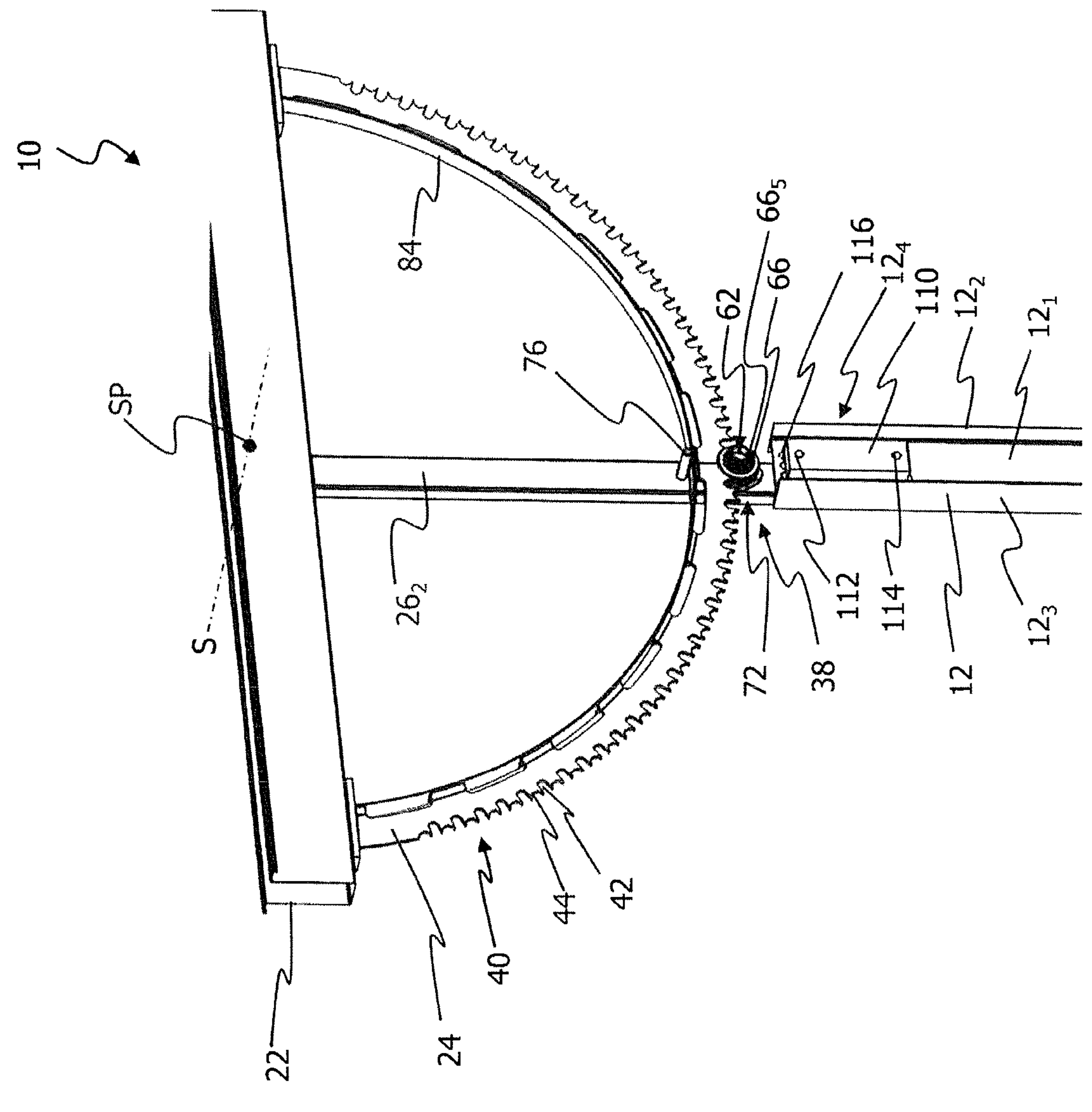


FIG.35


10
84
SP
76
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66
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116
12_4
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12_2
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26_2
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114
12_3
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38
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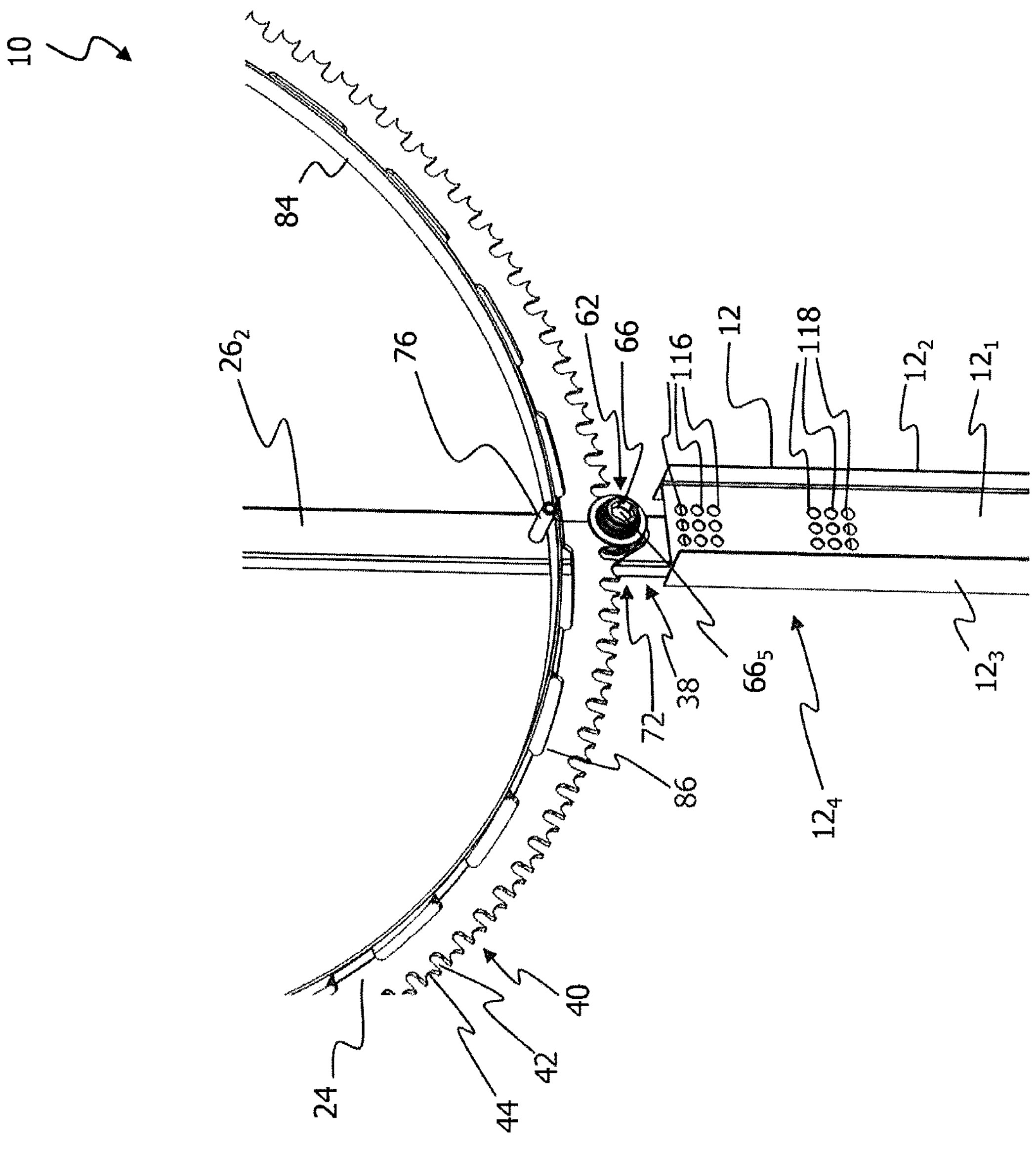
FIG.36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86
12_4
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42
44
24

FIG.37

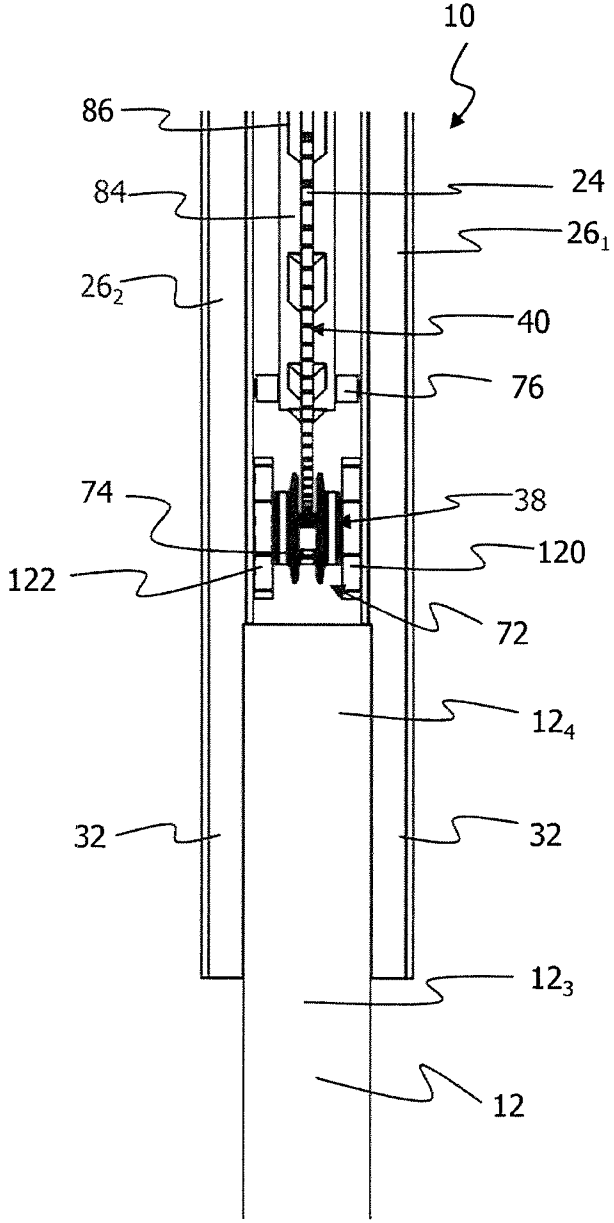

FIG.38

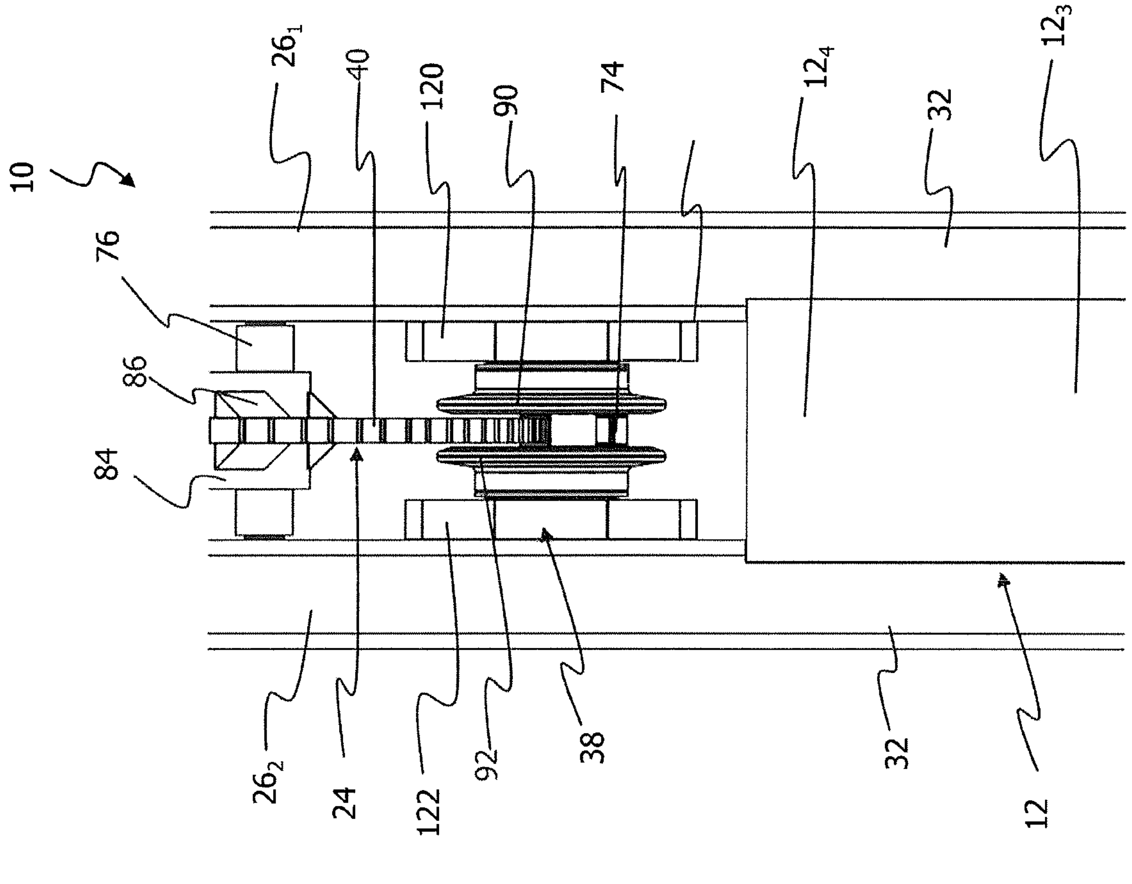

FIG.39

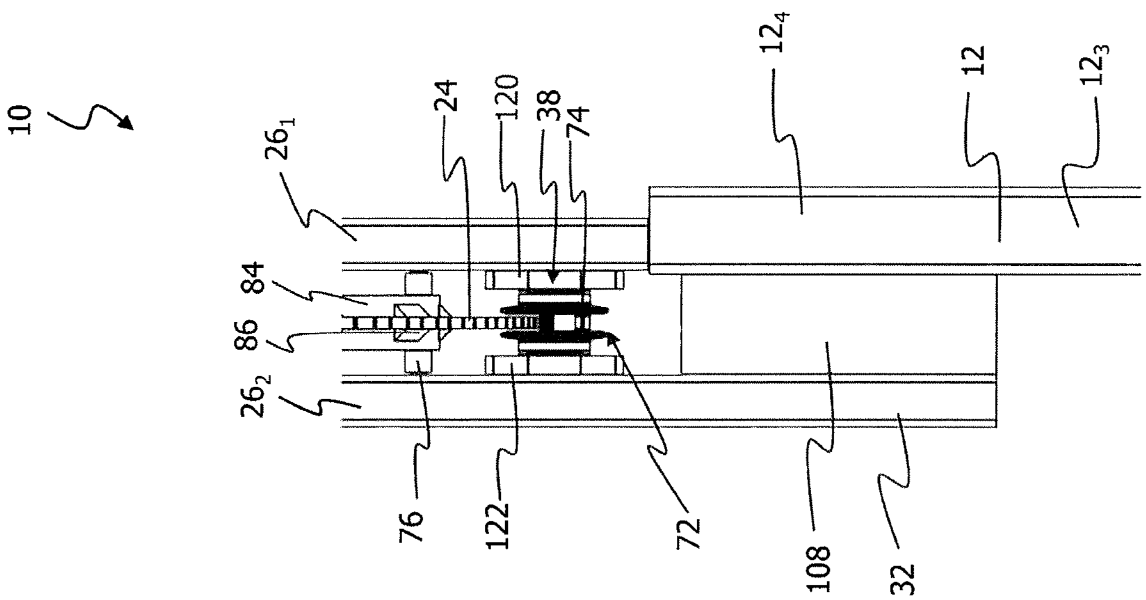

FIG.40

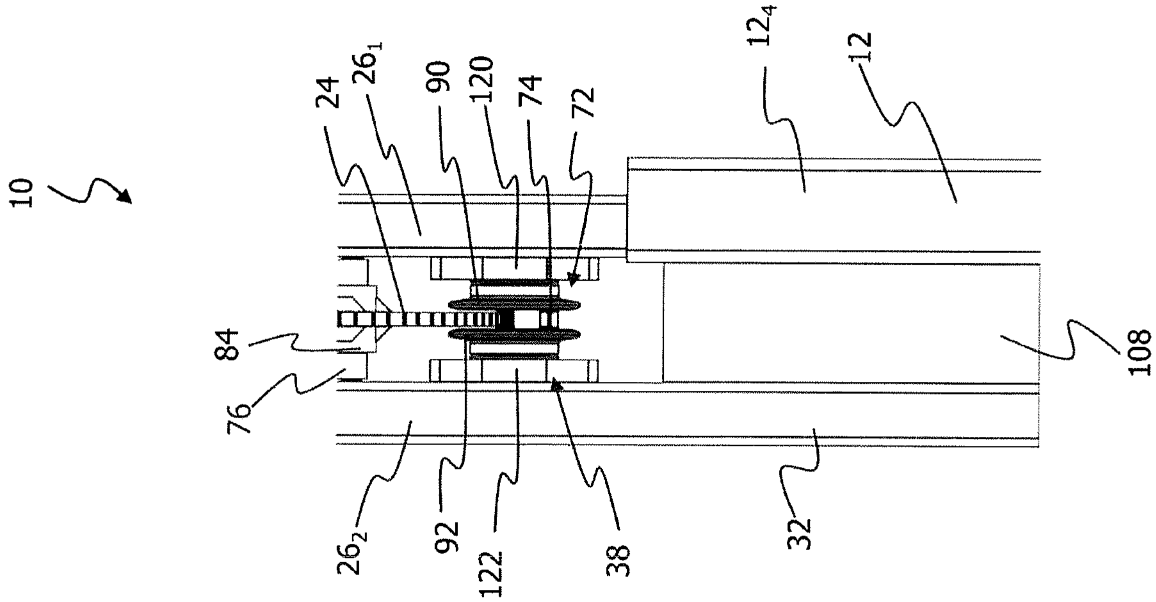

FIG.41

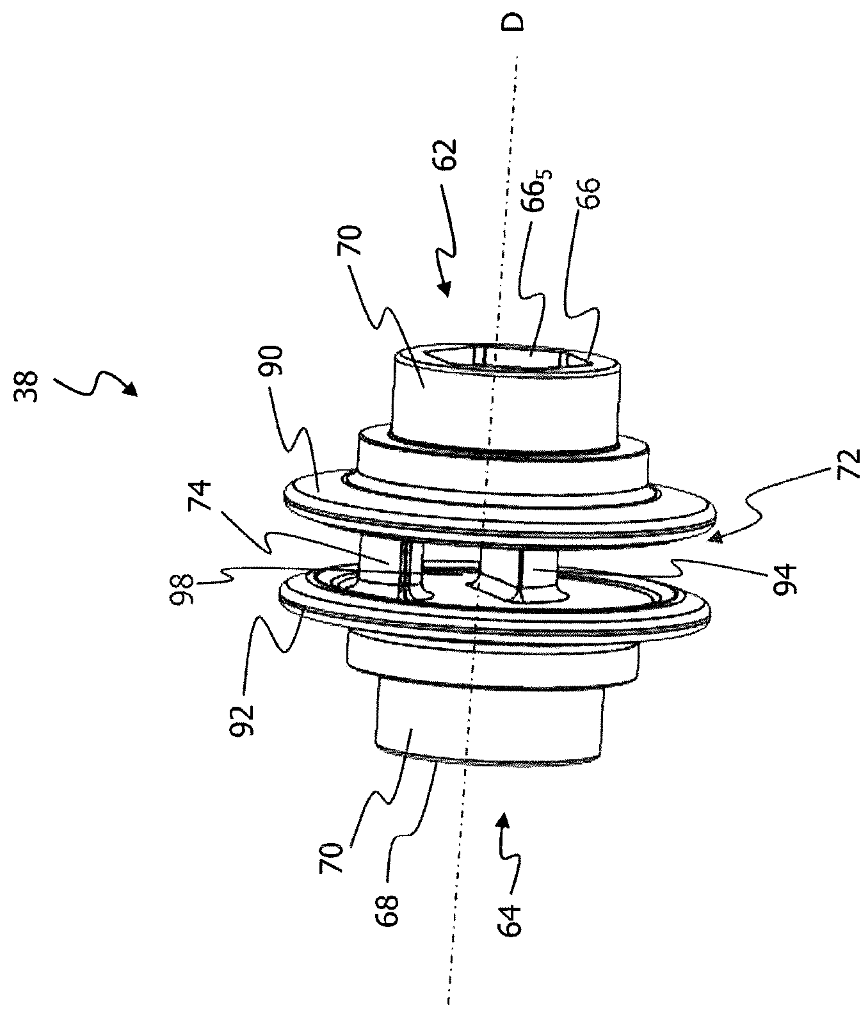

FIG.42