

Printed by Jouve, 75001 PARIS (FR)

Description

. Field of the invention

[0001] The present invention relates to an excavating assembly and an operating machine comprising this assembly.

[0002] In particular, the present invention relates to an assembly that comprises an excavating apparatus comprising an excavating tool, for example for forming trenches, or for removing layers of tarmac or the like.

. Prior art

[0003] It is known to use excavating devices that can be connected to excavators for making trenches or for removing layers of tarmac or the like.

[0004] However, when removing layers of tarmac, for example, it is quite common to come across manholes or drains arranged so that their frame and cover are preferably flush with the road surface or the operating surface.

[0005] Of course, the known excavating apparatus solutions have to interrupt the process of removing the tarmac layer and make it possible to remove the tarmac in the vicinity of the manhole.

[0006] If the manhole needs to be removed or replaced, circular milling cutters are known that are placed above the manhole and mill circularly with a rotary cutting motion around the manhole and with a depthwise traveling movement transversally to the operating surface until an annular groove has been dug that can remove the manhole.

[0007] Solutions of this type are known from US8011851, US8646847, US5522646, US4924951, US4458949, JP2668551, JP4794541, JP6322162, KR101771790, FR3034437, KR101614021, KR101454224, CN106498833, CN105544364, WO2013027754, EP1182299, EP0943735 and EP0796950, for example.

[0008] Conversely, when a hole needs to be made in the ground or the road surface, circular milling cutters are always used with a rotary cutting motion around the center of the hole that is intended to be made, and with a depthwise traveling movement transversally to the operating surface.

[0009] . Solutions of this type are known from the documents GB2489085, DE102010014711, EP2295642, EP1362954, US6536987 and US5470131, for example.

[0010] CN104594170 discloses a device for repairing paving. This device comprises a fixed part, a rotary part that is rotatably connected to the fixed part and rotates around the circumference of the fixed part. The rotary part is a disk cutter that oscillates around a fulcrum of the fixed part and is therefore always inclined with respect to the paving. When used, the device for repairing the paving is mounted so as to be held in an operating position with respect to the fixed part. The rotary part rotates

about an axis of the fixed part, or well-head, and the disk-shaped tool of the cutter part cuts the tarmac of the paving. This known device is only suitable for cutting along circular and converging paths, thus creating conical cuts.

This tool does not make it possible to mill a strip having a predefined width around the desired portion, for example the manhole, but only makes it possible to create a deep and inclined cut. Furthermore, this known device does not comprise a driven milling cutter, but requires a separate actuator and a complex transmission for transmitting the motion to the tool. Furthermore, this tool is permanently connected to the fixed structure, thereby preventing the use of the tool for other applications.

[0011] EP1048787 describes a method for repairing or replacing the road surface using a conical mill supported by a rotary arm such that it maintains its vertical axis. This known device is also only suitable for cutting along circular paths and creating conical cuts. This tool does not make it possible to mill a strip having a predefined width around the desired portion, for example the manhole, but only makes it possible to create a deep and inclined cut. Furthermore, this known device does not comprise a driven cutter, but requires a separate actuator and a complex transmission for transmitting the motion to the tool. Furthermore, this tool is permanently connected to the fixed structure, thereby preventing the use of the tool for other applications.

[0012] DE3319586 discloses a device for milling around the circular parts of road installations. This device is made up of a centering support that is inserted into the frame of a manhole. This centering device rotatably supports a frame that receives a tool that is powered by means of an external motor and a belt transmission. This known device does not comprise a driven milling cutter, but requires a separate actuator and a complex transmission for transmitting the motion to the tool. Furthermore, this tool is permanently connected to the fixed structure, thereby preventing the use of the tool for other applications, for example for milling along linear paths. Furthermore, this device requires an operator for rotating the rotary support structure around the manhole.

[0013] Therefore, there is a strong need to speed up the milling process, for example of a layer of the road surface when needing to maintain the manhole and only remove a layer of tarmac circularly arranged in the vicinity of said manhole.

[0014] Therefore, there is a strong need for a device that permits a cutting movement substantially in parallel with or tangentially with respect to the operating surface and a cutting path that travels in a circle around the manhole.

. Solutions

[0015] These and other objects are achieved by means of an assembly according to claim 1 and an operating machine according to claim 9 and a method for using the assembly according to claim 10.

[0016] A few advantageous embodiments form the subject matter of the dependent claims.

[0017] An analysis of this solution revealed how the assembly proposed makes it possible to considerably speed up the milling process, for example of a layer of the road surface when needing to preserve the manhole and only remove a layer of tarmac circularly arranged in the vicinity of said manhole.

[0018] Furthermore, the proposed solution makes it possible to use an excavating apparatus, which is used for excavating trenches or removing layers of the road surface, usually along rectilinear paths, and, using the same apparatus that is mounted in the assembly of the present invention, to obtain a cutting movement that is substantially parallel or tangential to the operating surface by rotating the cutting tool about its axis of rotation that is parallel to the operating surface, and a cutting path that travels in a circle around the manhole.

[0019] On account of this solution, it is possible to have a high cutting speed and small advancements of the tool, thereby ensuring a more accurate cut finish and longer life of the cutting tool, or faster cutting speeds and therefore limited stress on the cutting tool despite a faster traveling speed.

[0020] On account of the proposed solution, it is possible to carry out a circular milling process around the manhole using the same apparatus used to mill the road surface with a linear traveling path.

[0021] On account of the example of the use of a drum excavating tool, it is possible to carry out milling processes having a larger width around the manhole, making it considerably easier to mill the road surface, avoiding accidentally colliding with the pricks of the milling cutter on the metal of the manhole.

. Drawings

[0022] Additional features and the advantages of the invention will become clear from the description given below of preferred embodiments thereof, given by way of non-limiting example and with reference to the attached drawings, in which:

- Fig. 1 is an axonometric view of an excavating apparatus for a milling cutter comprising an excavating tool having a rotary drum;
- Fig. 2 is an axonometric view of the apparatus in Fig. 1 from the opposite side to that in Fig. 1 and with the walls that make up the self-leveling body transparent to show the sliding guides of the apparatus body;
- Fig. 3 is an axonometric view of the apparatus in Fig. 1 illustrating the drum of the excavating tool, the apparatus body comprising the device for adjusting the milling depth and the self-leveling body of the abutment sliding blocks on the operating surface as separate parts;
- Fig. 4 is a lateral view of the apparatus in Fig. 1 in which a key or a U-shaped adjustment tool that can

be connected to the adjustment device is also shown;

- Fig. 5 is a sectional view of the apparatus in Fig. 4 along the plane VIII-VIII indicated therein;
- Fig. 6 is a lateral view of an operating machine, in particular an excavator or a loader, comprising a movable operating machine arm to which an excavating assembly is connected, which comprises a rotary support to which an excavating apparatus that operates around a manhole is fastened;
- Fig. 7 is a lateral view of a detail of the operating machine in Fig. 6, in which the excavating assembly is in a rotated operating position around the manhole;
- Fig. 8 is a lateral view of the operating machine in Fig. 6, which operates around a manhole having different dimensions, showing the possible adjustment on the rotary support of the radius of the circular or curvilinear excavating path;
- Fig. 9 is a plan view of a detail of the operating machine, in which the assembly is shown in two different positions during the circular excavating path, showing the excavating width obtainable using an excavating apparatus having a drum excavating tool;
- Fig. 10 and 11 show two portions of the excavating assembly that are transverse to the axis of rotation of the rotary support, showing two possible adjustments to the assembly that allow for different radii of curvature of the curvilinear traveling path;
- Fig. 12 shows an excavating assembly during a procedure of dismounting the excavating apparatus from the rotary support in order to separately use the excavating apparatus as a milling cutter that cuts along a linear traveling path;
- Fig. 13 shows an operating machine, in particular an excavator, to the movable arm of which the excavating apparatus in Fig. 12 is connected and which carries out a milling process, for removing a layer of soil or tarmac, having a linear traveling path;
- Fig. 14 is an axonometric view of an excavating assembly comprising an excavating apparatus and a rotary support as separate parts;
- Fig. 15 shows a portion that is transverse to the axis of rotation of the rotary support of a driving device for rotating the rotary support;
- Fig. 16 is an axonometric view of an excavating assembly comprising an excavating apparatus and a rotary support according to another embodiment as separate parts; and
- Fig. 17 is a lateral view of the operating machine, here a loader, which operates around a manhole having different dimensions, showing the possible adjustment on the rotary support of the radius of the circular or curvilinear excavating path.

. Description of preferred embodiments

[0023] With reference to figures 1 to 4, reference numeral 1 indicates, as a whole, an apparatus for an oper-

ating machine.

[0024] In accordance with one embodiment, this apparatus is a trench-digging apparatus.

[0025] In accordance with one embodiment, this apparatus is a milling apparatus.

[0026] This excavating apparatus 1 comprises an apparatus body 2, a rotary excavating tool 8 and a self-leveling body 10.

[0027] In accordance with one embodiment, the excavating tool 8 is in the form of a wheel or disk.

[0028] In accordance with one embodiment, the excavating tool 8 is in the form of a roller or cylinder.

[0029] In accordance with one embodiment, the excavating tool 8 comprises a plurality of peripheral excavating elements 54, for example oriented in a direction that is tangential to an axis of rotation R of said tool.

[0030] It should be pointed out that, unless specified otherwise, the terms "axial," "radial" or "tangential" will always refer to the axis of rotation R.

[0031] The apparatus body 2 comprises a portion 4 for coupling it to the operating machine and delimits a first body compartment 6, in which the excavating tool 8 of the apparatus 1 is housed in part.

[0032] In accordance with one embodiment, the first body compartment 6 comprises a circular sector-shaped cross section in a plane that is orthogonal to the axis of rotation R.

[0033] In accordance with one embodiment, the coupling portion 4 comprises a fastening plate 56 through which a plurality of fastening holes 58 pass in order to lock the apparatus 1 to the operating machine, for example to a movable arm or to a movable arm support.

[0034] The self-leveling body 10 comprises a pair of abutment sliding blocks 12, 14 having an operating surface Z.

[0035] In the embodiment shown, the position of the abutment sliding blocks 12, 14 with respect to the excavating tool 8 can be adjusted in a mutually dependent manner, for which the spacing between these sliding blocks and the excavating surface can be the same for both sliding blocks. For example, this adjustment could be carried out by means of a single depth adjustment device 24.

[0036] In accordance with one embodiment, the position of the abutment sliding blocks 12, 14 with respect to the excavating tool 8 can be independently adjusted, and so the spacing between each sliding block and the excavating surface can be selected in an autonomous manner. For example, this adjustment could be carried out by means of a pair of adjustment devices 24 advantageously acting in parallel with one another.

[0037] In accordance with this variant, the apparatus 1 could advantageously comprise a device 24 for adjusting the excavating depth X - as described above - for each abutment sliding block 12, 14.

[0038] It follows that this variant advantageously provides that the transverse walls 16, 18 can be detached from one another such that each of said walls can assume

a different position with respect to the apparatus body 2, for example each wall assumes a different position by means of its own adjustment device 24, and therefore such that an abutment sliding block 12, 14 can be adjusted separately from the other sliding block.

[0039] In accordance with this variant, the apparatus 1 could advantageously not comprise the longitudinal walls 20, 22 that connect the transverse walls.

[0040] The self-leveling body 10 is mounted so as to be rotationally idle with respect to the apparatus body 2 such that the coupling portion 4 can assume different angular positions - with reference to an axis of rotation that is substantially parallel to or coincides with the axis R - with respect to the abutment sliding blocks 12, 14.

[0041] This freedom of movement is effectively illustrated by the coupling portion being respectively rotated to the left (into a first angular position) or to the right (into a second angular position), irrespective of the position of the tool and of the excavating depth thereof.

[0042] It follows that the excavating apparatus 11 is designed so that the abutment sliding blocks 12, 14 are always in contact with the operating surface Z, irrespective of the angular position of the coupling portion 4 (and of the arm or support of the operating machine connected thereto), specifically so that the excavating depth X remains constant or unchanged for a specific excavating procedure by the excavating tool 8.

[0043] In accordance with one embodiment, the self-leveling body 10 and the apparatus body 2 can therefore rotate in parallel with the axis of rotation R.

[0044] In accordance with one embodiment, the self-leveling body 10 is guided by the apparatus body 2 into the different angular positions by means of guide means that cooperate between these bodies 10, 2.

[0045] In accordance with one embodiment, the guide means comprise at least one side of a guide slot 64 in which at least one guide pin 66 slidably engages.

[0046] In accordance with one embodiment, the self-leveling body 10 comprises at least one pair of transverse walls 16, 18 that are axially offset along the axis of rotation R and are rigidly connected by means of a pair of longitudinal walls 20, 22 of this body 10 in order to delimit a housing structure that houses the excavating tool 8 such that it protrudes from the front of the abutment sliding blocks 12, 14.

[0047] In accordance with one embodiment, the self-leveling body 10 comprises at least one pair of transverse walls 16, 18 (or only comprises these walls) that are axially offset along the axis of rotation R and are slidably connected to the apparatus body 2. In this variant, the pair of transverse walls 16, 18 axially receives the excavating tool 8 such that it protrudes from the front of the abutment sliding blocks 12, 14.

[0048] In this way, this excavating tool 8 can remove or excavate a solid material starting from the operating surface Z, for example vertically downwards according to the orientation in the drawings.

[0049] This apparatus 1 can therefore move in an op-

erating direction W by virtue of the sliding contact between the abutment sliding blocks 12, 14 and the operating surface Z.

[0050] In accordance with one embodiment, the abutment sliding blocks 12, 14 are arranged at the side of the excavating tool 8.

[0051] In accordance with one embodiment, the abutment sliding blocks 12, 14 are formed by folded metal sheets.

[0052] In accordance with one embodiment, the abutment sliding blocks 12, 14 are formed in one piece with a particular transverse wall 16, 18.

[0053] In accordance with one embodiment, one or more transverse walls 16, 18 and/or one or more longitudinal walls 20, 22 are substantially planar.

[0054] In accordance with one embodiment, the transverse walls 16, 18 and the longitudinal walls 20, 22 are connected at right angles.

[0055] In accordance with one embodiment, the transverse walls 16, 18 and the longitudinal walls 20, 22 delimit a second body compartment 60.

[0056] In accordance with one embodiment, at least part of the apparatus body 2 is held between the transverse walls 16, 18 and the longitudinal walls 20, 22, in particular in the second body compartment 60.

[0057] In accordance with one embodiment, at least one longitudinal wall 20, 22 comprises structural stiffening means formed in one piece with this wall 20, 22.

[0058] In accordance with one embodiment, the stiffening means are formed as a folded portion 24 (in particular folded in the radial direction) of a sheet that forms at least part of this wall.

[0059] In accordance with one embodiment, the second body compartment 60 comprises a substantially square or rectangular cross section parallel to the operating surface Z.

[0060] In accordance with one embodiment, the transverse walls 16, 18 and the longitudinal walls 20, 22 are monolithically fastened to one another, for example welded or joined by mechanical locking means.

[0061] In accordance with one embodiment, the transverse walls 16, 18 and the longitudinal walls 20, 22 are joined by welding.

[0062] In accordance with one embodiment, the transverse walls 16, 18 and the longitudinal walls 20, 22 are joined by mechanical locking means, for example threaded means.

[0063] In accordance with one embodiment, one or both of the longitudinal walls 20, 22 could axially protrude with respect to the transverse walls 16, 18.

[0064] In accordance with one embodiment, at least one transverse wall 16, 18 (for example: both) could comprise at least one axial protrusion 62 (for example a pair of opposite protrusions 62) for coupling to one or to both of the transverse walls 16, 18.

[0065] In accordance with one embodiment, one or more axial protrusions 62 could engage in the mechanical means between the transverse walls 16, 18 and the

longitudinal walls 20, 22.

[0066] In accordance with one embodiment, the apparatus body 2 is mechanically connected to the self-leveling body 10 so as to weigh down on the transverse walls 16, 18 and on the abutment sliding blocks 12, 14 in a balanced manner.

[0067] In accordance with one embodiment, the apparatus body 2 is connected to the self-leveling body 10 by means of at least one device 24 for adjusting the excavating depth X of the apparatus 1.

[0068] The function of the adjustment device 24 according to this variant is therefore to modify or adjust the degree to which the excavating tool 8 protrudes with respect to the abutment sliding blocks 12, 14, and therefore to adjust the excavating depth.

[0069] It should be pointed out that the adjustment device 24 is actuated (for example by means of the key or the adjustment tool U, or pneumatically, hydraulically or mechanically) in order to establish the excavating depth X.

[0070] Nevertheless, after the desired excavating depth has been set (that is after the minimum or maximum degree to which the excavating tool 8 protrudes from the front with respect to the abutment sliding blocks 12, 14 has been set), this device 24 keeps this adjustment or setting constant or unchanged for the entire excavating procedure.

[0071] In accordance with one embodiment, the adjustment device 24 comprises adjustment elements 26, 28 that symmetrically act on the transverse walls 16, 18.

[0072] In accordance with one embodiment, the adjustment elements 26, 28 comprise one or more first radial levers 68.

[0073] In accordance with one embodiment, the adjustment elements 26, 28 are connected to one or more movable adjustment shafts 30 for both these elements 26, 28 in a synchronized manner.

[0074] In accordance with one embodiment, just one adjustment shaft 30 is provided, to which the adjustment elements 26, 28 are associated or joined.

[0075] In accordance with one embodiment, a pair of first radial levers 68 could be associated with or joined to axial ends of the adjustment shaft 30, in particular so as to be integral with this shaft for conjoint rotation therewith.

[0076] In accordance with one embodiment, at least one guide pin 66 could be fastened to a free end of a first radial lever 68.

[0077] In accordance with one embodiment, the transverse walls 16, 18 and the apparatus body 2 comprise means 36 for guiding the excavating tool 8 into different positions for adjusting the excavating depth X thereof.

[0078] The adjustment positions are arranged in an adjustment direction D shown schematically by the double-headed arrow in Fig. 1.

[0079] In accordance with one embodiment, the guide means 36 comprise a pair of lateral guides 38, 40 that are associated with the transverse walls 16, 18 (or with

the apparatus body) and delimit a sliding space 42 therebetween, and a sliding member 44 that is associated with the apparatus body 2 (or with the transverse walls) and is slidingly received, at least in part, in the sliding space 42.

[0080] In accordance with one embodiment, the sliding member 44 is connected to the apparatus body 2.

[0081] In accordance with one embodiment, the sliding member 44 is substantially annular.

[0082] In accordance with one embodiment, an outer annular surface 46 of the sliding member 44 abuts the lateral guides.

[0083] In accordance with one embodiment, an inner annular surface 48 of the sliding member 44 forms a rotational guide for the excavating tool 8.

[0084] In accordance with one embodiment, the adjustment device 24 comprises a first actuator 50 (for example a linear or rotational actuator) acting by pushing or pulling between the apparatus body 2 and the self-leveling body 10, to be specific in a tangential direction S with respect to a circumference that is centered on the axis of rotation R.

[0085] In accordance with one embodiment, a first portion 70 of the first actuator 50 is fastened to the apparatus body 2 and a second portion 72 is fastened to the self-leveling body 10, advantageously in an articulated fashion in these portions 70, 72.

[0086] In accordance with one embodiment, the first actuator 50 is mechanically connected to one or more adjustment shafts 30, for example by means of a second radial lever 74.

[0087] In accordance with one embodiment, the second radial lever 74 is integral with one or more adjustment shafts 30 for conjoint rotation therewith, and is hinged to a radial end of the first actuator 50.

[0088] In this way, after a force has been exerted by the actuator 50 - for example after the opposite ends thereof have moved closer to or away from one another - this actuator 50 will rotate the radial lever 74 in a direction that causes the self-leveling body 10 to raise or lower with respect to the apparatus body 2 (by virtue of the sliding motion of the guide pin 66 along the slot 64), and therefore a corresponding movement of the excavating tool 8.

[0089] This type of adjustment device 24 has been discussed purely by way of example. Other ways of adjusting the excavating depth are possible in accordance with other embodiments.

[0090] In accordance with one embodiment, the excavating tool 8 can be rotated with respect to the apparatus body 2 by means of a driving excavating motor or motor excavating means or drive motor 52.

[0091] In accordance with one embodiment, the drive motor 52 are hydraulic drive motor.

[0092] In accordance with one embodiment, the drive motor 52 engage with, and can move integrally with, the excavating tool 8 in the different positions for adjusting the excavating depth X.

[0093] The above-mentioned aims are also achieved by an excavating assembly comprising an operating machine and an excavating apparatus 1 according to any one of the embodiments illustrated above, which is fastened to a movable arm or to a support of the operating machine.

[0094] In accordance with one embodiment, the operating machine 10 could comprise a fluidic power take-off for supplying the hydraulic drive means 40.

[0095] The apparatus and the assembly of the present invention are suitable for successfully overcoming the problems reported above.

[0096] More specifically, the apparatus described makes it possible to ensure a greater degree of solidity over time with respect to the traditional apparatuses.

[0097] The apparatus and the assembly of the present invention advantageously make it possible to reduce or eliminate the bending forces acting on the body that said apparatus and assembly consist of.

[0098] Advantageously, the apparatus of the present invention allows it to be operated using a smaller number of levers or controllers compared with the traditional apparatuses.

[0099] The apparatus of the present invention is advantageously constructed in a reasonable manner.

[0100] In accordance with a general embodiment, an excavating assembly 100 comprises at least one excavating apparatus 1 suitable for use directly connected to an operating machine 106 for digging trenches or removing layers of tarmac along linear traveling paths, too, in an operating surface Z.

[0101] Said excavating apparatus 1 comprises an excavating tool 8.

[0102] Said excavating tool 8 comprises an excavating tool axis of rotation R that is substantially parallel to the operating surface Z.

[0103] Said excavating apparatus 1 comprises a driving excavating motor or driving motor 52 that actuate, and can move integrally with, the excavating tool 8.

[0104] Said assembly 100 also comprises a rotary support 101.

[0105] Said rotary support 101 comprises an excavator attachment saddle support 102 that can be connected to an excavator attachment saddle 125 of an operating machine 106, for example an excavator having a movable excavator arm 103 or a loader 128.

[0106] Said rotary support 101 comprises a lower framework 104.

[0107] Said lower framework 104 is rotatably connected to said excavator attachment saddle support 102 so as to rotate about a rotary support axis of rotation V that is substantially perpendicular to said operating surface Z.

[0108] Said rotary support 101 comprises a driving motor 105 for rotating the support or support motor, which can also be realized as a rotary joint that is hydraulically or electrically driven, which actuates, and can move integrally with, the excavator attachment saddle support 102, and drives the rotational movement of said lower

framework 104.

[0109] Said excavating apparatus 1 is detachably connected to said lower framework 104 such that, by rotating said lower framework 104 with respect to said attachment saddle support 102, said excavating tool 8 travels along a circular path.

[0110] In accordance with one embodiment, said attachment saddle support 102 supports a rotary case or support housing for the support motor 107 such that it is integral with said case or housing.

[0111] Said motor for rotating the rotary support or support motor 105, for example a hydraulic motor, for example an orbital motor or an electric motor, is operatively connected to a shaft by means of an endless screw or rotary support endless screw 108 that is connected to said support housing for the support motor 107 so as to turn freely.

[0112] Said lower framework 104 integrally supports a rotational gear or cogwheel 109.

[0113] Said cogwheel 109 engages with said rotary support endless screw 108, thereby allowing said lower framework 104 to rotate when said rotary support endless screw 108 rotates.

[0114] In accordance with one embodiment, said attachment saddle support 102 supports a leg or support column 110.

[0115] Said support column 110 juts out towards said operating surface Z and telescopically receives a centering device 111 or a support foot of the rotary support 112 that rests on said operating surface Z or on a manhole 113, around which a circular operation is intended to be carried out.

[0116] In accordance with one embodiment, said centering device 111 comprises a manhole center adjusting instrument 127 that can be connected to a frame 114 of a manhole 113 and comprises self-centering telescopic arms 115 that can automatically center said support column 110 with respect to said manhole frame 114. Said support column 110 is connected to said manhole center adjusting instrument 127 by means of a centering pin 126.

[0117] In accordance with one embodiment, said rotary support 101 comprises a sliding element 116.

[0118] Said sliding element 116 is slidably connected to said lower framework 104 and said excavating apparatus 1 is connected to said sliding element 116.

[0119] In accordance with one embodiment, said sliding element 116 comprises sliding guides 117.

[0120] Said lower framework 104 comprises support sliding blocks 118 that slidably engage in said sliding guides 117.

[0121] In accordance with one embodiment, an element for adjusting the milling radius 119 is provided between said lower framework 104 and said sliding element 116.

[0122] In accordance with one embodiment, said lower framework 104 comprises a lower framework endless screw 120 and said sliding element 116 comprises a nut

121 that receives said endless screw 120 by engaging therewith in order to adjust the position of said sliding element 116 with respect to said lower framework 104 by rotating said endless screw 120, thereby making it possible to adjust the radius of curvature RC of a curvilinear traveling path P of said excavating tool 8.

[0123] In accordance with one embodiment, said endless screw 120 comprises an attachment for an endless screw manual controller 122 or control lever or key or adjustment tool U.

[0124] In accordance with one embodiment, a drive is connected to said endless screw 120.

[0125] In accordance with one embodiment, an endless screw drive engages with, and can move integrally with, the lower framework 104 and initiates the rotational movement of said endless screw 120.

[0126] In accordance with one embodiment, said rotary support 101 comprises a milling cutter attachment 123.

[0127] Said milling cutter attachment 123 is connected to said sliding element 116 so as to oscillate.

[0128] In accordance with one embodiment, said rotary support 101 comprises devices for actuating the milling cutter attachment or resilient and damping devices 124.

[0129] Said devices for actuating the milling cutter attachment or resilient and damping devices 124 connect said milling cutter attachment 123 to said sliding element 116 in an adjustable manner so as to modify oscillation axis of rotation R of the excavating tool 8 or to dampen the vibrations caused by said excavating tool 8.

[0130] In accordance with one embodiment, said excavating apparatus 1 is a self-leveling apparatus.

[0131] In accordance with one embodiment, the excavating tool 8 is in the form of a wheel or disk.

[0132] In accordance with one embodiment, the excavating tool 8 is in the form of a roller or cylinder.

[0133] In accordance with one embodiment, the excavating tool 8 comprises a plurality of peripheral sharp elements or cutting edges or excavating elements 54.

[0134] In accordance with one embodiment, said plurality of sharp elements or cutting edges or excavating elements 54 are oriented in a direction that is tangential to an axis of rotation R of this tool 8.

[0135] In accordance with one embodiment, said excavating apparatus 1 comprises an excavating tool 8 that carries out a cutting movement that is substantially parallel or tangential to the operating surface Z by means of a rotational movement of the cutting tool 8 about its axis of rotation R that is parallel to the operating surface Z.

[0136] Said rotary support 101 allows for a rotational movement of the excavating apparatus 1 along a cutting path that travels in a circle.

[0137] The present invention also relates to an operating machine 106 comprising an excavating assembly 100 according to any one of the embodiments described above.

[0138] In accordance with one embodiment, said operating machine 106 comprises at least one fluidic power take-off for supplying hydraulic drive motor 52 in order

to move a cutting tool 8.

[0139] In accordance with one embodiment, said operating machine 106 comprises at least one electrical power take-off for supplying power to electric drive motor 52 in order to move a cutting tool 8.

[0140] In accordance with one embodiment, said operating machine 10 comprises at least one fluidic power take-off for supplying power to a hydraulic support motor 105 in order to initiate the rotational movement of a rotary support 101.

[0141] In accordance with one embodiment, said operating machine 10 comprises at least one electrical power take-off for supplying power to an electric motor for rotating the rotary support 105 in order to initiate the rotational movement of a rotary support 101.

[0142] In order to meet contingent and specific requirements, an expert in the field could make several modifications and adaptations to the embodiments described above and could substitute elements with other functionally equivalent elements, without, however, departing from the scope of the following claims.

[0143] Furthermore, each variant described as belonging to a possible embodiment can be instrumented independently of the other variants described.

LIST OF REFERENCE SIGNS

[0144]

1	excavating apparatus
2	apparatus body
4	coupling portion
6	first body compartment
8	excavating tool
10	self-leveling body
12	abutment sliding block
14	abutment sliding block
16	transverse wall
18	transverse wall
20	longitudinal wall
22	longitudinal wall
24	adjustment device
26	adjustment element
28	adjustment element
30	adjustment shaft
32	mechanical locking means
34	folded portion
36	guide means
38	lateral guide
40	lateral guide
42	sliding space
44	sliding member
46	outer annular surface
48	inner annular surface
50	first actuator
52	driving excavating motor or motor excavating means
54	excavating element

56	fastening plate
58	fastening hole
60	second body compartment
62	axial protrusion
5	64 guide slot
	66 guide pin
	68 first radial lever
	70 first portion
	72 second portion
10	74 second radial lever
	100 assembly
	101 rotary support
	102 excavator attachment saddle support
	103 movable arm of an operating machine or excavator
15	104 lower framework
	105 driving motor for rotating the support or support motor
	106 operating machine
20	107 support housing for the support motor
	108 rotary support endless screw
	109 rotational gear or cogwheel
	110 support column
	111 centering device
25	112 support foot of the rotary support
	113 manhole
	114 manhole frame
	115 self-centering telescopic arms
	116 sliding element
30	117 sliding guides
	118 support sliding block
	119 element for adjusting the milling radius
	120 lower framework endless screw
	121 nut
35	122 manual controller for the endless screw or control lever
	123 milling cutter attachment
	124 actuator devices for the milling cutter attachment
	125 excavator attachment saddle
40	126 centering pin
	127 manhole center adjusting instrument
	128 loader
	D adjustment direction
	X excavating depth
45	R axis of rotation
	S tangential direction
	U key or adjustment tool
	W operating direction
	Z operating surface
50	V rotary support axis of rotation
	RC radius of curvature of the curvilinear path
	P curvilinear path
	L excavating width

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Claims

1. An excavating assembly (100), comprising

- at least one excavating apparatus (1) that is directly connected to an operating machine (106) for excavating trenches or removing layers of tarmac along curvilinear traveling paths and along linear traveling paths in an operating surface (Z);
 - said excavating apparatus (1) comprising an excavating tool (8);
 - said excavating tool (8) comprising an excavating tool axis of rotation (R) that is substantially parallel to the operating surface (Z);
 - said assembly (100) also comprising a rotary support (101);
 - said rotary support (101) comprising a lower framework (104);
 - said lower framework (104) being rotatably connected such that it rotates about a rotary support axis of rotation (V) that is substantially perpendicular to said operating surface (Z);
 - said rotary support (101) comprising a rotating support driving motor (105) or support motor (105), which actuates, and move integrally with, an excavator attachment saddle support (102) to drive the rotational movement of said lower framework (104);
- characterized in that**
- said excavating apparatus (1) comprises a driving excavating motor or motor excavating means (52) that actuate the excavating tool (8) and can move integrally with the excavating tool (8); and
 - said rotary support (101) comprises said excavator attachment saddle support (102) that is connectable to an operating machine (106), for example an excavator having a movable excavator arm (103); and
 - said lower framework (104) is rotatably connected to said excavator attachment saddle (102) so as to rotate about a rotary support axis of rotation (V) that is substantially perpendicular to said operating surface (Z); and
 - said excavating apparatus (1) is detachably connected to said lower framework (104) such that, by rotating said lower framework (104) with respect to said attachment saddle (102), said excavating tool (8) travels along a circular path.
2. The excavating assembly (100) according to claim 1, wherein
- said attachment saddle (102) supports a rotary case or support housing for the support motor (107) such that it is integral therewith;
 - wherein said support motor (105) is operatively connected to a shaft by means of an endless screw or rotary support endless screw (108) that is connected to said support housing for the support motor (107) so as to turn freely;
- and wherein said lower framework (104) integrally supports a rotational gear or cogwheel (109);
 - and wherein said cogwheel (109) engages with said rotary support endless screw (108), thereby allowing said lower framework (104) to rotate when said rotary support endless screw (108) rotates.
3. The excavating assembly (100) according to claim 1 or claim 2, wherein
- said attachment saddle (102) supports a support column (110);
 - said support column (110) juts out towards said operating surface (Z) and telescopically receives a centering device (111) or a support foot of the rotary support (112) that rests on said operating surface (Z) or a manhole (113), around which a circular operation is intended to be carried out; and/or wherein
 - said centering device (111) can be connected to a frame (114) of a manhole (113) and comprises self-centering telescopic arms (115) that can automatically center said support column (110) with respect to said manhole frame (114).
4. The excavating assembly (100) according to any one of the preceding claims, wherein
- said rotary support (101) comprises a sliding element (116);
 - said sliding element (116) is slidably connected to said lower framework (104) and said excavating apparatus (1) is connected to said sliding element (116);
 - and/or wherein
 - said sliding element (116) comprises sliding guides (117);
 - said lower framework (104) comprises support sliding blocks (118) that slidably engage in said sliding guides (117); and/or wherein
 - an element (119) for adjusting the milling radius is provided between said lower framework (104) and said sliding element (116);
 - and/or wherein
 - said lower framework (104) comprises a lower framework endless screw (120) and said sliding element (116) comprises a nut (121) that receives said endless screw (120) by engaging therewith so as to adjust the position of said sliding element (116) with respect to said lower framework (104) by rotating said endless screw (120), thereby making it possible to adjust the radius of curvature (RC) of a curvilinear traveling path (P) of said excavating tool (8);
 - and/or wherein
 - said endless screw (120) comprises an attach-

- ment for an endless screw manual controller (122) or control lever or key or adjustment tool (U);
and/or wherein
- a drive is connected to said endless screw (120);
and/or wherein
- an endless screw drive engages with, and can move integrally with, the lower framework (104) and initiates the rotational movement of said endless screw (120).
5. The excavating assembly (100) according to any one of the preceding claims, wherein
- said rotary support (101) comprises a milling cutter attachment (123);
 - said milling cutter attachment (123) is connected to said sliding element (116) so as to oscillate; and/or wherein
 - said rotary support (101) comprises devices for actuating the milling cutter attachment or resilient and damping devices (124);
 - said devices for actuating the milling cutter attachment or resilient and damping devices (124) connect said milling cutter attachment (123) to said sliding element (116) in an adjustable manner so as to modify oscillation axis of rotation (R) of the excavating tool (8) or to dampen the vibrations caused by said excavating tool (8).
6. The excavating assembly (100) according to any one of the preceding claims, wherein
- said excavating apparatus (1) is a self-leveling apparatus.
7. The excavating assembly (100) according to any one of the preceding claims, wherein
- the excavating tool (8) is in the form of a wheel or a disk; or wherein
 - the excavating tool (8) is in the form of a roller or a cylinder; and/or wherein
 - the excavating tool (8) comprises a plurality of peripheral sharp elements or cutting edges or excavating elements (54); and/or wherein
 - said plurality of sharp elements or cutting edges or excavating elements (54) are oriented in a direction that is tangential with respect to an axis of rotation (R) of said tool (8).
8. The excavating assembly (100) according to any one of the preceding claims, wherein
- said excavating apparatus (1) comprises an excavating tool (8) that carries out a cutting
- movement that is substantially parallel or tangential to the operating surface (Z) by means of a rotational movement of the cutting tool (8) about its axis of rotation (R) that is parallel to the operating surface (Z), and wherein
- said rotary support (101) allows for a rotational movement of the excavating apparatus (1) along a cutting path that travels in a circle.
9. An operating machine (106) comprising an excavating assembly (100) according to any one of the preceding claims.
10. The operating machine (106) according to claim 9, wherein
- said operating machine (106) comprises at least one fluidic power take-off for supplying hydraulic drive motor (52) in order to move a cutting tool (8); and/or wherein
 - said operating machine (106) comprises at least one fluidic power take-off for supplying power to a hydraulic support motor (105) in order to initiate the rotational movement of a rotary support (101).
11. An operating method comprising the steps of:
- providing at least one excavating assembly (100) as defined in any one of the preceding claims;
 - providing an operating machine (106) to which said excavating assembly (100) is associated;
 - disconnecting said excavating apparatus (1) from said rotary support (101);
 - disconnecting said rotary support (100) from said operating machine (106); and
 - directly connecting said excavating apparatus (1) to said operating machine (106).
12. The operating method as per claim 11, comprising the steps of:
- disconnecting said excavating apparatus (1) from said operating machine (106);
 - connecting said rotary support (101) to said operating machine (106); and
 - connecting said excavating apparatus (1) to said rotary support (101).

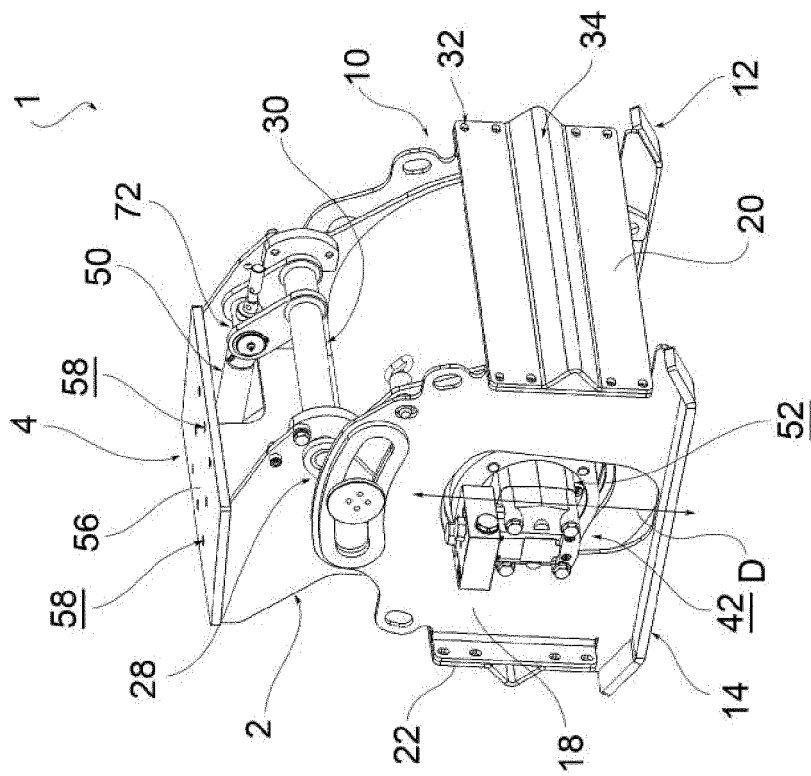


FIG.1

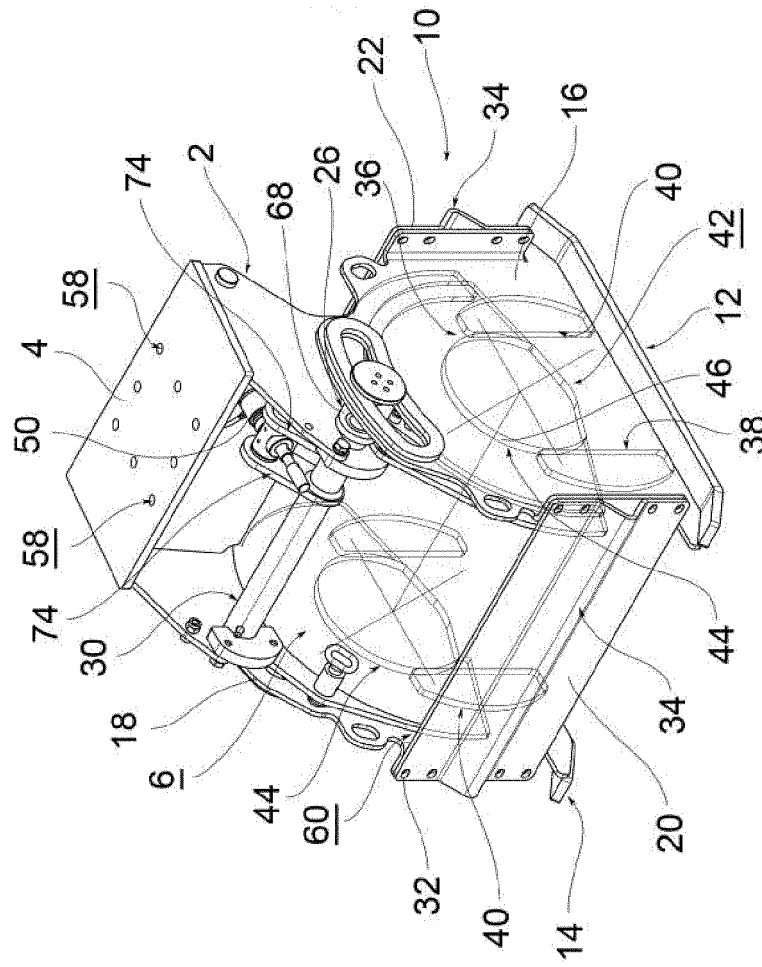


FIG.2

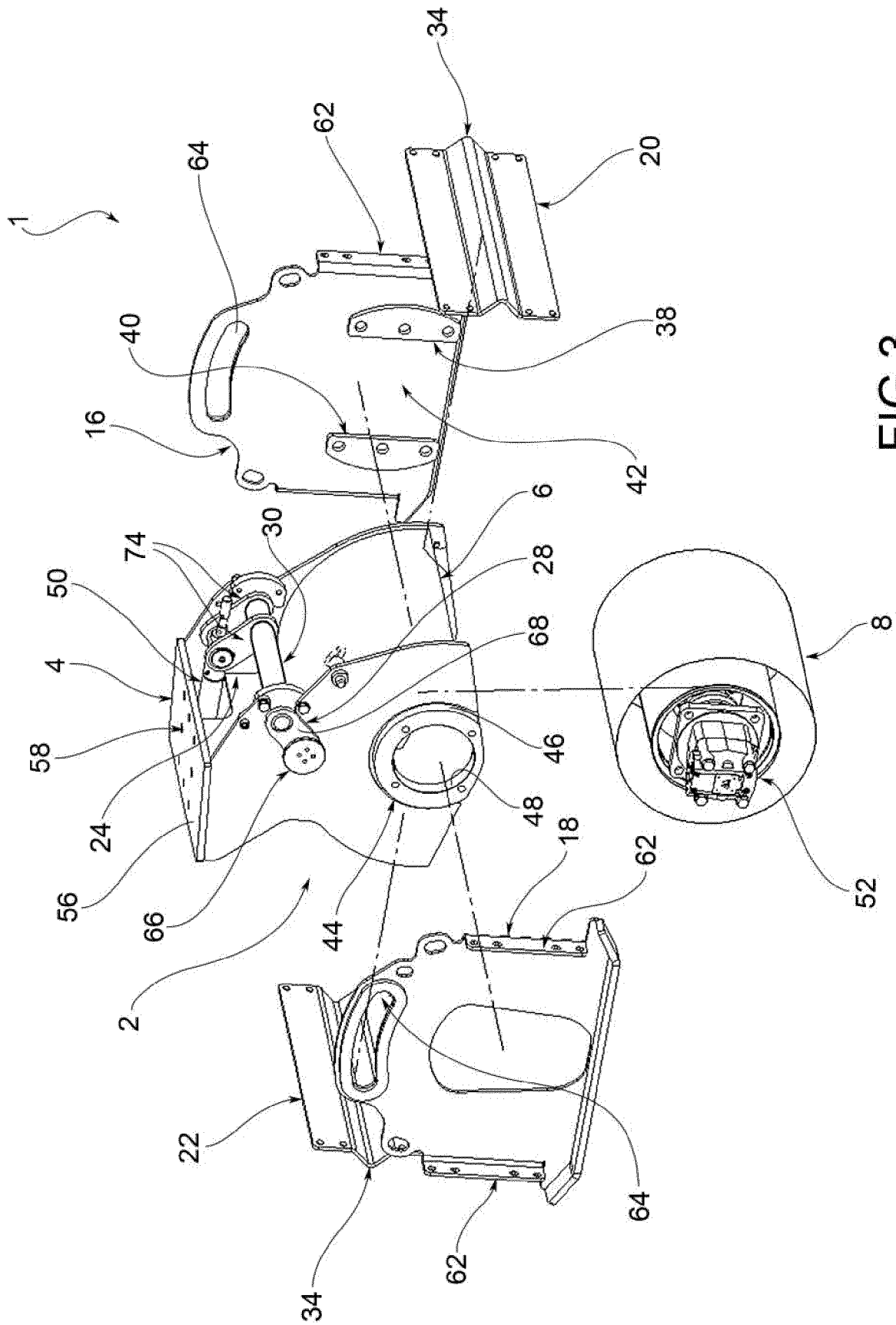


FIG.3

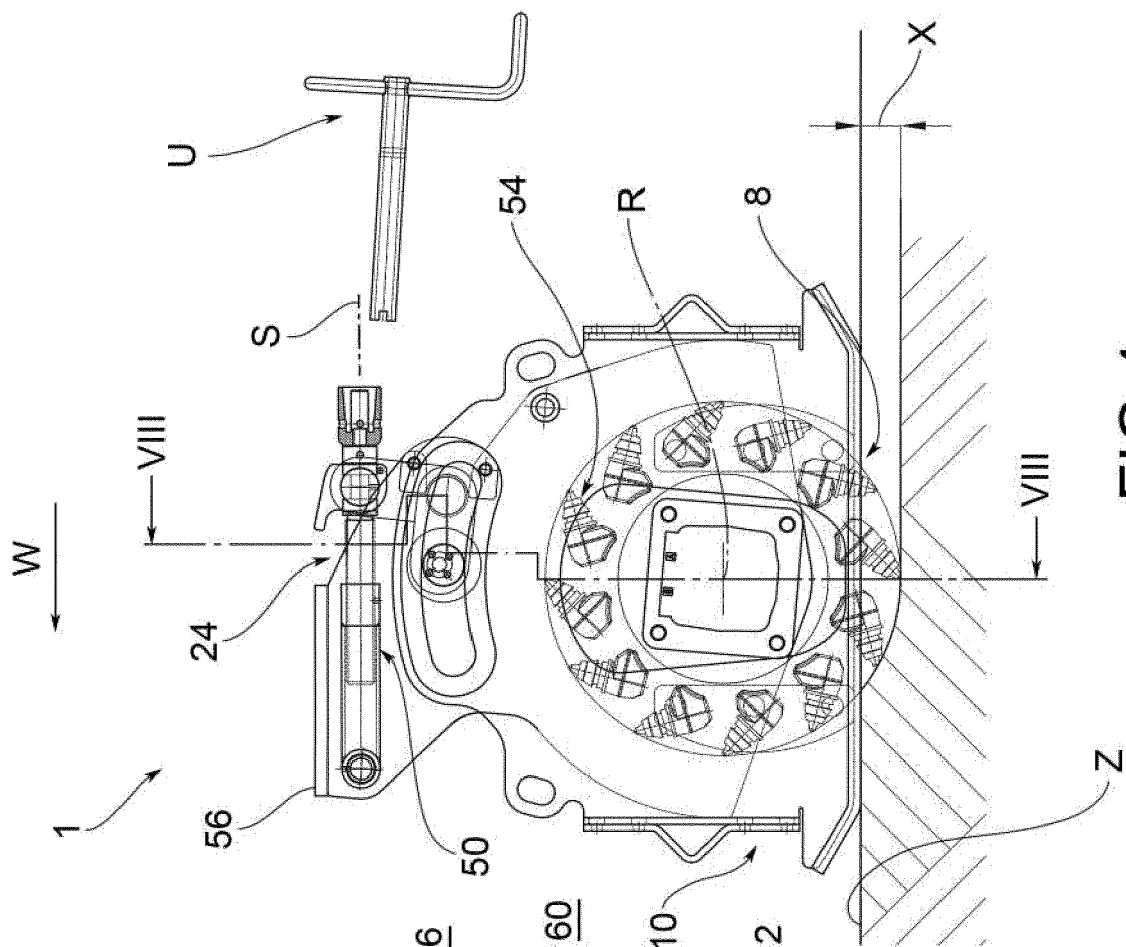


FIG. 4

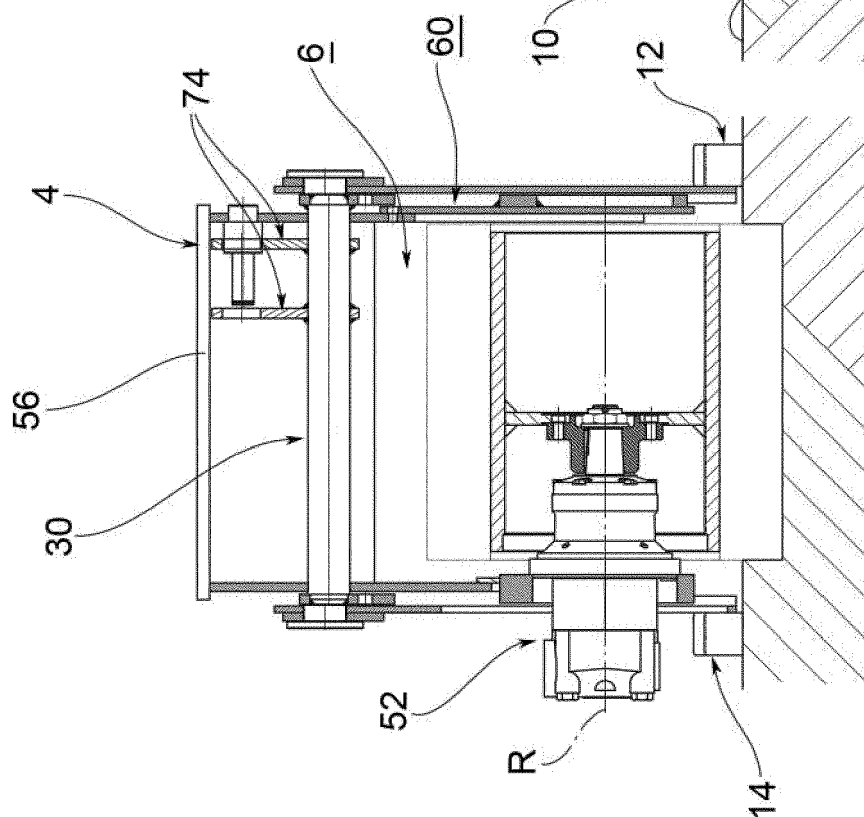


FIG. 5

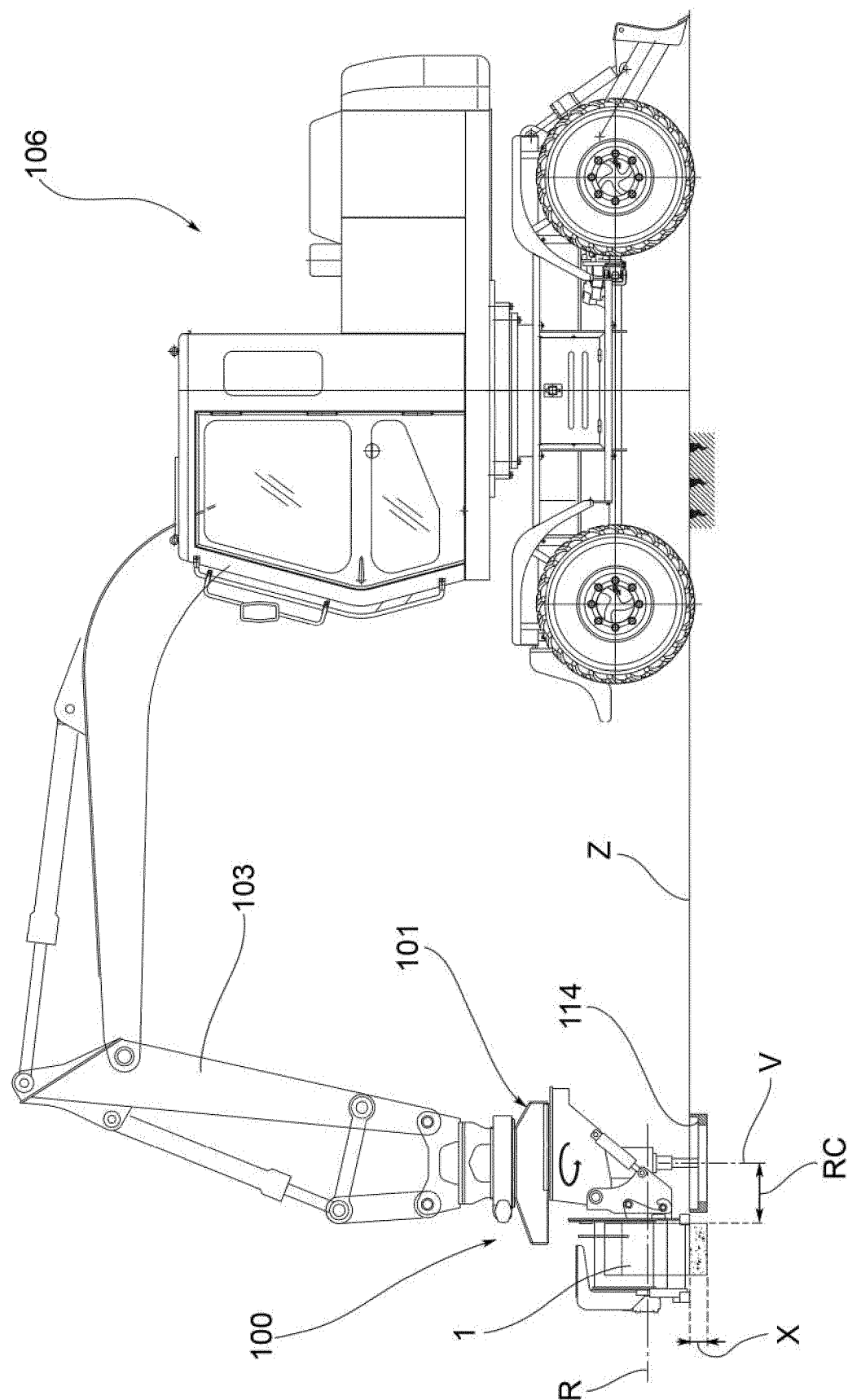


FIG.6

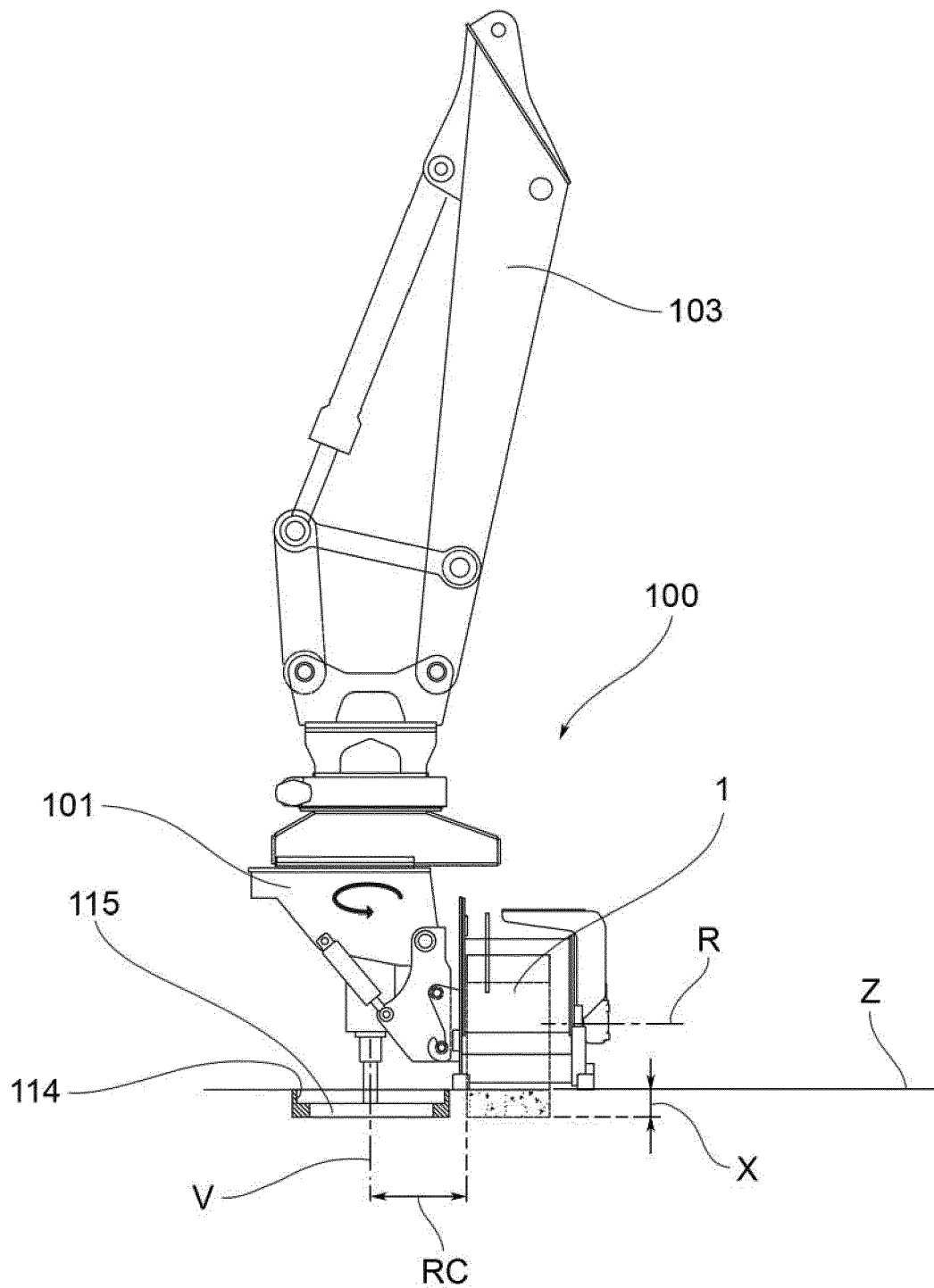


FIG.7

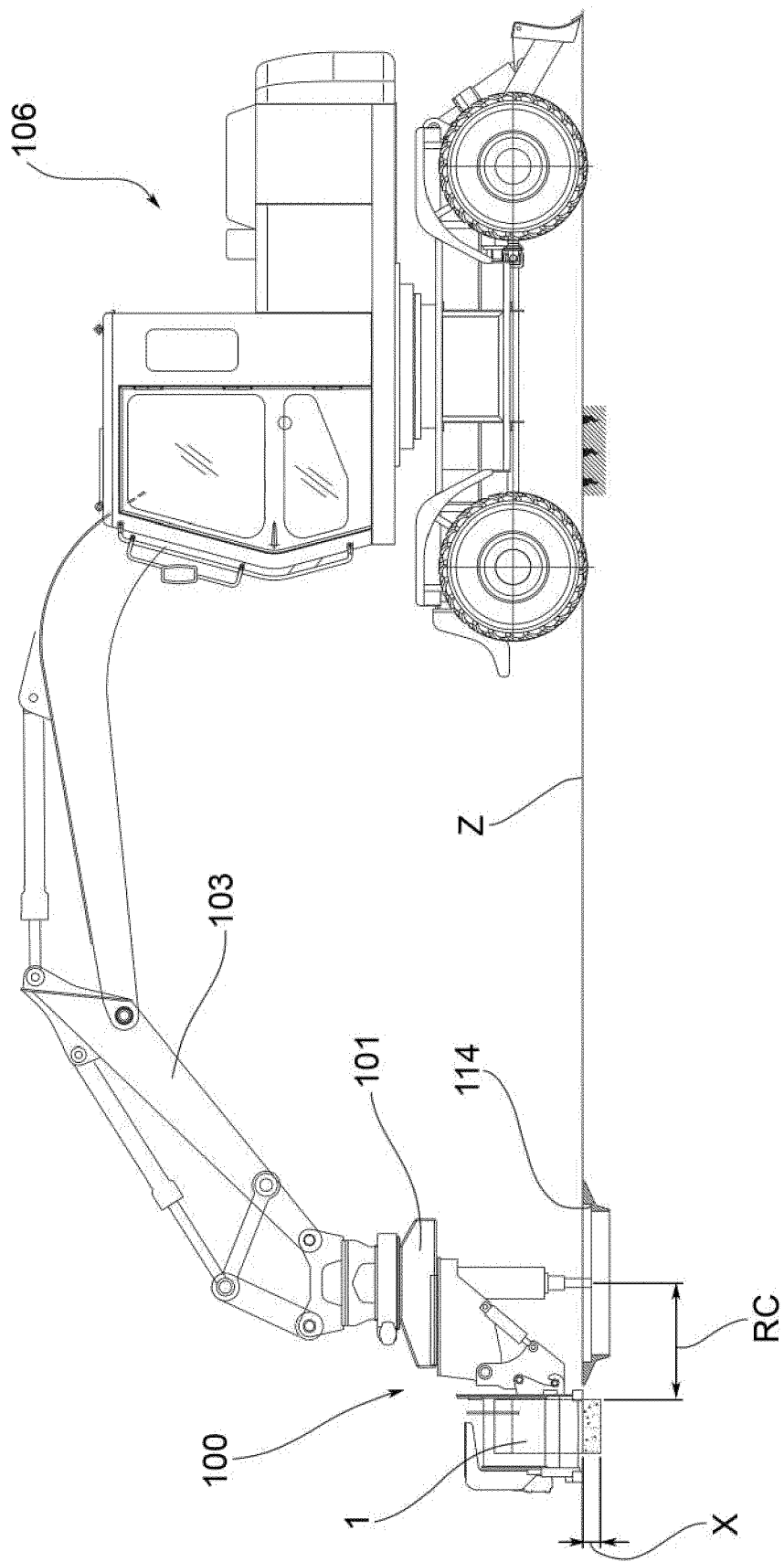


FIG.8

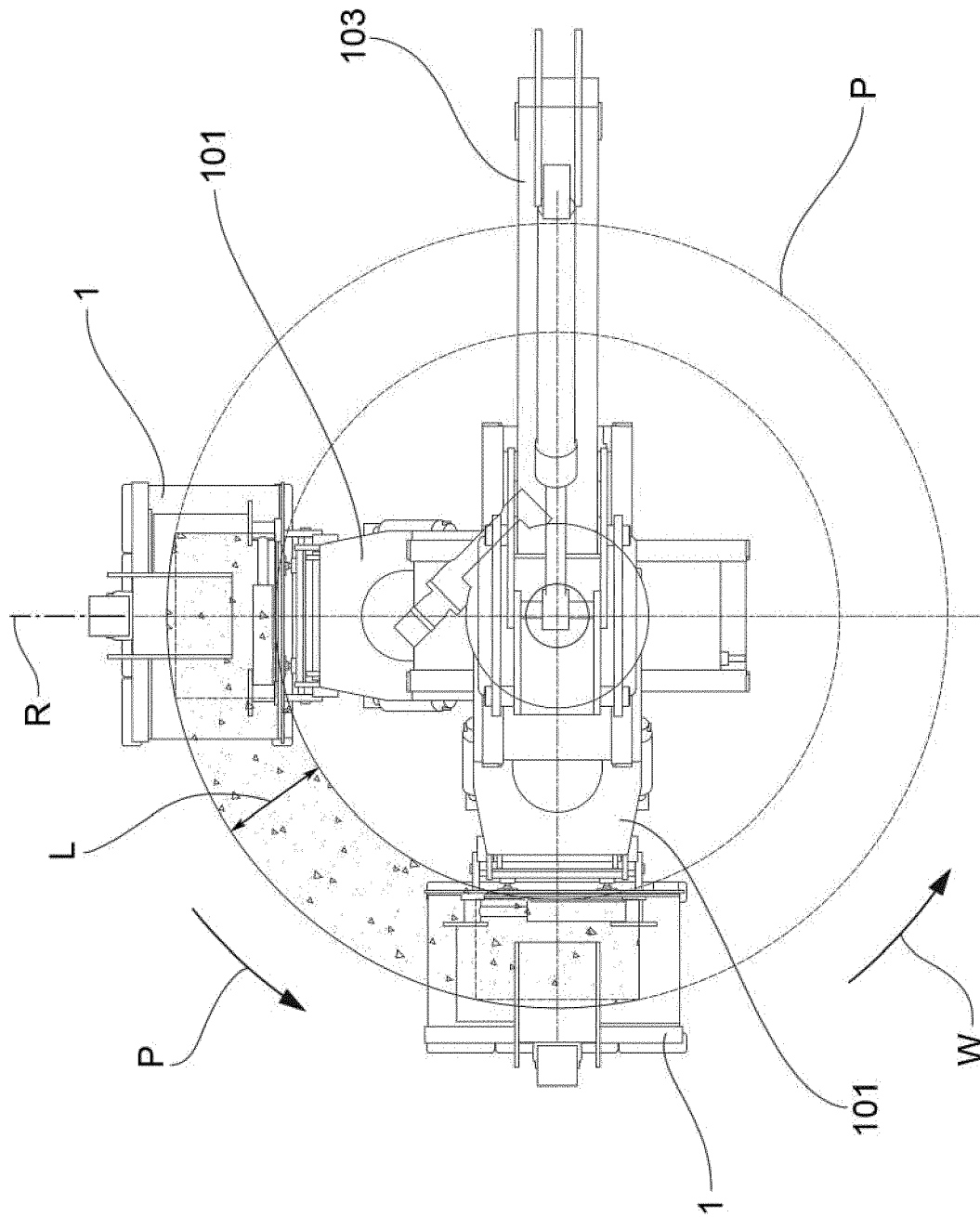


FIG. 9

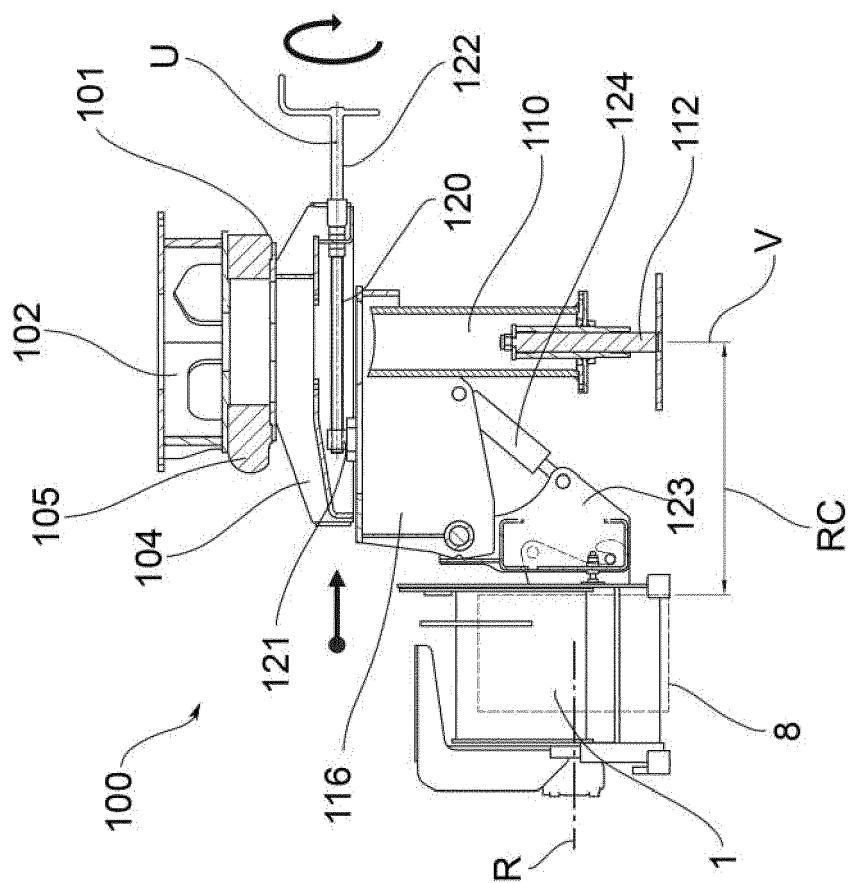
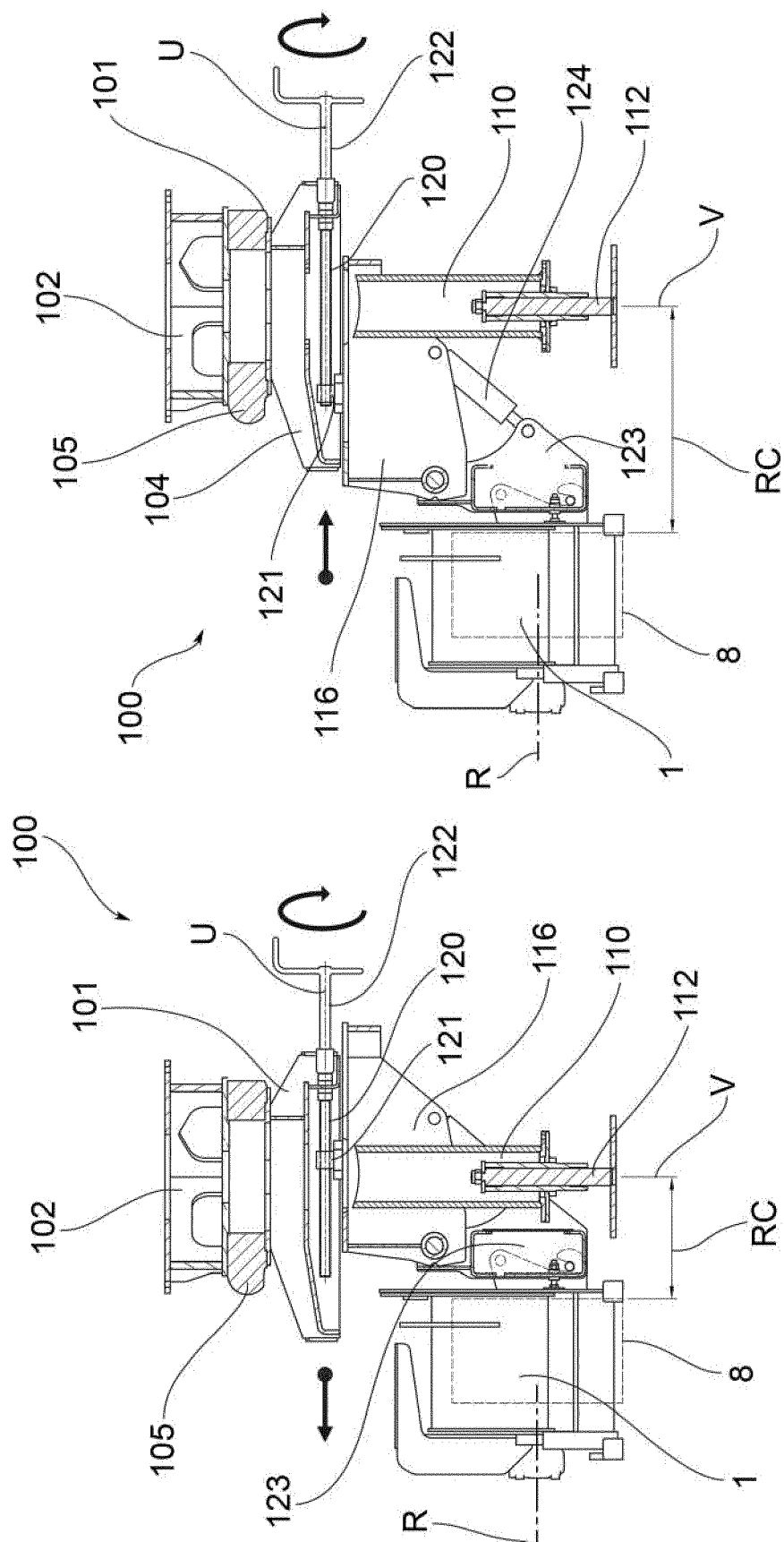
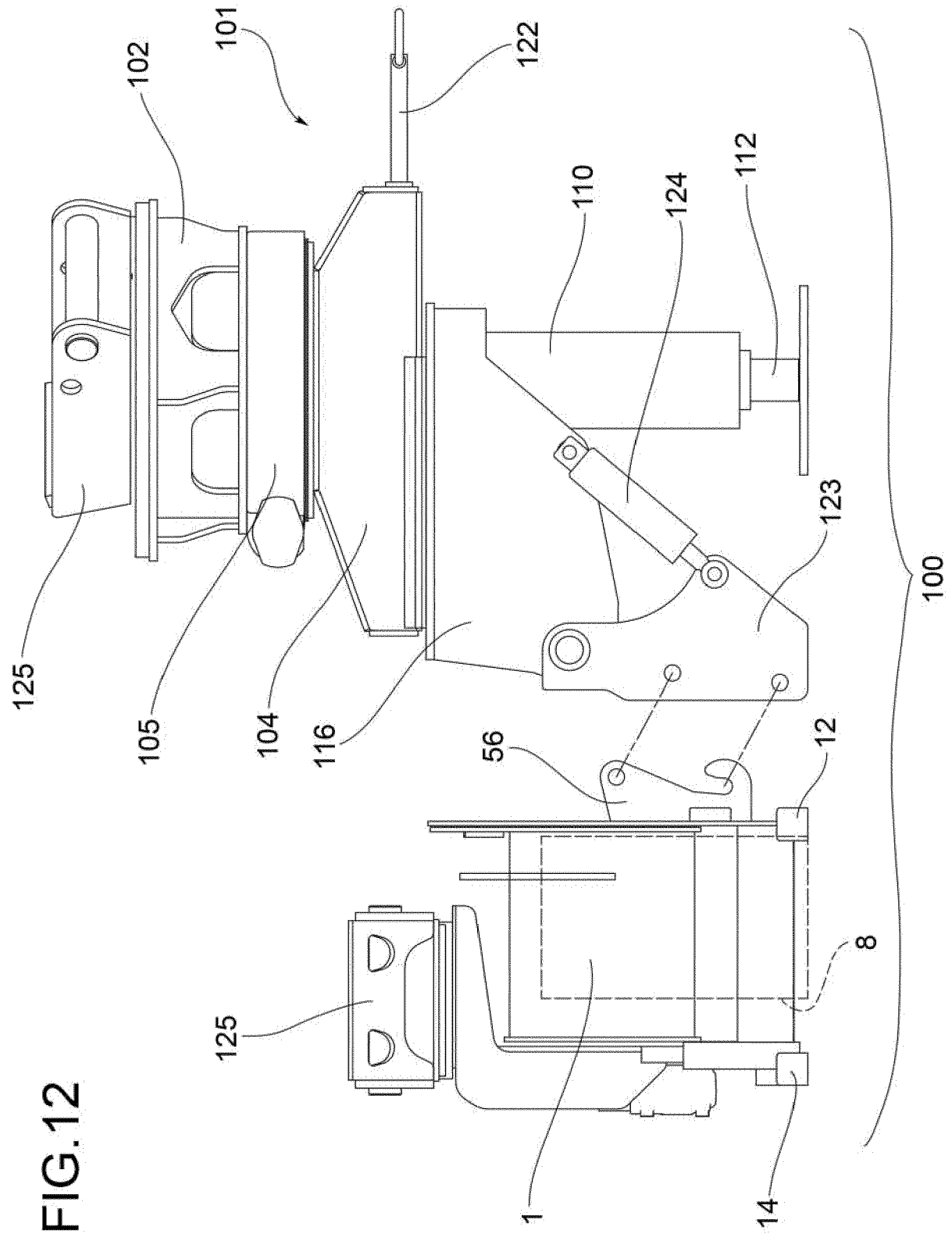


FIG.12



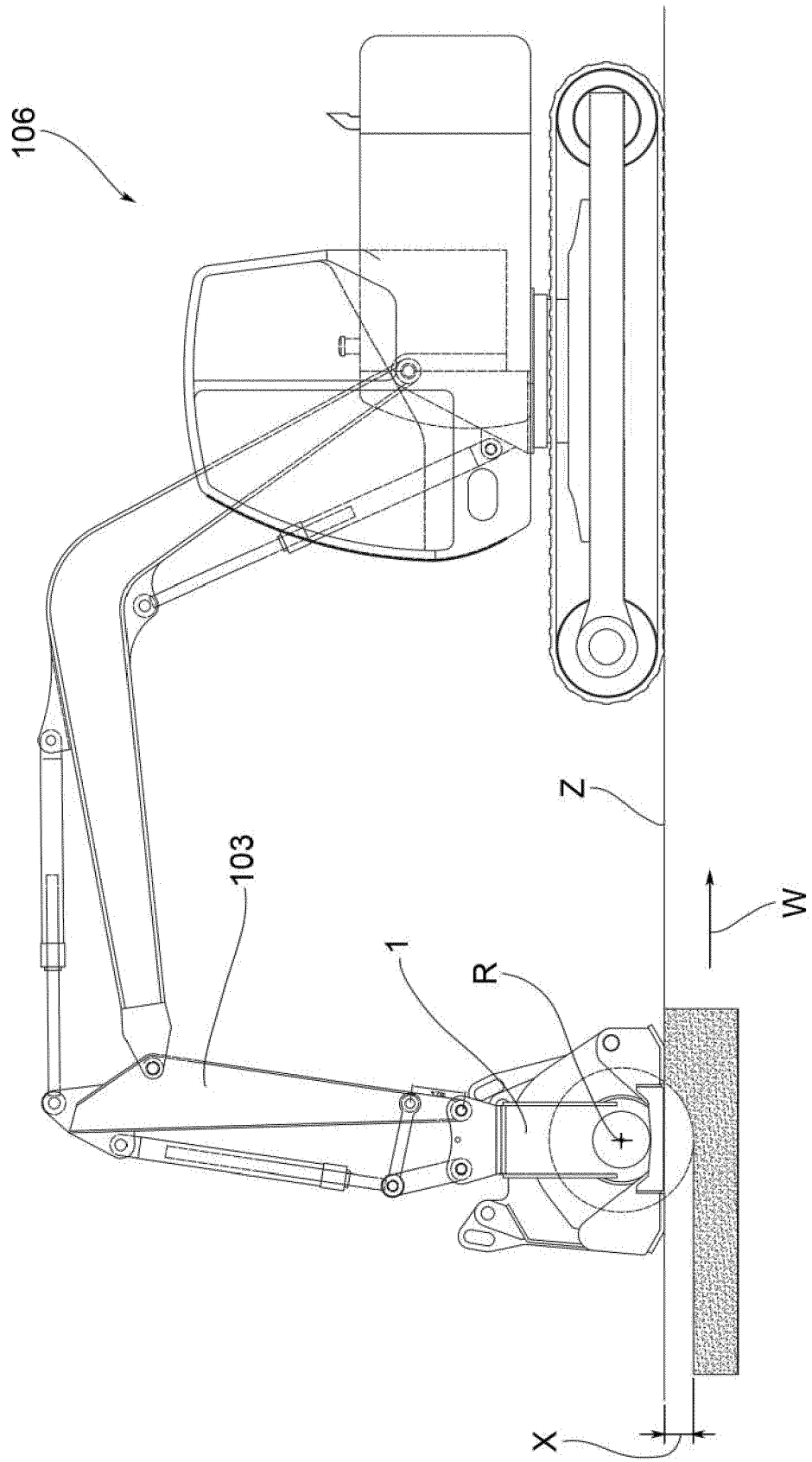


FIG.13

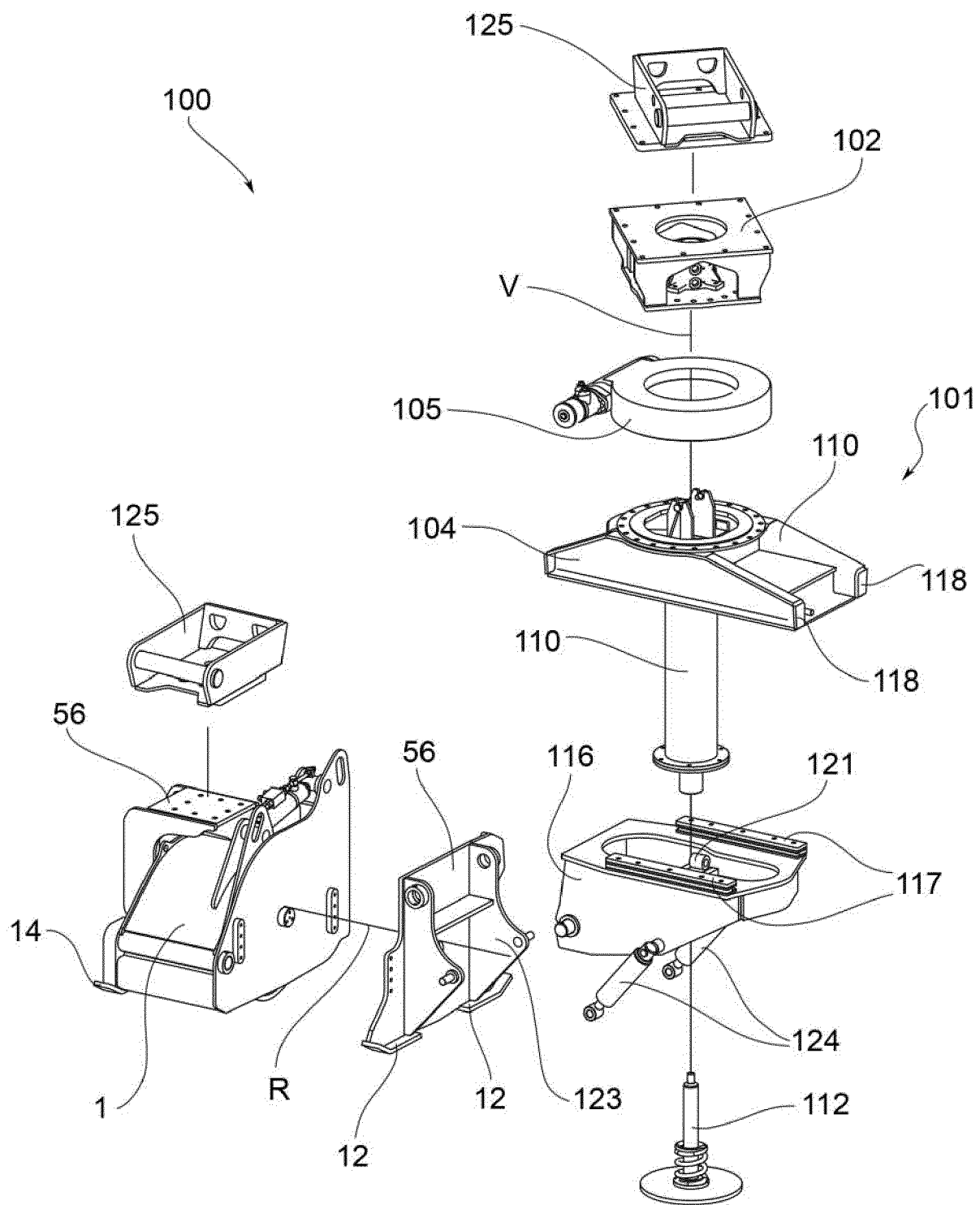


FIG.14

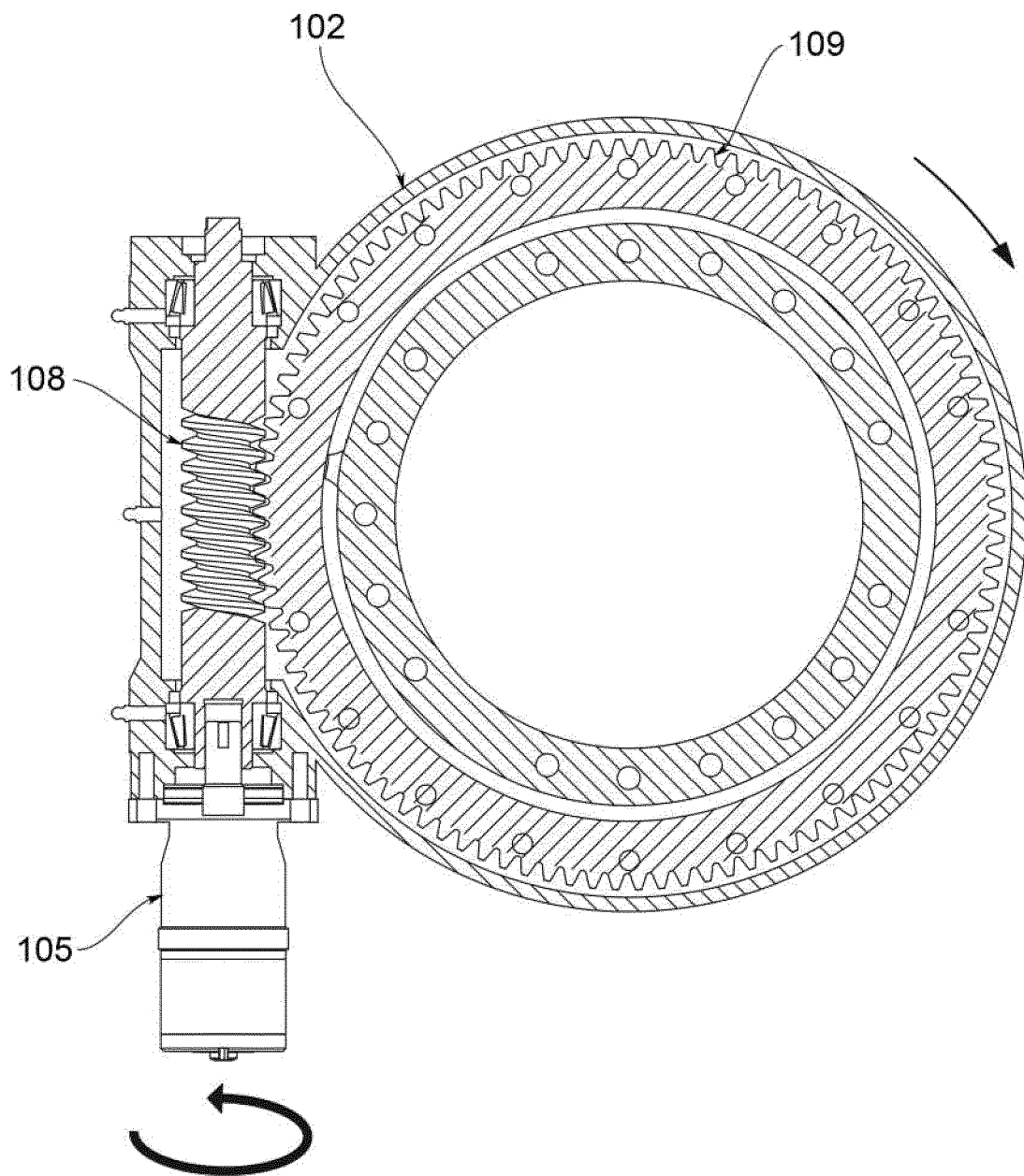


FIG.15

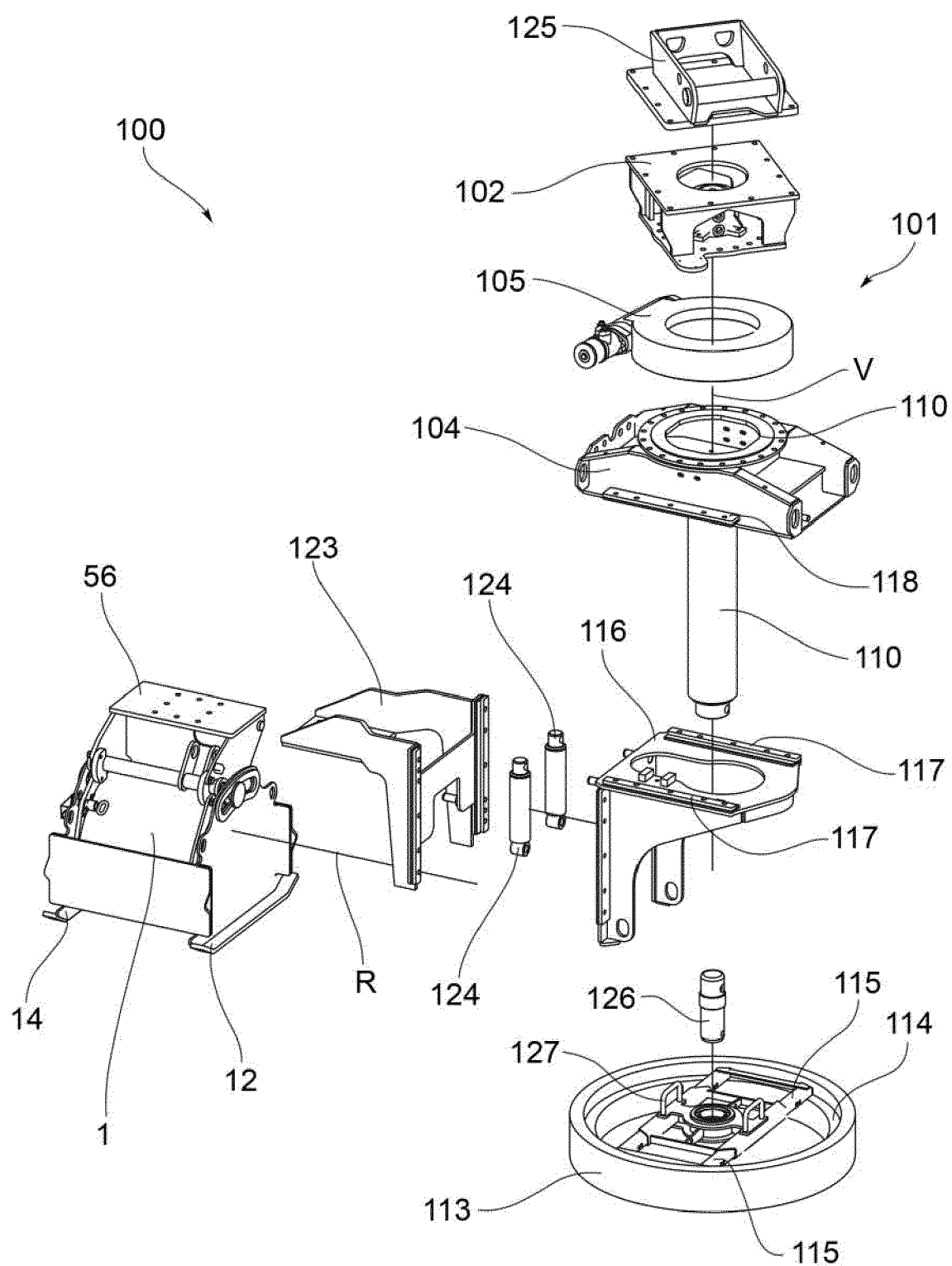


FIG.16

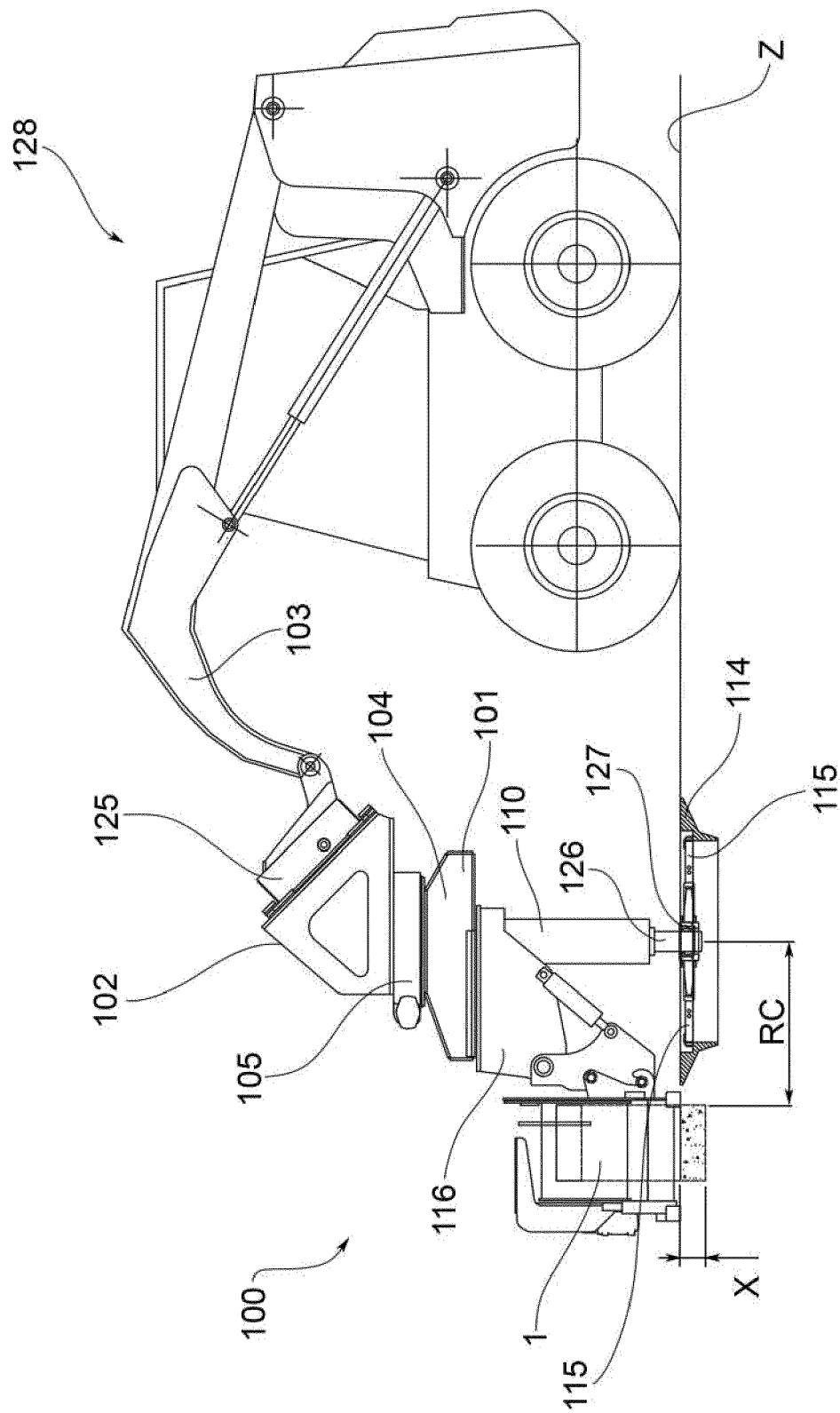


FIG.17

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 8011851 B [0007]
- US 8646847 B [0007]
- US 5522646 A [0007]
- US 4924951 A [0007]
- US 4458949 A [0007]
- JP 2668551 B [0007]
- JP 4794541 B [0007]
- JP 6322162 B [0007]
- KR 101771790 [0007]
- FR 3034437 [0007]
- KR 101614021 [0007]
- KR 101454224 [0007]
- CN 106498833 [0007]
- CN 105544364 [0007]
- WO 2013027754 A [0007]
- EP 1182299 A [0007]
- EP 0943735 A [0007]
- EP 0796950 A [0007]
- GB 2489085 A [0009]
- DE 102010014711 [0009]
- EP 2295642 A [0009]
- EP 1362954 A [0009]
- US 6536987 B [0009]
- US 5470131 A [0009]
- CN 104594170 [0010]
- EP 1048787 A [0011]
- DE 3319586 [0012]