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(54) **SHEET PILING INSTALLATION FOR SHEET PILES**

(57) The invention relates to a sheet piling installation for insertion of a sheet pile in a subsoil, wherein the sheet pile comprises a first sheet pile tube that defines a first sheet pile channel, and a second sheet pile tube that defines a second sheet pile channel, and wherein the sheet piling installation comprises an elongated king post, and a drill assembly and a sheet pile guide assembly on the king post, wherein the drill assembly comprises an elongated first soil drill and a first drill drive assembly for rotation of the first soil drill, and an elongated second soil drill and a second drill drive assembly for rotation of the second soil drill, wherein the first soil drill and the second soil drill extend parallel to each other and pass through the respective first sheet pile channel and second sheet pile channel.

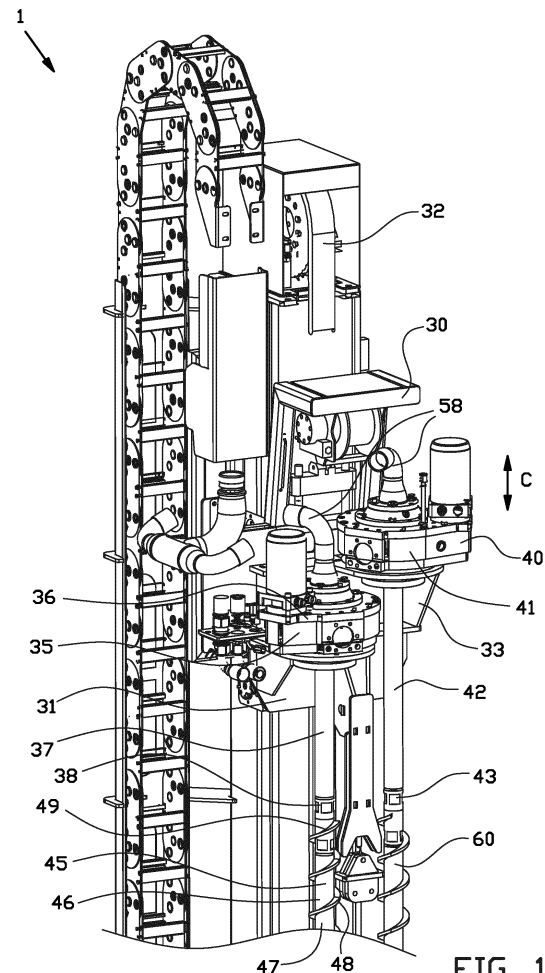


FIG. 1B

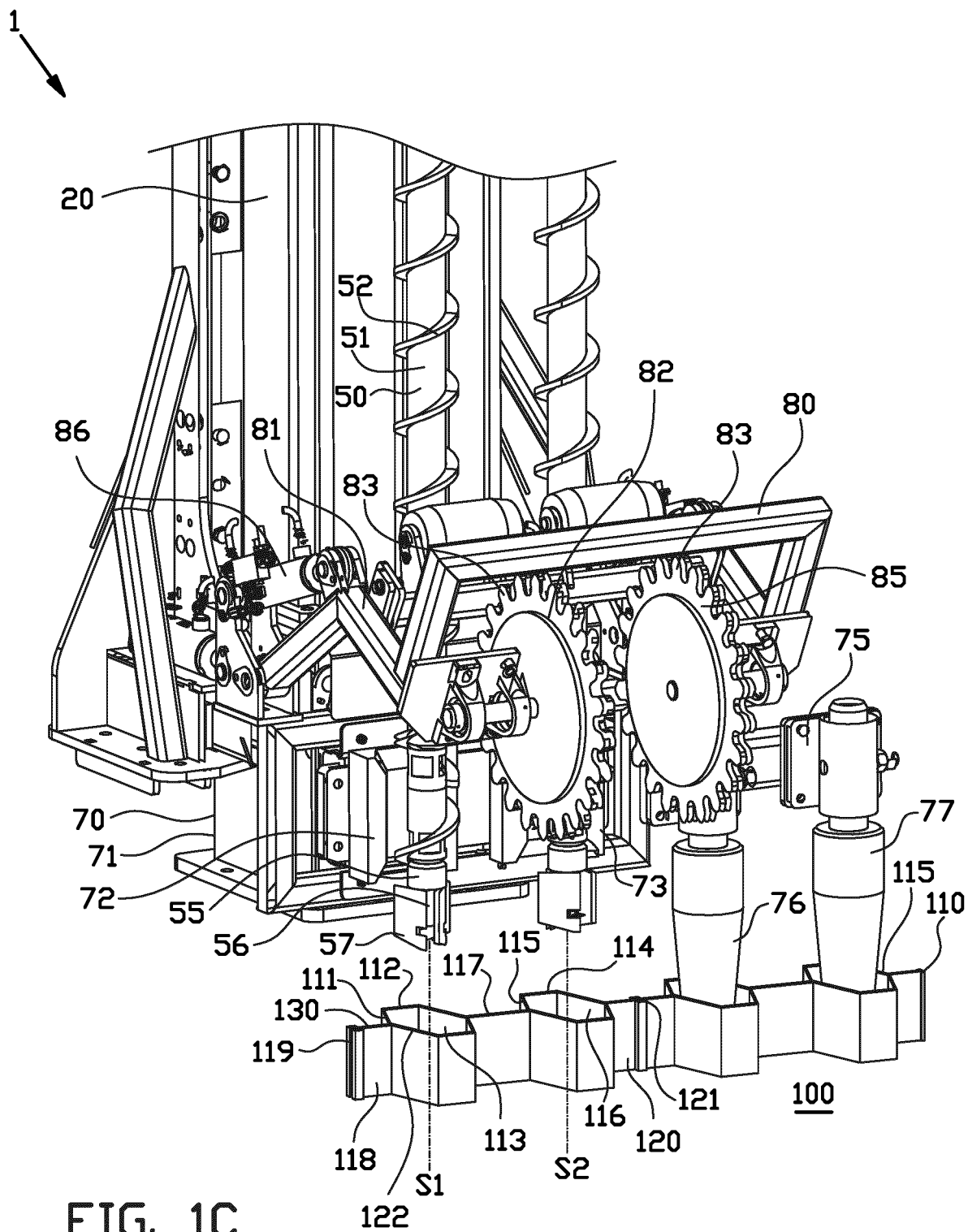


FIG. 1C

Description

BACKGROUND

[0001] The invention relates to a sheet piling installation for insertion of a sheet pile in a subsoil.

SUMMARY OF THE INVENTION

[0002] Sheet piles are used for the stabilization of a soil body. For large infrastructural projects, such as a deep underground parking garage, steel sheet piles are driven or vibrated into the subsoil. The steel sheet piles may have an inserted length of more than 15 meters. When the infrastructural project is finished, the steel sheet piles are usually removed to be reused.

[0003] For small infrastructural projects, such as a retention ditch in a garden or park, single use plastic sheet piles are installed. However, the inserted length is very limited, in practice to about 2 meters, which can be reached by flushing the surrounding subsoil while the plastic sheet pile is pushed downwards into the subsoil. Alternatively, as disclosed in for example US2007/0065235, the plastic sheet piles are inserted in the subsoil while being fully enclosed in a protective metal housing.

[0004] It is an object of the present invention to provide a sheet piling installation for insertion of a sheet pile in a subsoil that can be used for plastic sheet piles with a length of more than 2 meters.

[0005] According to a first aspect, the invention provides a sheet piling installation for insertion of a sheet pile in a subsoil, wherein the sheet pile comprises a first sheet pile tube that defines a first sheet pile channel, and a second sheet pile tube that defines a second sheet pile channel, wherein the first sheet pile tube and the second sheet pile tube extend parallel to each other, and wherein the sheet piling installation comprises an elongated king post, and a drill assembly and a sheet pile guide assembly on the king post, wherein the drill assembly comprises an elongated first soil drill and a first drill drive assembly for rotation of the first soil drill, and an elongated second soil drill and a second drill drive assembly for rotation of the second soil drill, wherein the first soil drill and the second soil drill extend parallel to each other and pass through the respective first sheet pile channel and second sheet pile channel.

[0006] The sheet piling installation according to the invention comprises a first soil drill and a second soil drill that extend parallel to each other and that pass through the respective first sheet pile channel and second sheet pile channel, whereby the distal ends, in practice the drill heads, project downwardly beyond the bottom of the sheet pile to loosen the subsoil under the sheet pile tubes to facilitate the insertion of the sheet pile. This can be performed for any insertion length, and therefore for any length of the sheet pile. In this manner long plastic sheet piles can be inserted in the subsoil.

[0007] In an embodiment the first soil drill and the second soil drill comprise a base tube and a drill head at the end of the base tube, wherein the drill head comprises a head base on the base tube and multiple drill teeth that are moveable with respect to the head base between a retracted position in which the drill head fits through the first sheet pile channel or second sheet pile channel, and an extended position in which the outer diameter of the drill head is larger than the largest inner diameter of the first sheet pile channel or second sheet pile channel. According to this embodiment the soil drills can pass through the sheet pile tubes, whereafter the drill teeth are extended to loosen the subsoil amply under the sheet pile tubes.

[0008] In an embodiment thereof the drill teeth are hingable connected with the head base, wherein the drill teeth hinge between the retracted position and the extended position by engagement of surrounding soil and in dependency on a rotation direction of the drill head.

[0009] In an embodiment the first soil drill and the second soil drill comprise a flight that spirals around the base tube to remove the loosened subsoil under the sheet pile tubes.

[0010] In an embodiment the first soil drill and the second soil drill extend parallel to the king post.

[0011] In an embodiment the sheet pile guide assembly comprises one or more sheet pile guides that engage the sheet pile, and a positioning device that engages a sheet pile that is already inserted in the subsoil to facilitate the subsequent insert operations.

[0012] In an embodiment thereof the sheet pile comprises a first coupling edge and a second coupling edge along its length, wherein the positioning device is positioned with respect to the one or more sheet pile guides to bring the first coupling edge of the already inserted sheet pile in engagement with the second coupling edge of the sheet pile to be inserted in the subsoil.

[0013] In an embodiment the positioning device comprises one or more positioning cones that tightly wedge into the first sheet pile channel or second sheet pile channel.

[0014] In an embodiment the sheet pile is made of plastic.

[0015] According to a second aspect, the invention provides a method for insertion of a sheet pile in a subsoil by means of a sheet piling installation, wherein the sheet pile comprises a first sheet pile tube that defines a first sheet pile channel, and a second sheet pile tube that defines a second sheet pile channel, wherein the first sheet pile tube and the second sheet pile tube extend parallel to each other, and wherein the sheet piling installation comprises an elongated king post, and a drill assembly and a sheet pile guide assembly on the king post, wherein the drill assembly comprises an elongated first soil drill and a first drill drive assembly for rotation of the first soil drill, and an elongated second soil drill and a second drill drive assembly for rotation of the second soil drill, wherein the first soil drill and the second soil drill

extend parallel to each other and pass through the respective first sheet pile channel and second sheet pile channel, wherein the method comprises insertion of the sheet pile while the first soil drill and the second soil drill are rotated, wherein during the insertion the first soil drill and the second soil drill project with their distal ends downwardly from a bottom edge of the sheet pile.

[0016] GB 2 060 742 discloses an apparatus for driving sheet piles, wherein the sheet piles comprise a web and a pair of oppositely sloping flange walls on both sides of the web. The apparatus comprises a screw auger and a tubular screw enclosure that is releasably hooked onto the sheet pile so as to leave exposed only the drill head of the screw auger.

[0017] The various aspects and features described and shown in the specification can be applied, individually, wherever possible. These individual aspects, in particular the aspects and features described in the attached dependent claims, can be made subject of divisional patent applications.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The invention will be elucidated on the basis of an exemplary embodiment shown in the attached drawings, in which:

Figures 1A-1C are an isometric view of a sheet piling installation for insertion of sheet piles in a subsoil, and two details thereof; and

Figures 2A and 2B are an isometric view and a detail of the sheet piling installation during insertion of a sheet pile in the soil.

DETAILED DESCRIPTION OF THE INVENTION

[0019] Figure 1A shows a sheet piling installation 1 according to an embodiment of the invention for vertical insertion of sheet piles 110, 130 in a subsoil 100. The subsoil 100 comprises sand or clay that can be loosened.

[0020] The sheet piles 110, 130 consist of a rigid plastic, in this example polyvinylchloride (PVC), and are intended for single use. The sheet piles 110, 130 are prismatic and each comprise a hexagonal first sheet pile tube 111 with six straight tube wall sections 112 that define a first sheet pile channel 113, and a hexagonal second sheet pile tube 114 with six straight tube wall sections 115 that define a second sheet pile channel 116. The first sheet pile tube 111 and the second sheet pile tube 114 are connected to each other by means of a straight intermediate wall section 117. The sheet piles 110, 130 comprise a first end wall section 118 on the first sheet pile tube 111 that merges into a first coupling edge 119, and a second end wall section 120 on the second sheet pile tube 114 that merges into a second coupling edge 121. The first coupling edge 119 and the second coupling edge 121 mate with each other to interlock the sheet piles 110, 130 along their length. The first end wall section

118, the intermediate wall section 117 and the second end wall section 120 extend in a common straight plane. The sheet piles 110, 130 comprise a top edge 122 as shown in figure 1C, and a bottom edge 123 as shown in figure 2B.

[0021] The sheet piling installation 1 comprises an hydraulically driven crawler crane 2 that is displaceable over the subsoil 100. The crawler crane 2 comprises a crawler base 3, a crane body 4 that is rotatable with respect to the crawler base 3 around a vertical axis, a boom 5 that is hingeable connected with the crane body 4 to hinge around a horizontal axis with respect to the crane body 4 by means of hydraulic cylinders, and an arm 6 that is hingeable connected with the boom 5 to hinge around a horizontal axis with respect to the boom 5 by means of hydraulic cylinders.

[0022] The sheet piling installation 1 comprises an elongate king post 20 with a centreline A that is kept vertically upright during insertion of the sheet piles 110, 130. The sheet piling installation 1 comprises a first bracket 7 that is hingeable connected to the distal end of the arm 6 to hinge around a horizontal axis with respect to the boom 5 by means of an hydraulic cylinder 8, and a second bracket 21 that carries the king post 20 and that is hingable connected with the first bracket 7 to hinge around a hinge axis that extends parallel to the king post 20 by means of hydraulic cylinders. The hinging connections enable the sheet piling installation 1 to bring the vertical king post 20 at any location on the subsoil 101 around the crawler base 3, and in any orientation around its centreline A within reach of the hinging connections. The hinging connections also enable the sheet piling installation 1 to turn up the king post 20 into its vertical position and to turn down the king post 20 to an oblique or horizontal position.

[0023] The sheet piling installation 1 comprises a hydraulically driven linear drive 22 between the king post 20 and the first bracket 7 that enables the sheet piling installation 1 to hoist and lower the king post 20 with respect to the first bracket 7 in direction B over a limited linear stroke.

[0024] The sheet piling installation 1 comprises a drill assembly 30 along the king post 20. The drill assembly 30 comprises a carriage 31 that is guided along the king post 20 and a schematically indicated hydraulically driven drive belt 32 between the king post 20 and the carriage 31 for driving the carriage up and down in direction C along the king post 20. The drill assembly 30 comprises a frame 33 on the carriage 31 that carries a first drill drive assembly 35 and a second drill drive assembly 40. The first drill drive assembly 35 comprises a first hydraulic drill drive 36 that supports and rotates a hollow first drill drive shaft 37. The first drill shaft 37 merges into a first drill drive coupling 38. The second drill drive assembly 40 comprises a second hydraulic drill drive 41 that supports and rotates hollow second drill drive shaft 42. The second drive shaft 42 merges into a second drill drive coupling 43. The first drill drive coupling 38 and the sec-

ond drill drive coupling 43 are positioned spaced apart from each other and extend at the same vertical height with respect to the carriage 31.

[0025] The drill assembly 30 comprises an elongated first soil drill 45 with a first centreline S1 that is coupled with the first drill coupling 38, and an elongated second soil drill 60 with a second centreline S2 that is coupled with the second drill coupling 43. The first soil drill 45 and the second soil drill 60 extend with their centrelines S1, S2 parallel to each other and parallel to the centreline A of the king post 20.

[0026] The soil drills 45, 60 have the same length and both comprise one or more drill intermediate sections 46 and a drill end section 50 that are coupled in series. The drill intermediate sections 46 are selectively applied to adjust the length of the soil drills 45, 60 to the length of the sheet piles 110, 130. The drill intermediate sections 46 comprise a hollow base tube 47, one or more flights 48 spiralling around the base tube 47, and end couplings 49 that mate with each other and with the drill drive couplings 38, 43.

[0027] The drill end sections 50 comprise a hollow base tube 51, one or more flights 52 spiralling around the base tube 51, and an end coupling 53 that mates with the end coupling 49 of the intermediate section 46 and with the drill drive coupling 38, 43. The drill end sections 50 comprise a drill head 55 at the end of the base tube 51. The drill head 55 comprises a head base 56 on the base tube 51 and multiple drill teeth 56, in this example three drill teeth 57 that are hingeable connected with the head base 56. The drill teeth 57 hinge over a limited rotational stroke between a retracted position as shown in figure 1C, and an extended position as shown in figure 2B. The drill teeth 57 are evenly distributed around the circumference of the head base 56. In the retracted position the distal ends of the drill teeth 57 are in the direction as from the head base 56 to the distal end all directed in the same tangential direction. In the retracted position the drill head 55 fits inside and can pass through the channels 113, 116 of the sheet piles 110, 130. In the extended position the outer diameter of the drill head 55 along the distal ends of the drill teeth 57 is larger than the circumscribed circle of the tubes 111, 115 of the sheet piles 110, 130. The drill teeth are automatically extended by engagement of the surrounding soil when the drill head 55 is rotated in the drilling direction of the soil drill 45, 60, and are automatically retracted by engagement of the surrounding soil when the drill head 55 is rotated in the opposite direction. The drill heads 55 of the first soil drill 45 and the second soil drill 60 extend at the same vertical height.

[0028] The drill assembly 30 comprises conduits 58 that are connected with the first soil drill 45 and the second soil drill 60 via the first drill drive assembly 35 and the second drill drive assembly 40. The conduits 58 are connected with a flush water source for inserting flush water into the soil drills 45, 60 that escapes via the drill heads 55 when needed for a particular subsoil 100.

[0029] The sheet piling installation 1 comprises a sheet pile guide assembly 70 at the bottom side of the king post 20. The sheet pile guide assembly 70 comprises a frame 71 against the king post 20, and on the frame 71 a first sheet pile guide 72 for slidably engaging the first sheet pile tube 111 and a second sheet pile guide 73 for slidably engaging the second sheet pile tube 115 of the sheet piles 110, 130. The pile guide assembly 70 comprises a positioning device 75 on the frame 71 that comprises a first positioning cone 76 that tightly wedges in the first sheet pile channel 113, and a second positioning cone 77 that tightly wedges in the second sheet pile channel 116.

[0030] The sheet piling installation 1 comprises a drill scraper device 80 for releasing soil from the first soil drill 45 and the second soil drill 60 when retracted from the subsoil 100. The scraper device 80 comprises a bracket 81 that is in this embodiment hingeable mounted to the frame 71 of the sheet pile assembly 70. The drill scraper device 80 comprises a first scrape wheel 82 for the first soil drill 45 and a second scrape wheel 85 for the second soil drill 60. The scraper wheels 82, 85 comprise circumferential fingers 83 that loosely enclose the flights 48, 52 of the first soil drill 45 and the second soil drill 60 when the bracket 81 is hinged upwards by means of an hydraulic cylinder 86.

[0031] The sheet piling installation 1 comprises a not shown pushing device that is guided along the king post 20 and that engages the sheet pile 110, 130 to push it in direction D downwards into the subsoil 100.

[0032] The sheet piles 110, 130 are inserted one after the other along an installation path F. For the first insert operation for the first sheet pile 110, the drill assembly 30 is brought upwards along the king post 20 and the first first sheet pile 110 is hoisted or brought into the sheet piling installation 1. The first soil drill 45 is thereby fed through the first sheet pile channel 113 and the second soil drill is fed through the second sheet pile channel 116, wherein the drill teeth 57 are in their retracted position with respect to the head base 56. The drill assembly 30 is positioned such that with respect to the first sheet pile 110 the drill heads 55 project downwardly from the bottom edge 123 of the first sheet pile 110. The first sheet pile tube 112 and the second sheet pile tube 114 are engaged and vertically guided by the first sheet pile guide 72 and the second sheet pile guide 73.

[0033] After the first sheet pile 110 is brought into the sheet piling installation 1, the king post 20 is positioned to bring the bottom side of the first sheet pile 110 onto the installation path F. The first hydraulic drive assembly 36 and the second hydraulic drive assembly 41 rotate the first drill 45 and the second drill 60 in their drilling rotation direction E, whereby the drill teeth 57 hinge in direction G into their expanded position under the bottom of the first sheet pile 110 to simultaneously loosen the soil below the first sheet pile tube 112 and the second sheet pile tube 114. The pushing device pushes the first sheet pile 110 downwards in direction D into the subsoil

100 while the drill assembly 30 is simultaneously moved downwards in direction C to keep the drill heads 55 in their leading position with respect to the bottom of the first sheet pile 100. When the first sheet pile 100 has reached its final depth in the subsoil 100, the drill assembly 30 changes the rotation direction of the soil drills to retract the drill teeth 57, whereafter the soil drills are simultaneously hoisted out of the first sheet pile channel 112 and the second sheet pile channel 115.

[0034] Subsequently the second sheet pile 130 is brought into the sheet piling installation 1 and inserted in the same manner. During this second insert operation, the first positioning cone 76 and the second positioning cone 77 are wedged in the first sheet pile channel 113 and the second sheet pile channel 116 of the first sheet pile 110 to ensure that the first coupling edge 119 and the second coupling edge 121 engage each other.

[0035] It is to be understood that the above description is included to illustrate the operation of the preferred embodiments and is not meant to limit the scope of the invention. From the above discussion, many variations will be apparent to one skilled in the art that would yet be encompassed by the scope of the present invention.

Claims

1. Sheet piling installation (1) for insertion of a sheet pile (110) in a subsoil (100), wherein the sheet pile comprises a first sheet pile tube (111) that defines a first sheet pile channel (113), and a second sheet pile tube (114) that defines a second sheet pile channel (116), wherein the first sheet pile tube and the second sheet pile tube extend parallel to each other, and wherein the sheet piling installation comprises an elongated king post (20), and a drill assembly (30) and a sheet pile guide assembly (70) on the king post, wherein the drill assembly comprises an elongated first soil drill (45) and a first drill drive assembly (35) for rotation of the first soil drill, and an elongated second soil drill (60) and a second drill drive assembly (40) for rotation of the second soil drill, wherein the first soil drill (45) and the second soil drill (60) extend parallel to each other and pass through the respective first sheet pile channel (113) and second sheet pile channel (116).
2. Sheet piling installation (1) according to claim 1, wherein the first soil drill (45) and the second soil drill (60) comprise a base tube (51) and a drill head (55) at the end of the base tube, wherein the drill head comprises a head base (56) on the base tube and multiple drill teeth (57) that are moveable with respect to the head base between a retracted position in which the drill head (55) fits through the first sheet pile channel (113) or second sheet pile channel (116), and an extended position in which the outer diameter of the drill head (55) is larger than the largest inner diameter of the first sheet pile channel (113) or second sheet pile channel (116).
3. Sheet piling installation (1) according to claim 2, wherein the drill teeth (57) are hingable connected with the head base (56), wherein the drill teeth hinge (G) between the retracted position and the extended position by engagement of surrounding soil and in dependency on a rotation direction (E) of the drill head (55).
4. Sheet piling installation (1) according to claim 2 or 3, wherein the first soil drill (45) and the second soil drill (60) comprise a flight (52) that spirals around the base tube (51).
5. Sheet piling installation (1) according to any one of the preceding claims, wherein the first soil drill (45) and the second soil drill (45) extend parallel to the king post (20).
6. Sheet piling installation (1) according to any one of the preceding claims, wherein the sheet pile guide assembly (70) comprises one or more sheet pile guides (72, 73) that engage the sheet pile (110), and a positioning device (75) that engages a sheet pile (110) that is already inserted in the subsoil (100).
7. Sheet piling installation (1) according to claim 6, wherein the sheet pile (110) comprises a first coupling edge (119) and a second coupling edge (121) along its length, wherein the positioning device (75) is positioned with respect to the one or more sheet pile guides (72, 73) to bring the first coupling edge (119) of the already inserted sheet pile (110) in engagement with the second coupling edge (121) of the sheet pile (110) to be inserted in the subsoil (100).
8. Sheet piling installation (1) according to claim 6 or 7, wherein the positioning device (75) comprises one or more positioning cones (76, 77) that tightly wedge into the first sheet pile channel (113) or second sheet pile channel (116).
9. Sheet piling installation (1) according to any one of the preceding claims, wherein the sheet pile is made of plastic.
10. Method for insertion of a sheet pile (110) in a subsoil (100) by means of a sheet piling installation (1), wherein the sheet pile comprises a first sheet pile tube (111) that defines a first sheet pile channel (113), and a second sheet pile tube (114) that defines a second sheet pile channel (116), wherein the first sheet pile tube and the second sheet pile tube extend parallel to each other, and wherein the sheet piling installation comprises an elongated king post (20), and a drill assembly (30) and a sheet pile guide as-

sembly (70) on the king post, wherein the drill assembly comprises an elongated first soil drill (45) and a first drill drive assembly (35) for rotation of the first soil drill, and an elongated second soil drill (60) and a second drill drive assembly (40) for rotation of the second soil drill, wherein the first soil drill (45) and the second soil drill (60) extend parallel to each other and pass through the respective first sheet pile channel (113) and second sheet pile channel (116), wherein the method comprises insertion of the sheet pile (110) while the first soil drill (45) and the second soil drill (60) are rotated, wherein during the insertion the first soil drill and the second soil drill project with their distal ends (55) downwardly from a bottom edge (123) of the sheet pile (110).

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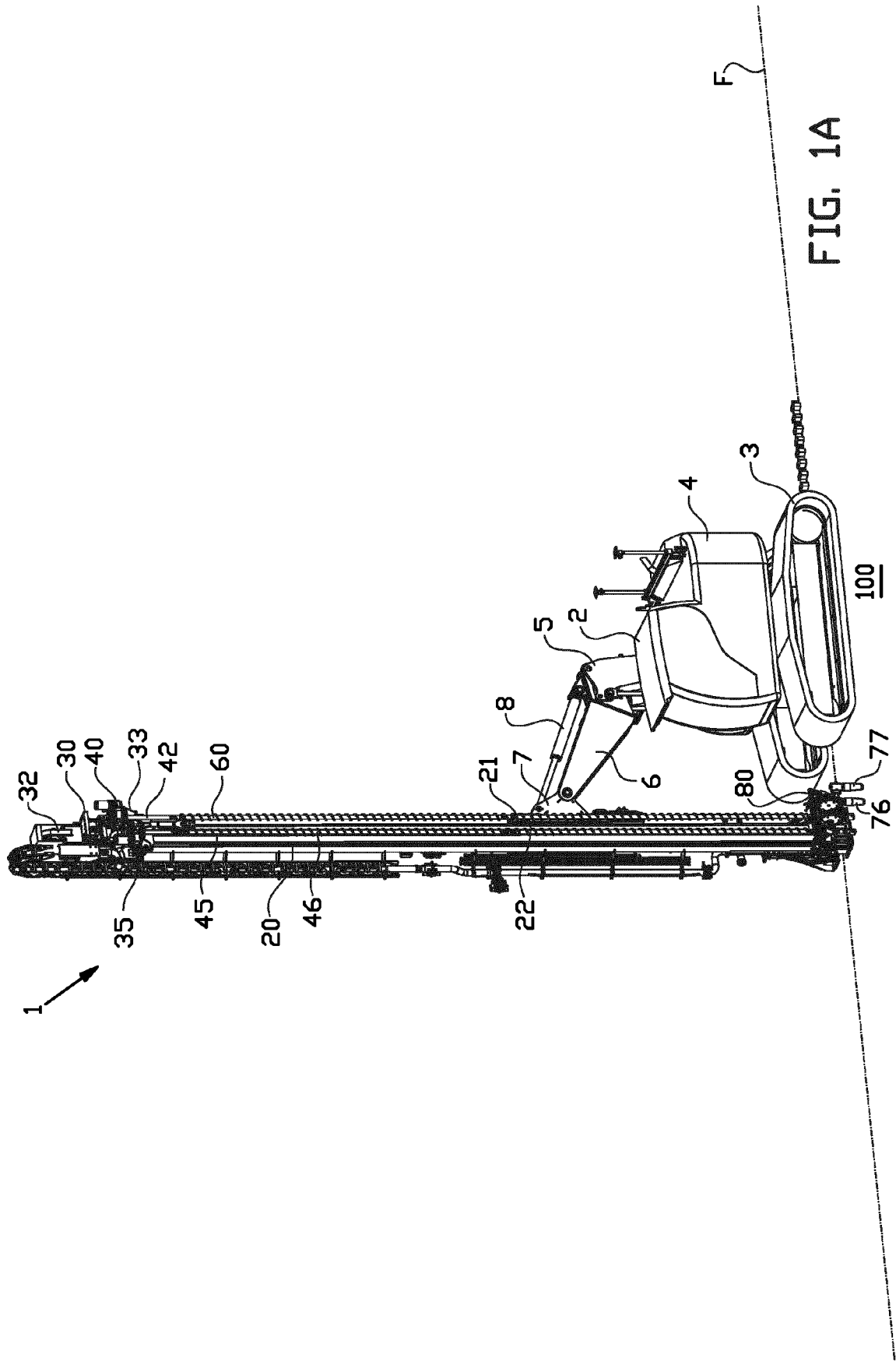
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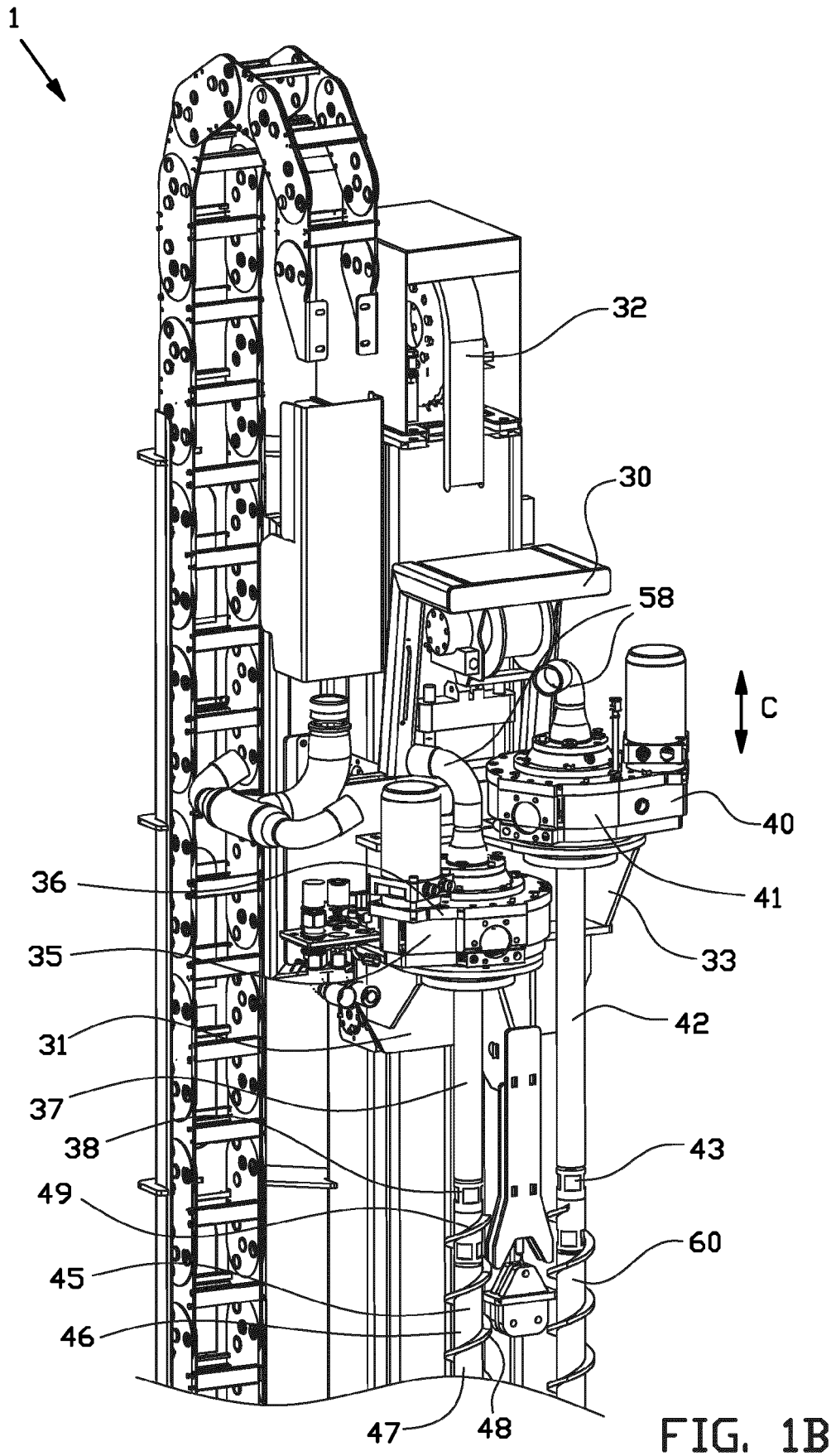
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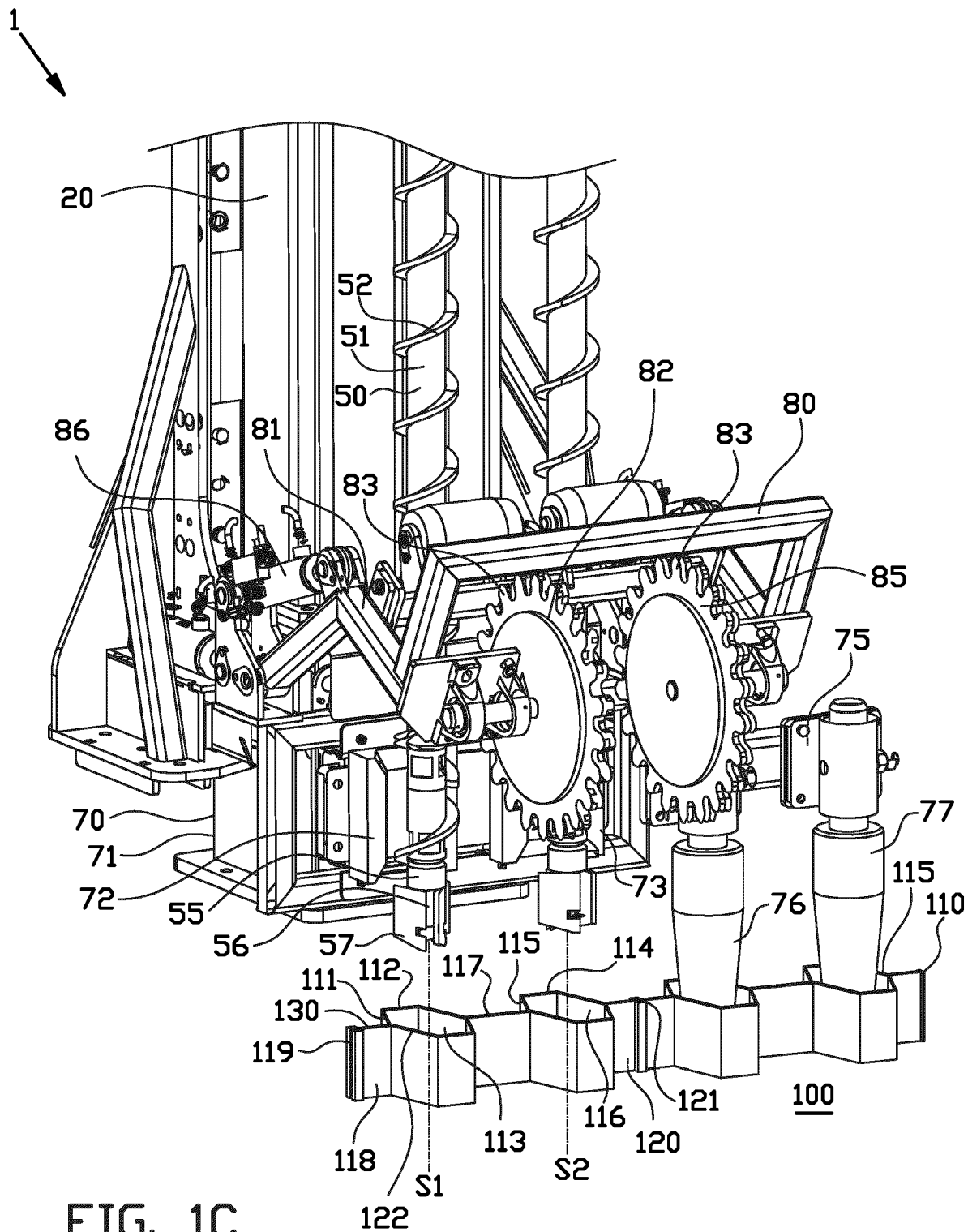


FIG. 1C

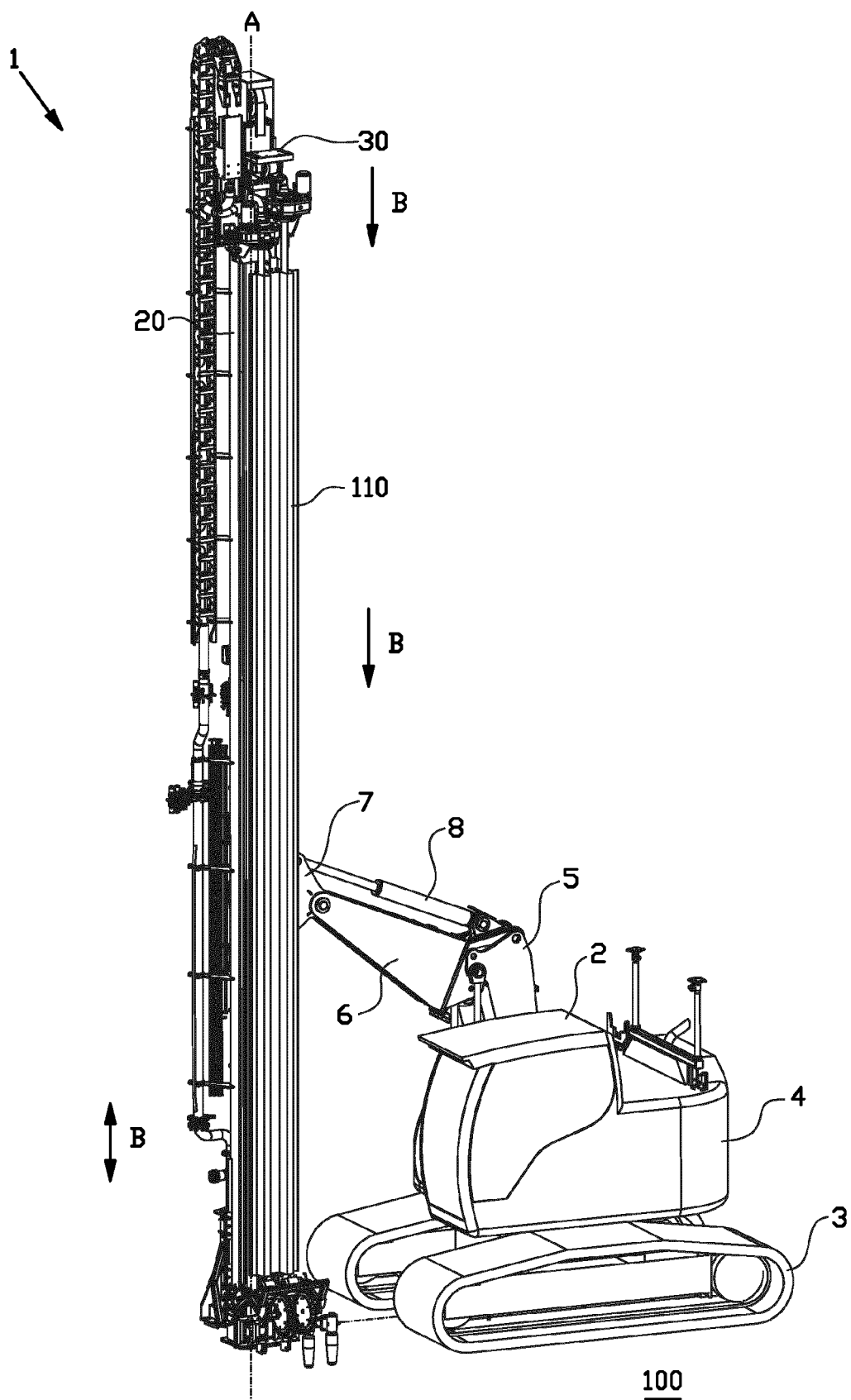


FIG. 2A

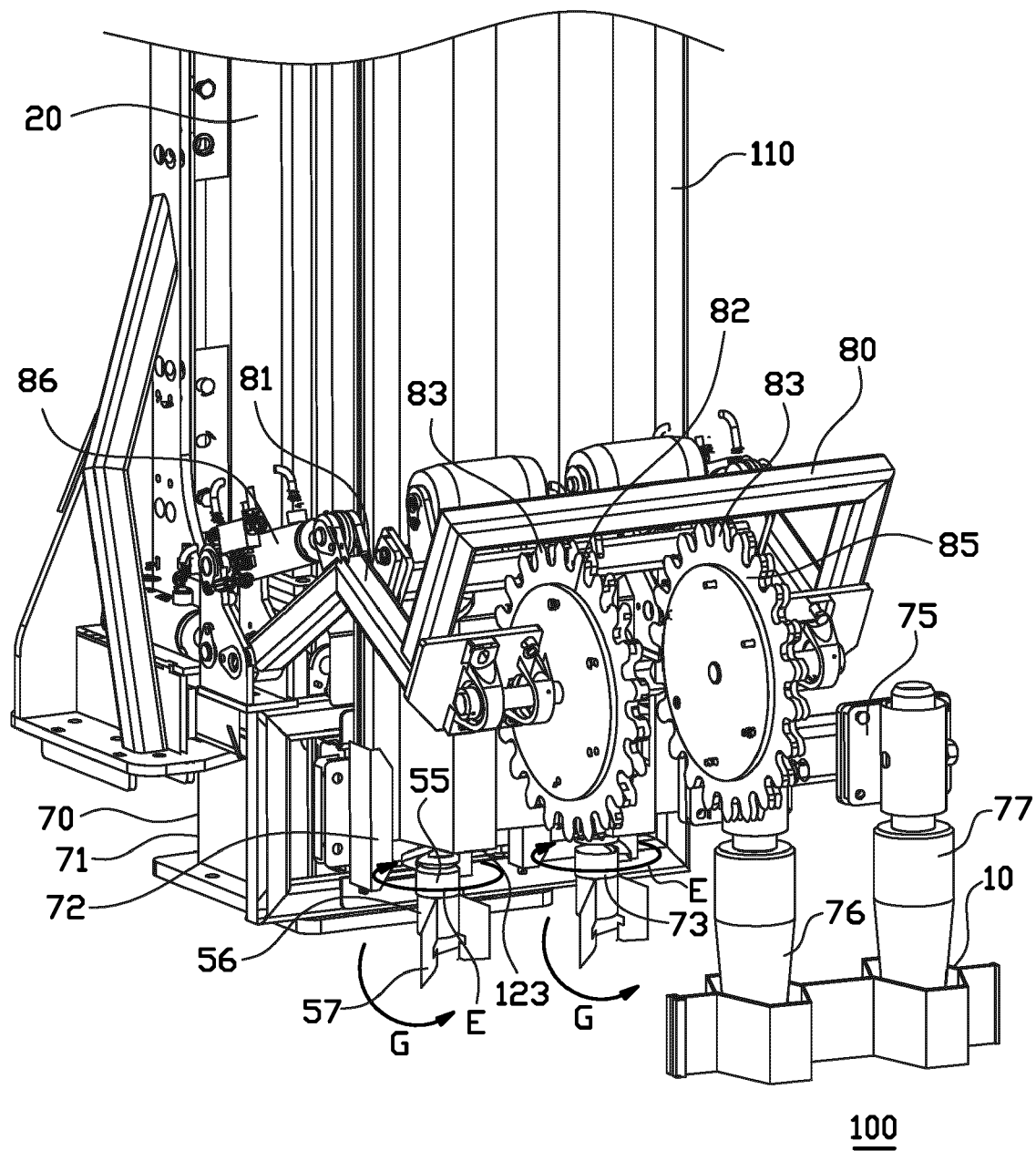


FIG. 2B



EUROPEAN SEARCH REPORT

Application Number

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EPO FORM 1503 03.82 (P04C01)

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			TECHNICAL FIELDS SEARCHED (IPC)
			E02D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 27 March 2023	Examiner Geiger, Harald
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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