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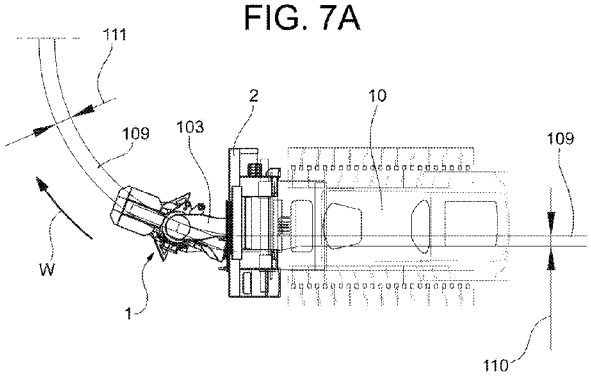
(54) Title: EXCAVATION EQUIPMENT FOR AN OPERATING MACHINE, AND AN OPERATING MACHINE COMPRISING SUCH EQUIPMENT

FIG. 7A



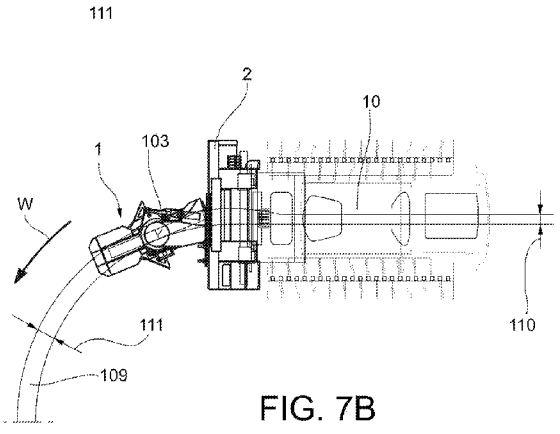


FIG. 7B

(57) Abstract: The present invention relates to an excavation equipment (1) adapted to cooperate with an operating machine (10) comprising: - an internal frame (101); - said internal frame (101) rotatably supports an excavation tool (12) adapted to make, for example, trenches (109) dug in a work surface (Z) along an advancement direction or working direction (W); said excavation tool (12) being rotatable about a rotation axis (R) of excavation tool; - said excavation equipment (1) further comprising a rear frame (103); - said rear frame (103) supports said internal frame (101); - a steering device (108) is provided between said rear frame (103) and said internal frame (101); - said steering device (108) comprises a steering bearing (106); - said steering bearing (106) comprises a first steering bearing part (112) which rotatably cooperates with a second steering bearing part (113) thereof; - said steering bearing (106) is connected with said first steering bearing part (112) thereof to said rear frame (103) and with said second steering bearing part (113)

[Continued on next page]

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thereof is connected with said internal frame (101); and wherein - said steering bearing (106) defines a steering axis (VE) around which said excavation tool (12) rotates; steering axis (VE) is arranged orthogonal to said advancement direction or working direction (W).

"Excavation equipment for an operating machine, and an operating machine comprising such equipment"

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DESCRIPTION

[0001]. Field of the invention

[0002]. The present invention relates to excavation equipment for an operating machine, and an operating machine comprising such equipment.

[0003]. In particular, the present invention relates to excavation equipment having an excavation tool for the construction of trenches having longitudinal extensions or paths that can become tortuous.

[0004]. Prior art

[0005]. Equipment is known which allows operating when the excavator moves on a non-horizontal plane, when a track, or a pair of wheels on the same side of the vehicle, could be higher (or lower) than the opposite track or pair of wheels.

[0006]. This situation occurs when an excavation or a trench must be made, for example, close to a step or a sidewalk, where there is not enough space for all the tracks or wheels of the excavator to rest on a single horizontal plane.

[0007]. In the case of narrow and relatively deep excavations,

where a toothed disk must penetrate the material to be excavated substantially for the entire radius thereof, and where an inclination of the rotation axis of such a disk would make it impossible to create a trench of this type, mainly due to impacts against the edges and side walls delimiting the trench.

[0008]. Known solutions to these problems are partially known from **US5864970A1, US2002/195869A1, EP2735654A1,** as well as **IT102018000004753** by the same applicant.

[0009]. **US4878713** shows a drum cutter for paving carried on the front ends of the twin lift arms of a tracked front loader. This solution has a drum cutter with radially protruding teeth. The cutter is contained in a box-shaped housing which is open at the bottom and is supported in the central front part by a height-adjustable roller. The cutter is fixed to lifting arms by means of a vertical plate frame element with wheels on each of its ends. The housing is connected to the frame element so as to be adjustable laterally with respect to the work surface and also tilting in an adjustable manner around an axis which extends in the advancement direction. Both of these adjustments are made by a single hydraulic jack connected between the housing and the frame element. This known solution allows milling surfaces both by machining trenches with flat bottom and trenches with inclined bottom, but it forces the rotation axis of the cutter to remain orthogonal to the advancement direction.

[0010]. Document **GB2512945** shows very similar to that presented in US4878713.

[0011]. Document **EP0310074** shows a milling cutter which can be fixed to a movable structure, in particular a construction machine, a Unimog or the like. This cutter is a rotary drum cutter housed in an inverted U-shaped support structure and rotatably connected to an inverted L-shaped support. The rotation axis of the drum cutter is adjustable only in sequence in a first pitching oscillation and in yaw sequence, with respect to the advancement direction of the vehicle, in order to also perform milling operations of trenches oriented in the advancement direction of the vehicle and with flat or inclined bottom, even when the cutter is placed alongside or on the side of the vehicle and not in front of it. If this solution was used in front of the vehicle and the pitch oscillation adjustment was used, there would be a change in the excavation depth.

[0012]. However, the need to create even deep trenches with tortuous and in particular curvilinear paths, guaranteeing a constant excavation depth, remains strongly felt.

[0013]. The present invention falls within the previous context, proposing to provide excavation equipment and an operating machine capable of overcoming the above drawbacks.

[0014]. Solution

[0015]. These and other objects are achieved by an excavation equipment according to claim **1**, as well as an operating machine according to claim **10**.

[0016]. Some advantageous embodiments are the subject of the dependent claims.

[0017]. From the analysis of this solution it emerged that the

proposed solution allows making even deep trenches having curved paths, therefore with curvilinear path in the work plane.

[0018]. Furthermore, the present invention also allows simultaneously maintaining an additional degree of freedom (that of tilting of the excavation tool, in fact) with respect to traditional machines, without however moving the center of gravity of the assembly away from the operating machine.

[0019]. Figures

[0020]. Further features and the advantages of the invention will be made readily apparent from the following description of preferred embodiment examples thereof, provided purely by way of a non-limiting example, with reference to the accompanying figures, in which:

[0021]. - figure 1 is a front view of an operating machine which frontally supports an excavation equipment during an excavation in a work surface all at the same level, i.e. flat;

[0022]. - figure 2 shows a front view of an operating machine which frontally supports an excavation equipment during an excavation on a surface that has a difference in height, for example a step, on which the operating machine must climb to make the excavation, and thanks to the tilting excavation equipment it makes an excavation close to the difference in height but with the vertical excavation tool, that is, which follows a substantially vertical excavation;

[0023]. - figures 3 and 4 show a side view of the operating machine of figure 1 which follows an excavation of a first depth and

one of a second depth smaller than the first;

[0024]. - figure 5 shows a side view of a detail of the Skid-Loader coupling portion or coupling translator with which a sliding support is slidably associated, highlighting the articulation means or tilting joint around the tilting axis indicated with T;

[0025]. - figures 6A, 6B, 7A, 7B; figures 6A and 7A show an operating machine to which an excavation equipment is associated frontally while making a trench, or excavation, having a predefined straight path and therefore a curve to the right (in figures 6A and 7A) and therefore straight and therefore a curve to the left (figures 6B and 7B), in which the steering of the internal frame, and the associated external one, with respect to the rear frame is highlighted, in figures 6A and 7A to the right and in figures 6B and 7B to the left;

[0026]. - figure 8 shows an axonometric view with separate parts of an excavation equipment viewed from its left side, in respect of the working direction W;

[0027]. - figure 9 shows an axonometric view with separate parts of the excavation equipment of figure 8 viewed from its right side, in respect of to the working direction W.

[0028]. Description of some preferred embodiment examples

[0029]. According to a general embodiment, excavation equipment 1 suitable for cooperating with an operating machine 10 comprises an internal frame 101.

[0030]. Said internal frame 101 rotatably supports an excavation tool 12 adapted to make, for example, trenches 109 dug in a work

surface Z along an advancement direction or working direction W.

[0031]. Said excavation tool 12 being rotatable about a rotation axis R of excavation tool.

[0032]. Said excavation equipment 1 further comprising a rear frame 103.

[0033]. Said rear frame 103 supports said internal frame 101.

[0034]. A steering device 108 is provided between said rear frame 103 and said internal frame 101.

[0035]. Said steering device 108 defines a steering axis VE, or yaw axis, around which said excavation tool 12 rotates.

[0036]. Said excavation equipment 1 is adapted to position itself frontally on an operating machine 10, so as to precede the operating machine 10 according to the working direction W.

[0037]. Said steering axis VE is arranged substantially orthogonal to said advancement direction or working direction W and to said excavation tool rotation axis R.

[0038]. Said excavation equipment 1 comprises a coupling portion or coupling translator 2, indicated with reference numeral 2 in the figures, with which a sliding support 105 to which said rear support 103 is connected is slidably supported and associated.

[0039]. Said excavation equipment 1 comprises a tilting joint or articulation means 20 interposed between said sliding support 105 and said rear frame 103.

[0040]. Said tilting joint or articulation means 20 defines a tilting axis T, or roll axis, arranged substantially orthogonal to said excavation tool rotation direction R.

[0041]. Said tilting axis T is arranged substantially orthogonal to said steering axis VE.

[0042]. By virtue of this solution it is possible to oscillate the rotation axis of the tool, for example cutter, R in roll, that is, in steering following the curve to be given to the excavation.

[0043]. Furthermore, by virtue of the proposed solution, it is possible to associate the roll or steering of the cutter rotation axis R to a yaw or tilting oscillation avoiding a pitch oscillation that would cause the tool to rise from the desired excavation depth.

[0044]. According to an embodiment, said steering axis VE is arranged substantially orthogonal to said advancement direction or working direction W.

[0045]. According to an embodiment, said steering axis VE is arranged substantially orthogonal to said excavation tool rotation axis R.

[0046]. According to an embodiment, said steering device 108 comprises at least one steering bearing 106.

[0047]. Said steering bearing 106 comprises a first steering bearing part 112 which rotatably cooperates with a second steering bearing part 113 thereof.

[0048]. Said steering bearing 106 is connected with said first steering bearing part 112 thereof to said rear frame 103 and with said second steering bearing part 113 thereof is connected with said internal frame 101.

[0049]. Said steering bearing 106 defines a steering axis VE around which said excavation tool 12 rotates.

[0050]. According to an embodiment, said steering axis VE is arranged orthogonal to said advancement direction or working direction W.

[0051]. According to an embodiment, said excavation tool rotation axis R is arranged orthogonal to said advancement direction or working direction W.

[0052]. and/or wherein

[0053]. - said advancement direction or working direction W is parallel to said work surface Z; and wherein

[0054]. - said excavation tool rotation axis R is arranged parallel to said working direction Z;

[0055]. and/or wherein

[0056]. - said steering axis VE is arranged orthogonal to said advancement direction or working direction W and to said excavation tool rotation axis R.

[0057]. According to an embodiment, said steering bearing 106 defines steering axis VE arranged orthogonal to said advancement direction or working direction W and orthogonal to said rotation axis R of the excavation tool 12.

[0058]. According to an embodiment, said excavation equipment 1 comprises a steering adjustment actuator 104.

[0059]. Said steering adjustment actuator 104 acts in thrust or traction between said rear frame 103 and said internal frame 101 so as to allow rotation of the excavation tool 12 around said steering axis VE.

[0060]. According to an embodiment, said steering adjustment

actuator 104 is hydraulic, mechanical or electric.

[0061]. According to an embodiment, said excavation tool 12 is rotatable around said excavation tool rotation axis R with respect to said internal frame 101 by means of motor means 40, for example of the hydraulic, mechanical or electric type, said motor means 40 being engaged with, and being movable in a manner integral with, the excavation tool 12.

[0062]. According to an embodiment, said excavation equipment 1 comprises a Skid-Loader coupling portion or coupling translator 2 with which a sliding support 105 is associated and slidably supported.

[0063]. According to an embodiment, said excavation equipment 1 comprises a tilting joint or articulation means 20.

[0064]. Said tilting joint or articulation means 20 comprises a tilting bearing 107.

[0065]. Said tilting bearing 107 is connected with a first tilting bearing part thereof to said sliding support 105 and with a second part thereof, rotatably connected to the first part, it is connected to said rear frame 103.

[0066]. According to an embodiment, said tilting bearing 107 defines a tilting axis T arranged orthogonal to said excavation tool rotation direction R.

[0067]. According to an embodiment, said tilting bearing 107 defines a tilting axis T arranged parallel to said advancement direction or working direction W.

[0068]. According to an embodiment, said tilting bearing 107

defines a tilting axis T arranged substantially orthogonal to said steering axis VE.

[0069]. According to an embodiment, said excavation equipment 1 comprises a first actuator or actuator for actuating the excavation tool 38 acting in thrust or in traction between said sliding support 105 and said rear frame so as to allow rotation of the excavation tool 12 around a tilting axis T.

[0070]. According to an embodiment, said steering bearing 106 comprises an internal fifth wheel 112 connected to said rear frame 103, and an external fifth wheel 113 connected to said internal frame 101.

[0071]. According to an embodiment, said steering bearing 106 comprises curvilinear guides integral with said internal frame 101 or with said rear frame 103.

[0072]. Said steering bearing 106 comprises shoes fitted on said curvilinear guides, said shoes being integral with said rear frame 103 or said internal frame 101.

[0073]. According to an embodiment, said excavation equipment 1 is of the self-leveling type in which an internal frame 191 supports an excavation tool 12 and is housed inside an equipment body or external frame 4.

[0074]. According to an embodiment, said excavation equipment 1 comprises an excavation depth adjustment actuator 102.

[0075]. According to an embodiment, said excavation depth adjustment actuator 102 acts in thrust or traction between said internal frame 101 and said external frame 4 so as to allow the exit

of said excavation tool 12 from said external frame 4 increasing or decreasing the excavation depth X.

[0076]. The present invention also relates to an operating machine 10 comprising excavation equipment 1 according to any one of the preceding embodiments.

[0077]. According to an embodiment, said excavation equipment 1 is placed frontally to said operating machine 10 so that said excavation equipment 1 precedes said operating machine 10 in the working direction W.

[0078]. With reference to the aforementioned tables and according to a further embodiment, reference numeral 1 identifies as a whole an equipment for an operating machine 10.

[0079]. According to an embodiment, such equipment is a trench excavator equipment.

[0080]. According to an embodiment, such equipment is a milling equipment.

[0081]. Such excavation equipment 1 comprises a coupling portion 2 to the operating machine 10, an equipment body 4, an excavation tool 12, articulation means 20 and optional adjustment means 16 of the excavation depth Q1, Q2.

[0082]. According to an embodiment, the coupling portion 2 comprises one or more translation guides 54, 56 which extend parallel to the thickness of the excavation equipment 12, to allow a lateral displacement of the excavation tool 12, for example laterally with respect to a longitudinal center line U of the operating machine 10.

[0083]. The equipment body 4 comprises a pair of abutment shoes 6 with a work surface Z.

[0084]. In the tables only one of these shoes is clearly visible, the opposite abutment shoe being arranged on the hidden side of the equipment 1, advantageously aligned with the visible one.

[0085]. Such equipment 1 may therefore be moved in a working direction W by virtue of the sliding contact between the abutment shoes 6 and the work surface Z.

[0086]. According to an embodiment, the abutment shoes 6 are arranged side by side with the excavation tool 12.

[0087]. According to an embodiment, the abutment shoes 6 are made of folded metal sheets.

[0088]. The excavation tool 12 is mounted supported to an internal frame 101 which movably supports an external frame 4, forming said equipment body 4; said excavation tool is movably supported around a rotation axis R partially protruding in front of the abutment shoes 6, therefore in operation below the equipment body or external frame 4.

[0089]. In this way, such a tool 12 is capable of removing or excavating a solid material starting from the work surface Z, for example vertically downwards according to the orientation in the figures.

[0090]. According to an embodiment, the excavation tool 12 is in the form of a wheel or disk.

[0091]. According to an embodiment, the excavation tool 12 is in the form of a roller or cylinder.

[0092]. The excavation tool 12 peripherally comprises a plurality of excavation elements 14, for example oriented in a tangential direction with respect to the rotation axis R.

[0093]. According to an embodiment, the excavation elements 14 comprise element ends 44 alternately axially oriented on opposite sides of the excavation tool 12.

[0094]. According to an embodiment, the excavation tool 12 is rotatable with respect to the equipment body 4 by means of motor means 40.

[0095]. According to an embodiment, the motor means 40 are hydraulic, mechanical or electric.

[0096]. According to an embodiment, the excavation depth adjustment means Q1, Q2 of the equipment 1 are functionally connected to the equipment body 4 and to the excavation tool 12 to adjust a relative distance between one or both abutment shoes 6 and the excavation elements 14, in particular between a lower surface 58 of at least one abutment shoe 6 with respect to the element ends 44.

[0097]. The adjustment direction is schematized by the double arrow 60.

[0098]. According to an embodiment, the motor means 40 are engaged with, and can be moved integrally with, the excavation tool 12 by the excavation depth Q1, Q2 adjustment means 16.

[0099]. According to an embodiment, the adjustment means 16 comprise a translation support 46 of the excavation tool, an adjustment arm 48 and an actuator 50 (optionally linear) connected to the equipment body 4.

[00100]. More precisely, the actuator 50 is pivoted on one side to the equipment body 4 and on the other side to the adjustment arm 48. The adjustment arm 48 is in turn pivoted with the translation support 46 and is slidably mounted along a sliding guide 52 of the equipment body 4, for example in the form of a curved slot.

[00101]. In this way, following a force exerted by the actuator 50 - for example following an approach or a removal of the opposite sides thereof - such actuator 50 will rotate the adjustment arm 48 in a direction such as to cause a lifting or a lowering of the translation support 46 with respect to the equipment body 4 (by virtue of the consequent sliding of this arm 48 along the sliding guide 52), and therefore a corresponding movement of the excavation tool 12.

[00102]. This type of adjustment means 16 has been discussed only by way of example. Other ways of adjusting the excavation depth according to other embodiments are possible.

[00103]. The articulation means 20 are mechanically interposed between the coupling portion 2 and the excavation tool 12 to allow the rotation axis R to move around a tilting axis T incident or orthogonal to the rotation axis R.

[00104]. Therefore, as discussed at the beginning, the articulation means 20 are configured to allow desired orientations of the rotation axis R, so that the excavation tool is positioned satisfactorily in any event.

[00105]. According to an embodiment, the articulation means 20 are adjustable or controllable to maintain a substantially horizontal

orientation of the rotation axis R, for example despite possible lateral imbalances of the coupling portion 2 and of the operating machine 10 connectable to such a portion 2.

[00106]. According to an embodiment, the tilting axis T is arranged substantially parallel to a working direction W of the excavation equipment 1, or parallel to a longitudinal direction of the operating machine 10.

[00107]. According to an embodiment, the articulation means 20 are integrated between the coupling portion 2 and the equipment body 4.

[00108]. According to an embodiment, the articulation means 20 comprise a rotation fulcrum 18 between the coupling portion 2 and the equipment body 4.

[00109]. According to an embodiment, the articulation means 20 comprise at least a pair of sliding surfaces 22, 24 delimited by the coupling portion 2 and by the equipment body 4, radially spaced from the tilting axis T for guiding the tilting movement.

[00110]. Such pairs of surfaces 22, 24 are therefore in mutual contact to accompany the tilting movement of the equipment body 4.

[00111]. According to an embodiment, the excavation equipment 1 comprises internal sliding surfaces 22 which extend - for example annularly - around the rotation fulcrum 18.

[00112]. It should be noted that the expressions "internal" and "external" will be understood in a radial direction with respect to the tilting axis T, unless otherwise specified. Furthermore, these expressions will have an exclusively relative meaning, in the sense that a surface defined as internal will be innermore with respect to

a surface defined as external.

[00113]. According to an embodiment, the excavation equipment 1 comprises external sliding surfaces 24, radially offset with respect to the internal sliding surfaces 22 and which, according to a variant - extend in the form of a circular sector around the rotation fulcrum 18.

[00114]. According to an embodiment, the excavation equipment 1 comprises the internal sliding surfaces 22 and the external sliding surfaces 24, which extend in sliding planes P1, P2 substantially orthogonal with respect to the tilting axis T.

[00115]. According to an embodiment, the sliding planes P1, P2 are substantially parallel or coincident.

[00116]. According to an embodiment, the sliding surfaces P1, P2 are axially spaced apart from the tilting axis T.

[00117]. According to an embodiment, the external sliding surfaces 24 overtake the internal sliding surfaces 22 in the working direction W of the excavation equipment 1.

[00118]. According to an embodiment not shown, the internal sliding surfaces overtake the external sliding surfaces in the working direction W of the excavation equipment 1.

[00119]. According to an embodiment, the excavation equipment 1 comprises guiding means 26, 28 of the equipment body 4 in different tilting positions.

[00120]. The "tilting positions" are therefore the positions that the excavation tool 12 and the equipment body 4 reach following rotation around the tilting axis T.

[00121]. According to an embodiment, the guiding means 26, 28 extend substantially arcuate around the tilting axis T and, specifically, are centered on this axis T.

[00122]. According to an embodiment, the guiding means 26, 28 comprise at least one guide slot 30 (for example, a pair of slots 30, optionally opposite to each other) obtained at the equipment body 4 or the coupling portion 2, and at least one guide pin 32 connected to the coupling portion 2 or to the equipment body 4, slidably accommodated in the guide slot 30.

[00123]. According to an embodiment, end edges 34, 36 of the guide slot 30 provide end-of-stroke elements for the guide pin 32, in particular in limit tilting positions.

[00124]. According to an embodiment not shown, the guiding means comprise a guide member at the equipment body 4 or at the coupling portion 2, delimiting a recess in which a guide wall of the coupling portion 2 or of the equipment body 4 is slidably inserted.

[00125]. According to an embodiment, the guide member may comprise an open box-like structure.

[00126]. According to an embodiment, the articulation means 20 comprise at least a first actuator 38, optionally linear, acting in thrust or in traction between the coupling portion 2 and the equipment body 4, and configured for moving the latter in the different tilting positions.

[00127]. According to an embodiment, the first actuator 38 works in a tangential direction S with respect to the tilting axis T, in at least a working position thereof.

[00128]. According to an embodiment, the articulation means comprise a non-linear actuator.

[00129]. According to an embodiment, the articulation means comprise a pinion and wheel/crown gear system - reciprocally meshed - for moving the equipment body 4 in the various tilting positions.

[00130]. The above objects are also achieved by means of an excavation assembly 100 comprising an operating machine 10 and an excavation equipment 1, according to any one of the embodiments illustrated above, fixed to a movable arm 42 or to a support of the operating machine 10.

[00131]. According to an embodiment, the operating machine 10 may comprise a fluidic power take-off for supplying the hydraulic motor means 40.

[00132]. According to an embodiment, the operating machine 10 may comprise a power take-off for supplying the motor means 40 of a mechanical type.

[00133]. According to an embodiment, the operating machine 10 may comprise supply means for supplying the electric motor means 40.

[00134]. According to an embodiment, the operating machine 10 may be or may comprise a skid steer machine.

[00135]. Innovatively, the equipment and the assembly object of the present invention allow overcoming the drawbacks of the prior art.

[00136]. More precisely, the described equipment allows the inclination of the rotation axis of the tool to be changed for removing material in a different way according to the arrangement of the coupling portion.

[00137]. Advantageously, the equipment and the assembly object of the present invention allow an additional degree of freedom (that of tilting precisely) with respect to traditional machines, without however moving the center of gravity of the assembly away from the operating machine.

[00138]. Advantageously, the equipment object of the present invention allows maintaining reduced dimensions in the longitudinal direction.

[00139]. This allows an operator of the operating machine, when the equipment is in the park position (i.e. when the tool is placed above the work surface), to be able to freely exit the passenger compartment, without this equipment constituting an obstacle when opening a front door thereof.

[00140]. Moreover, this feature allows increasing the productivity of a single operator, who can carry out replacements of the excavation equipment on his own without the support of other workers.

[00141]. Advantageously, the equipment object of the present invention is extremely solid, and therefore suitable for withstanding without damage the excavation stresses despite the increased degrees of freedom.

[00142]. Advantageously, the equipment object of the present invention has a reliable tilting movement, and precise limit switch positions.

[00143]. Advantageously, the equipment object of the present invention is connected in a detachable manner removable from the

operating machine, through simple operations.

[00144]. Advantageously, the equipment object of the present invention maintains the degrees of freedom of traditional machines, including the lateral displacement of the excavation tool.

[00145]. Those skilled in the art may make several adjustments and replacements of elements with others which are functionally equivalent to the embodiments described above in order to meet incidental and specific needs, without departing from the scope of the following claims.

[00146]. Moreover, each variant described as belonging to a possible embodiment may be implemented independently of the other variants described.

[00147]. According to an embodiment, the excavation equipment 1 comprises external sliding surfaces 24 and internal sliding surfaces 22. Said external sliding surfaces 24 are arranged, with respect to said tilting axis T, radially externally, that is, further away from a surface to be machined Z with respect to said internal sliding surfaces 22.

[00148]. Said external sliding surfaces 24 are arranged and extend in sliding planes P1, P2. Said sliding planes P1, P2 are substantially orthogonal with respect to said tilting axis T.

[00149]. Said sliding planes P1, P2 are substantially parallel and, with respect to said tilting axis T, are axially spaced. Said external sliding surfaces 24 overtake the internal sliding surfaces 22 in the working direction W of the excavation equipment 1.

[00150]. Thanks to the provision of external sliding surfaces 24

offset both radially and axially with respect to the internal sliding surfaces 22, in particular so that the external sliding surfaces overtake said internal sliding surfaces, it is possible to connect the excavation equipment 1 to a Skid-Loader which notoriously has an access opening for an operator placed at the front, that is, facing the excavation equipment, and allow the excavation equipment to be placed, parking it, with the tool resting on a surface to be worked and, at the same time, keep said access opening of the Skid-Loader accessible even by leaving the excavation equipment 1 connected to the Skid-Loader, which was not possible in the solutions of the prior art, thus having to bring, in the solutions of the prior art, the connecting arms of the Skid-Loader, and consequently the excavation equipment 1 parked above the surface to be machined, in a front position and facing the access opening of the Skid-Loader, preventing access thereto and making it necessary to always have at least two operators, one of which external to the Skid-Loader, to allow the operator inside the Skid-Loader to exit by previously uncoupling the excavation equipment 1 from the Skid-Loader.

[00151]. According to an embodiment, said excavation equipment 1 is of the self-leveling type in which an internal frame 101 supports an excavation tool 12 and wherein said internal frame 101 is housed inside an equipment body or external frame 4.

[00152]. Said external frame 4 comprises opposite external frame side walls 201, 202 and at least one external frame front wall 203, wherein said external frame front wall 203 is rigidly connected to

said opposite external frame side walls 201, 202 forming a structure in a single body that surrounds said internal frame 101 frontally, that is, surrounds it preceding the excavation tool 12 in the advancement direction or working direction W.

[00153]. According to an embodiment, said external frame 4 comprises at least one shoe 204 suitable for resting on the work surface or surface to be machined Z so that said external frame 4 rests on said surface to be machined Z.

[00154]. Thanks to the provision of an external frame 203 with a box-like structure with external frame front wall 203 rigidly connected to opposite external frame side walls 201, 202, it is possible to ensure greater rigidity and durability of the external frame and therefore less maintenance of the equipment.

REFERENCE LIST

1 Excavation equipment

2 Skid-Loader coupling portion or coupling translator

4 Equipment body or external frame

6 Abutment shoe

10 Operating machine

12 Excavation tool, for example excavation wheel

14 Excavation element

16 Adjustment means

18 Rotation fulcrum

20 Articulation means or tilting joint

22 Internal sliding surfaces

24 External sliding surfaces

26 Guiding means

28 Guiding means

30 Guide slot

32 Guide pin

34 End edge

36 End edge

38 First actuator - excavation tool tilting actuator

40 Excavation tool motor means

42 Movable arm

44 Element end

46 Translation support

48 Adjustment arm

50 Second actuator

52 Sliding guide

54 Translation guide

56 Translation guide

58 Lower surface

60 Adjustment direction

100 Excavation assembly

101 Internal frame

102 Excavation depth adjustment actuator

103 Rear frame

104 Excavator tool steering adjustment actuator

105 Sliding support

106 Steering bearing

107 Tilting bearing

108 Steering device

109 Trench or excavation with predefined path

110 Excavation width

111 Excavation curve width

112 First part of steering bearing

113 Second part of steering bearing

114 Tilting stroke

115 Inclination of the operating machine with respect to the excavation tool

201 First side wall of external frame

202 Second opposite wall of external frame

203 Front wall of external frame

204 At least one external frame shoe resting on the surface to be worked

P1 Sliding plane

P2 Sliding plane

Q1 Excavation depth

Q2 Excavation depth

R Rotation depth of the excavation tool

S Tangential direction

T Tilting axis

V Center line longitudinal plane

W Work direction

Z Work surface or surface to be worked

VE Steering axis

X Excavation depth

CLAIMS

1. Excavation equipment (1) adapted to cooperate with an operating machine (10) comprising:

- an internal frame (101);
- said internal frame (101) rotatably supports an excavation tool (12) adapted to make, for example, trenches (109) dug in a work surface (Z) along an advancement direction or working direction (W);
- said excavation tool (12) being rotatable about a rotation axis (R) of excavation tool;
- said excavation equipment (1) further comprising a rear frame (103);
- said rear frame (103) supports said internal frame (101);

wherein

- a steering device (108) is provided between said rear frame (103) and said internal frame (101);
- said steering device (108) defines a steering axis (VE) around which said excavation tool (12) rotates;

and wherein

- said excavation equipment (1) is adapted to position itself frontally on an operating machine (10), so as to precede the operating machine (10) according to the working direction (W);

characterized in that

- said steering axis (VE) is arranged substantially orthogonal to said advancement direction, or working direction (W), and to said excavation tool rotation axis (R); and wherein
- said excavation equipment (1) comprises a coupling portion, or coupling translator (2), with which a sliding support (105), to which said rear support (103) is connected, is slidably supported and associated; and wherein
- said sliding support (105) comprises a tilting joint, or articulation means (20), interposed between said sliding support (105) and said rear frame (103); and wherein

- said tilting joint, or articulation means (20), defines a tilting axis (T) arranged substantially orthogonal to said excavation tool rotation direction (R); and wherein
- said tilting axis (T) is arranged substantially orthogonal to said steering axis (VE).

2. Excavation equipment (1) according to claim 1, wherein
- said excavation tool rotation axis (R) is arranged orthogonal to said advancement direction or working direction (W);
and/or wherein
- said advancement direction or working direction (W) is parallel to said work surface (Z); and wherein
- said excavation tool rotation axis (R) is arranged parallel to said working direction (Z);
and/or wherein
- the excavation equipment (1) comprises external sliding surfaces (24) and internal sliding surfaces (22); said external sliding surfaces (24) are arranged, with respect to said tilting axis (T), radially externally, that is, further away from a surface to be machined (Z) with respect to said internal sliding surfaces (22); and wherein
- external sliding surfaces (24) extend in sliding planes (P1, P2); and wherein said sliding planes (P1, P2) are substantially orthogonal with respect to said tilting axis (T); and wherein
- said sliding planes (P1, P2) are substantially parallel and, with respect to said tilting axis (T), are axially spaced; and wherein the external sliding surfaces (24) overtake the internal sliding surfaces (22) in the working direction (W) of the excavation equipment (1).

3. Excavation equipment (1) according to any one of the preceding claims, wherein
- said steering device (108) comprises a steering bearing (106);

- said steering bearing (106) comprises a first steering bearing part (112) which rotatably cooperates with a second steering bearing part (113) thereof;
- said steering bearing (106) is connected with said first steering bearing part (112) thereof to said rear frame (103) and with said second steering bearing part (113) thereof is connected with said internal frame (101); and wherein
- said steering bearing (106) defines the steering axis (VE) around which said excavation tool (12) rotates.

4. Excavation equipment (1) according to any one of the preceding claims, wherein
- said excavation equipment (1) comprises a steering adjustment actuator (104);
- said steering adjustment actuator (104) acts in thrust or traction between said rear frame (103) and said internal frame (101) so as to allow rotation of the excavation tool (12) around said steering axis (VE);
and/or wherein
said steering adjustment actuator (104) is hydraulic, mechanical or electric.

5. Excavation equipment (1) according to any one of the preceding claims, wherein
- said excavation tool (12) is rotatable around said excavation tool rotation axis (R) with respect to said internal frame (101) by means of motor means (40), for example of the hydraulic, mechanical or electric type, said motor means (40) being engaged with, and being movable in a manner integral with, the excavation tool (12).

6. Excavation equipment (1) according to any one of the preceding claims, wherein
- said coupling portion or coupling translator (2) with which a sliding support (105) is slidably supported and associated is a Skid-Loader coupling portion or coupling translator;

- said tilting joint or articulation means (20) comprises a tilting bearing (107);
- said tilting bearing (107) is connected with a first tilting bearing part thereof to said sliding support (105) and with a second part thereof, rotatably connected to the first part, it is connected to said rear frame (103);
and/or wherein
- said tilting bearing (107) defines a tilting axis (T) arranged orthogonal to said excavation tool rotation direction (R);
and/or wherein
- said tilting bearing (107) defines a tilting axis (T) arranged parallel to said advancement direction or working direction (W)
and/or wherein
- said tilting bearing (107) defines a tilting axis (T) arranged substantially orthogonal to said steering axis (VE).

7. Excavation equipment (1) according to any one of the preceding claims, wherein
- said excavation equipment (1) comprises a first actuator or actuator for actuating the excavation tool (38) acting in thrust or in traction between said sliding support (105) and said rear frame so as to allow rotation of the excavation tool (12) around a tilting axis (T).

8. Excavation equipment (1) according to any one of the preceding claims, wherein
- said steering bearing (106) comprises an internal fifth wheel (112) connected to said rear frame (103), and an external fifth wheel (113) connected to said internal frame (101);
and/or wherein
- said steering bearing (106) comprises curvilinear guides integral with said internal frame (101) or with said rear frame (103); and wherein

- said steering bearing (106) comprises shoes fitted on said curvilinear guides, said shoes being integral with said rear frame (103) or said internal frame (101).

9. Excavation equipment (1) according to any one of the preceding claims, wherein
- said excavation equipment (1) is of the self-leveling type in which an internal frame (101) supports an excavation tool (12) and is housed inside an equipment body or external frame (4);
and/or wherein
- said excavation equipment (1) comprises an excavation depth adjustment actuator (102); and wherein
- said excavation depth adjustment actuator (102) acts in thrust or traction between said internal frame (101) and said external frame (4) so as to allow the exit of said excavation tool (12) from said external frame (4) increasing or decreasing the excavation depth (X);
and/or wherein
- said external frame (4) comprises opposite external frame side walls (201, 202) and at least one external frame front wall (203), wherein said external frame front wall (203) is rigidly connected to said opposite external frame side walls (201, 202) forming a structure that surrounds said internal frame (101) frontally, that is, preceding the excavation tool (12) in the advancement direction or working direction (W);
and/or wherein
- said external frame (4) comprises at least one shoe (204) suitable for resting on the work surface or surface to be machined (Z) so that said external frame (4) rests on said surface to be machined (Z).

10. Operating machine (10) comprising excavation equipment (1) according to any one of the preceding claims.

11. Operating machine (10) according to claim 10, wherein

- said excavation equipment (1) is placed frontally to said operating machine (10) so that said excavation equipment (1) precedes said operating machine (10) in the working direction (W).

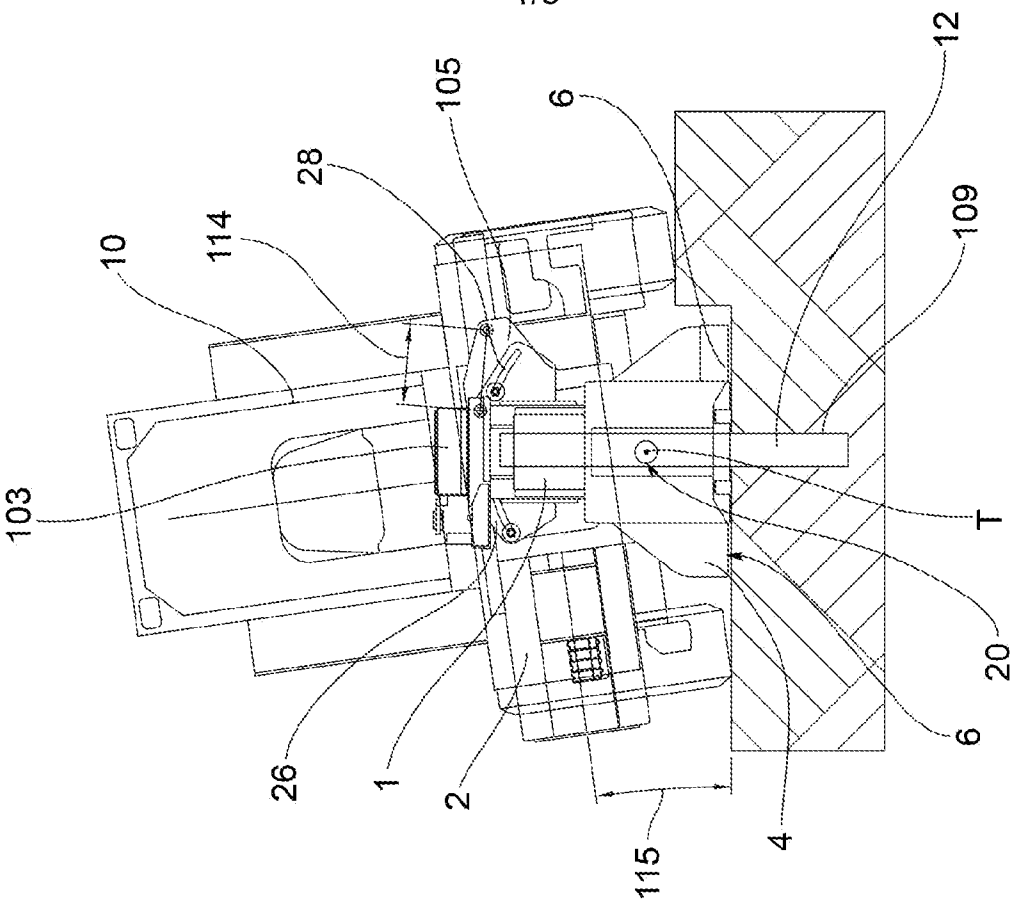

12
105
6
28
109
114
10
103
T
20
26
1
2
6
4
115

FIG.2

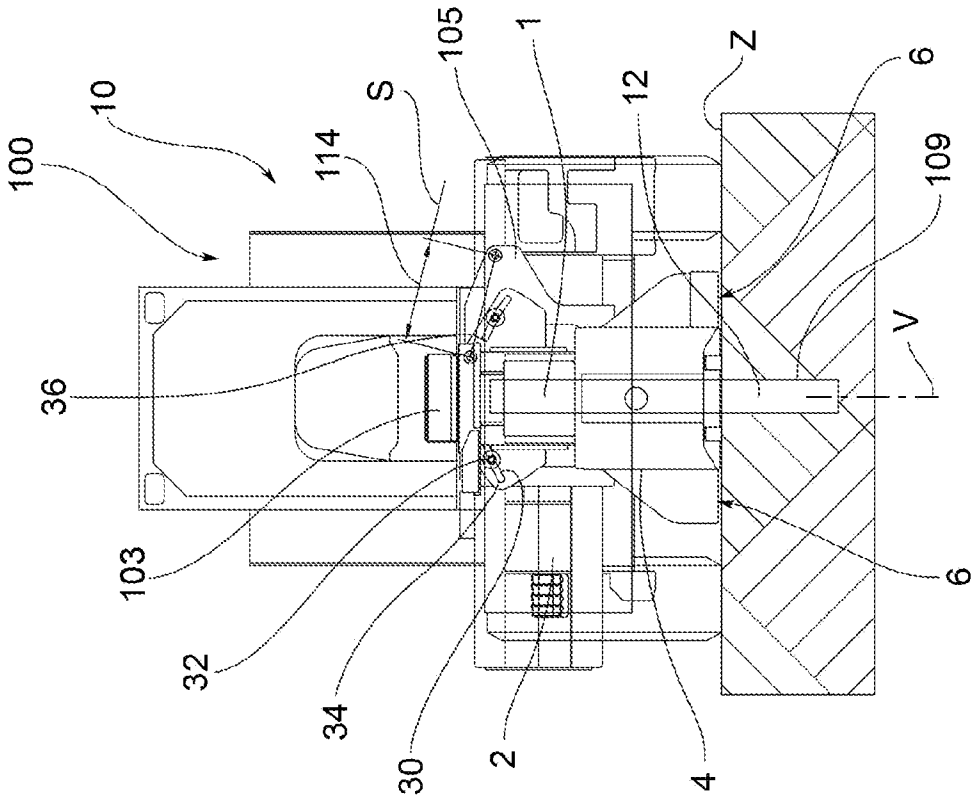

105
1
Z
6
S
12
10
109
114
100
V
36
6
103
32
34
30
2
4

FIG.1

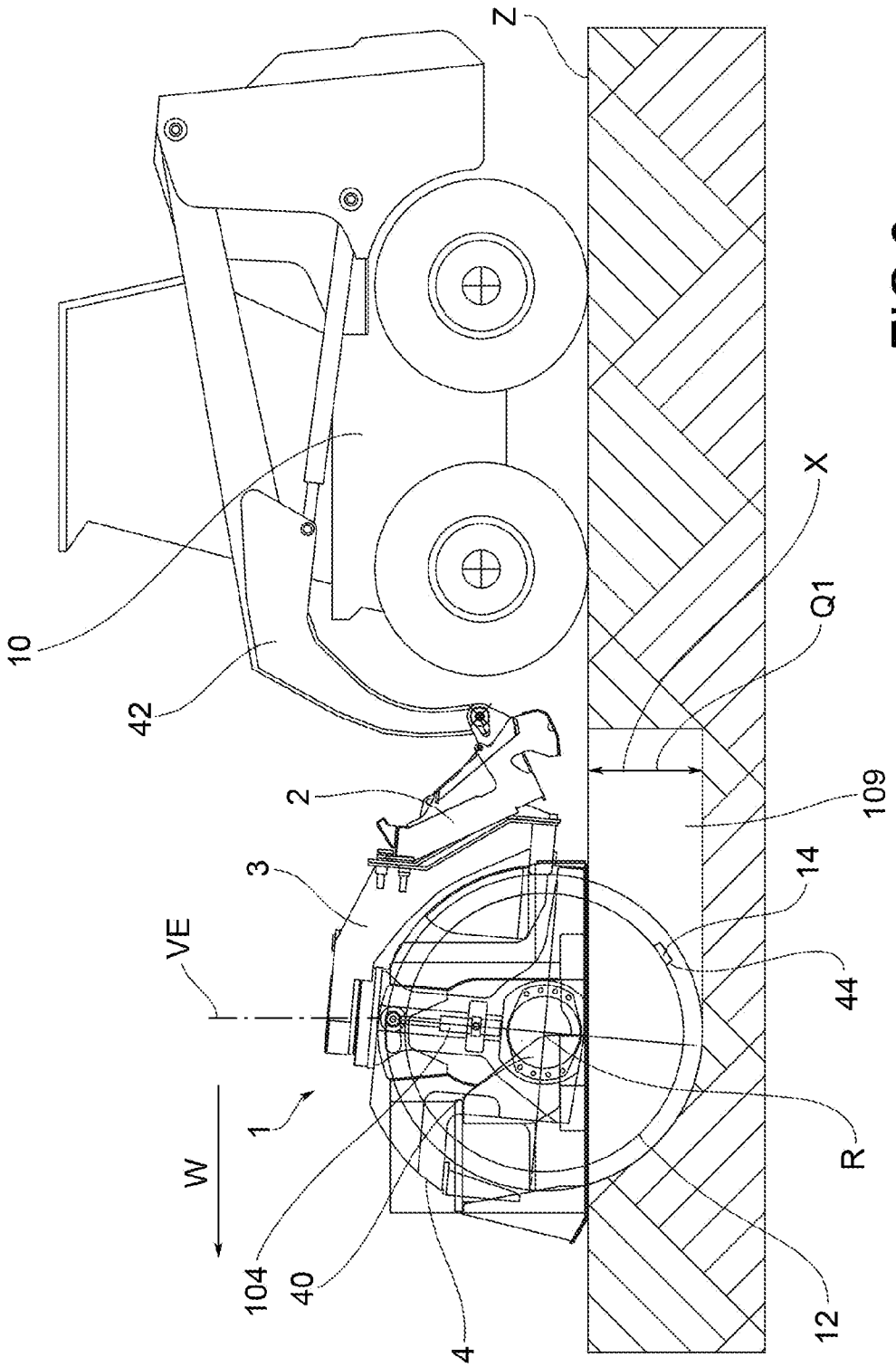


FIG.3

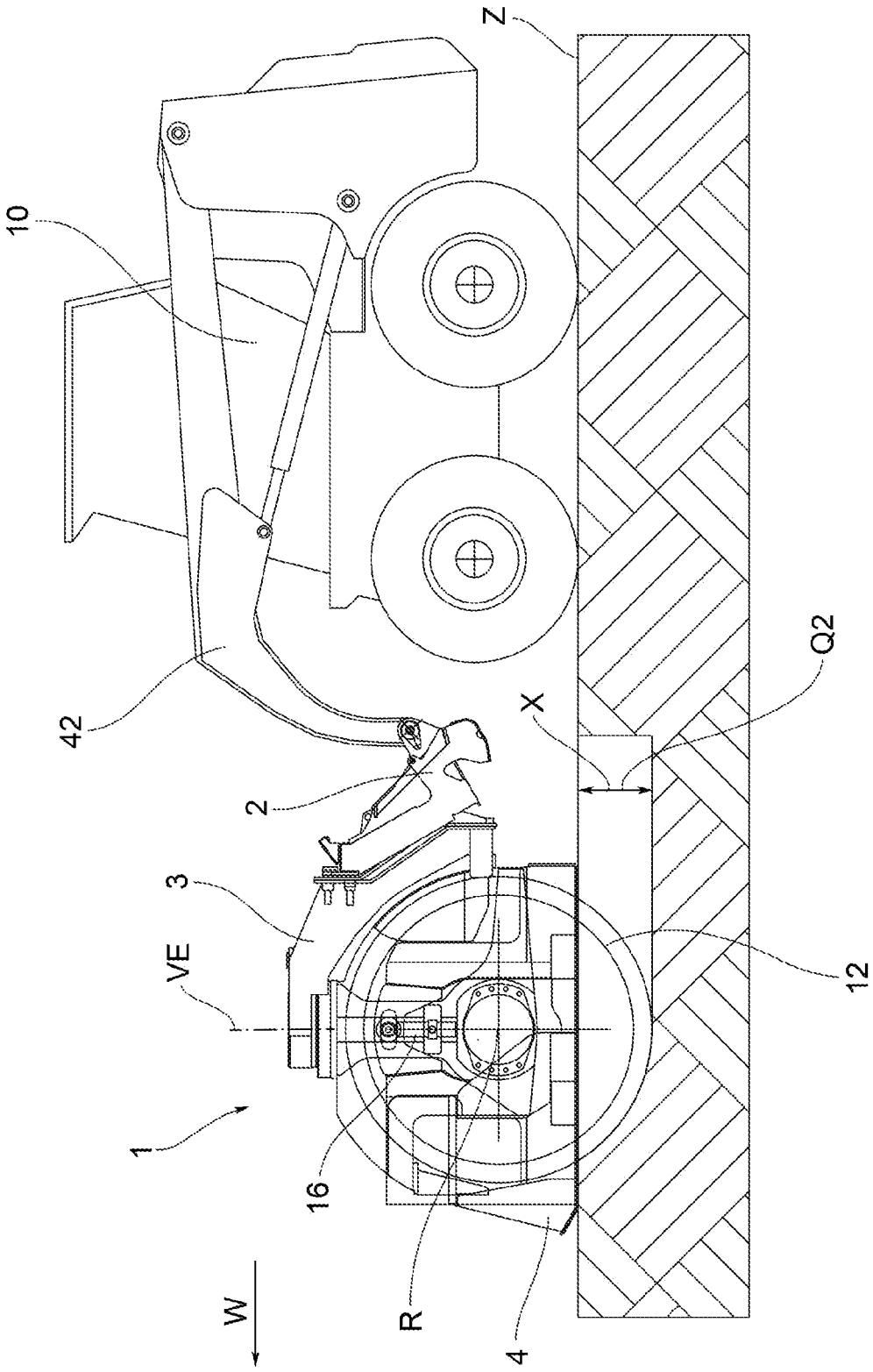


FIG.4

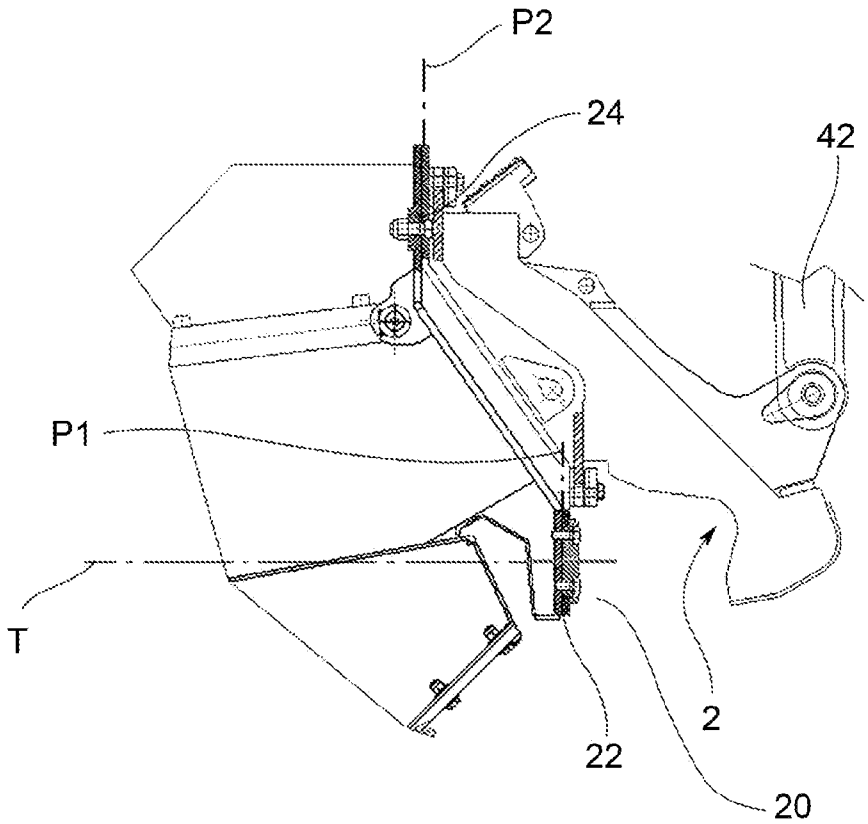


FIG.5

FIG. 6A

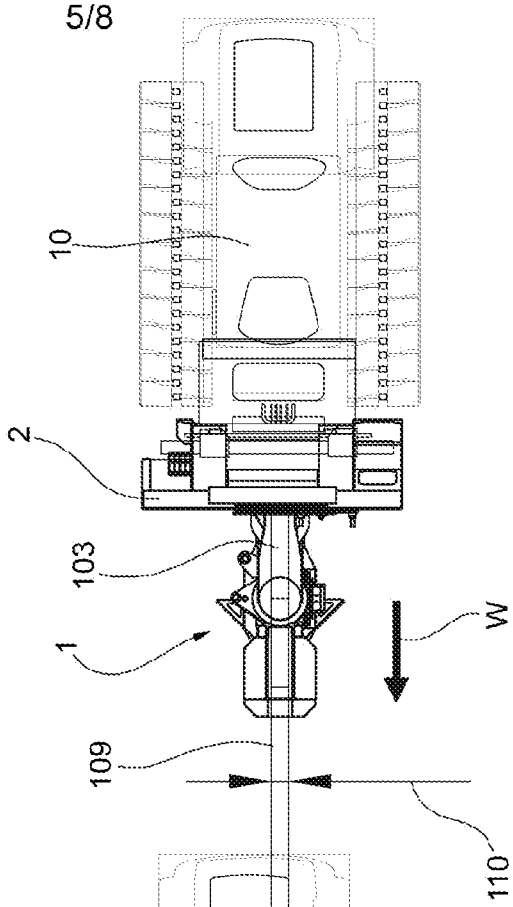
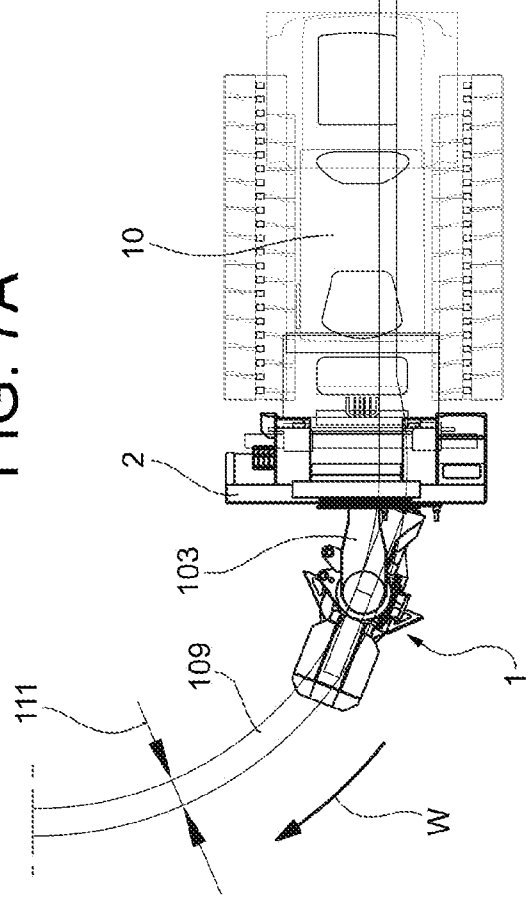


FIG. 7A



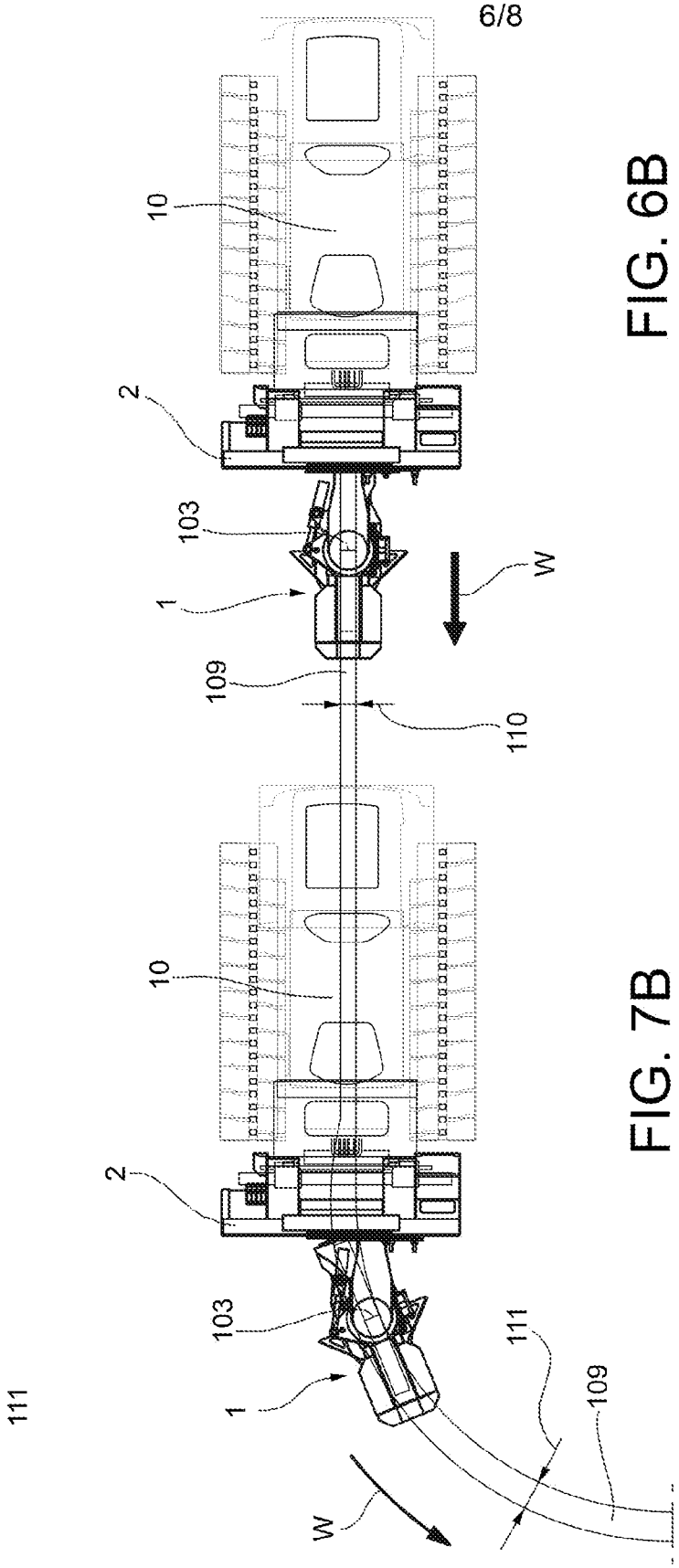
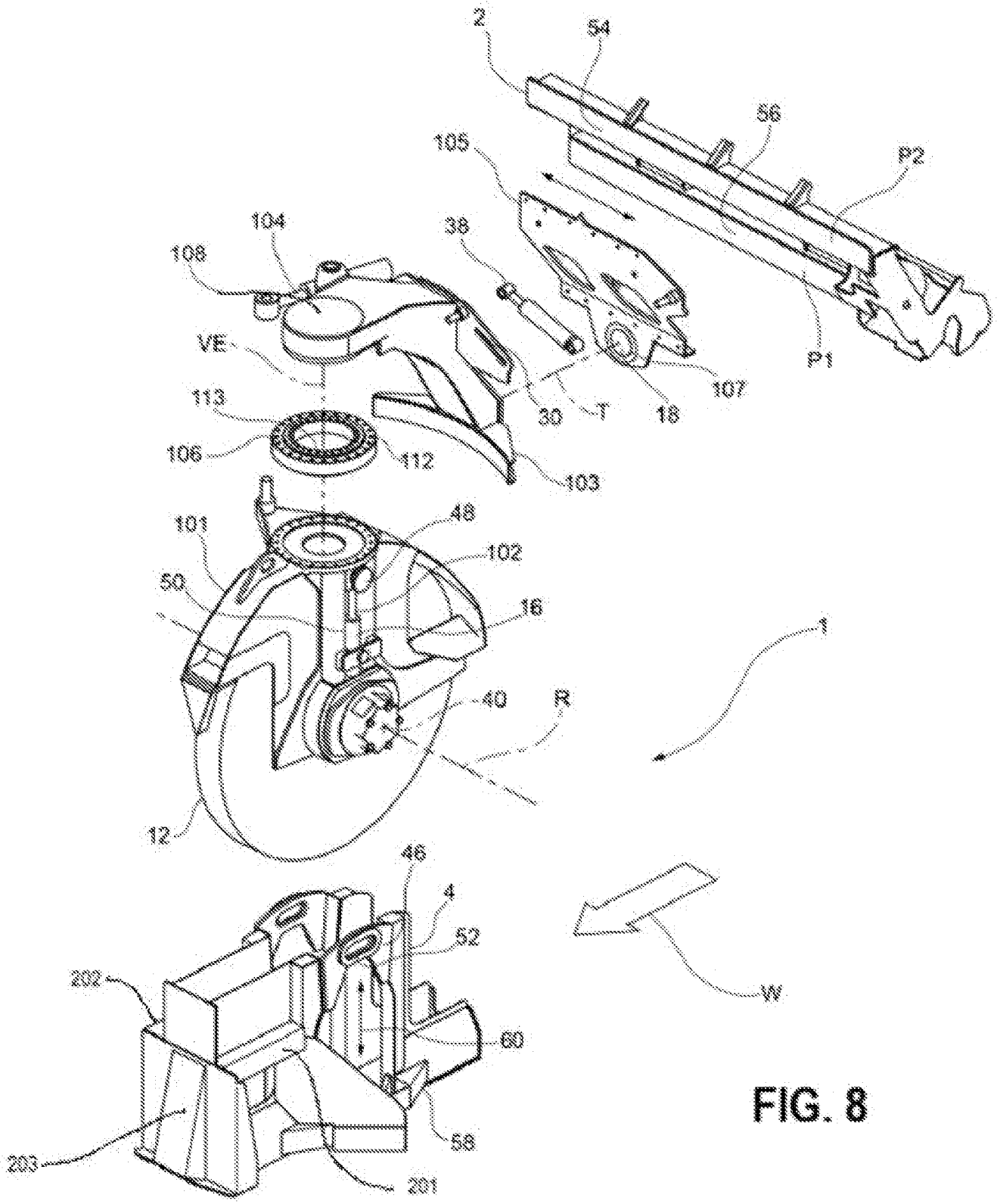


FIG. 6B

FIG. 7B


2
54
56
105
P2
104
38
108
VE
113
106
112
103
30
T
18
107
P1
101
48
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50
16
1
40
R
12
46
4
52
202
60
58
203
201
W

FIG. 8

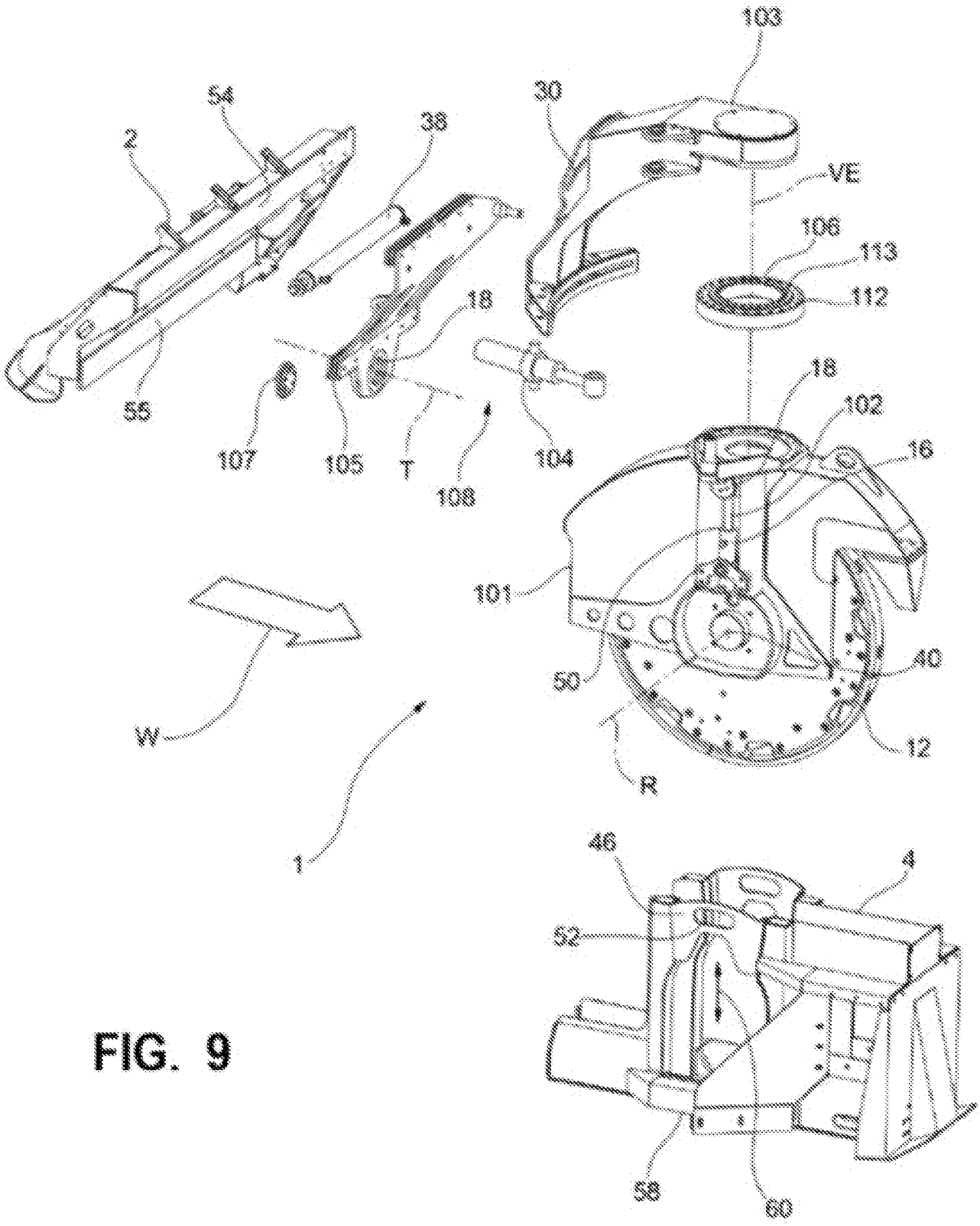
103
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FIG. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2020/053091

A. CLASSIFICATION OF SUBJECT MATTER
INV. E02F3/20 E02F5/02 E01C23/088 E02F3/18 E02F5/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E02F E01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 878 713 A (ZANETIS C CHRISTOPHER [US]) 7 November 1989 (1989-11-07) column 7, line 53 - column 8, line 17; figure 9	1
A	GB 2 512 945 A (AUGER TORQUE EUROP LTD [GB]) 15 October 2014 (2014-10-15) page 5, line 23 - page 6, line 4	1
A	EP 0 310 074 A2 (BROHL FRANZ) 5 April 1989 (1989-04-05) column 7, line 37 - line 47; figures 1,2	1
A	WO 2016/038126 A1 (SIMEX ENGINEERING S R L [IT]) 17 March 2016 (2016-03-17) figure 4	1

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 June 2020	24/06/2020

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Papadimitriou, S

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2020/053091

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 496 699 A (JAMES BAIRD QUINN) 2 May 1893 (1893-05-02) page 1, line 49 - line 61; figures 1,3,4	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2020/053091

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