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(54) INJECTION DEVICE FOR VERTICAL SOIL RETAINING WALLS AND/OR FOUNDATIONS

(57) An injection device for use with a device for manufacturing a vertical soil retaining wall and/or foundation, wherein the injection device (100) is configured to be coupled to a cutting frame and comprises at least one first outlet (110) and at least one second outlet (120), wherein the at least one second outlet is intended to lie higher than the at least one first outlet (110), as seen in a substantially vertical direction, wherein the injection device is configured to inject binding agent via the at least one first outlet and a gas via the at least one second outlet during driving into the ground, and wherein the injection device is configured to inject binding agent via the at least one second outlet (120) during removal of the cutting frame from the trench.

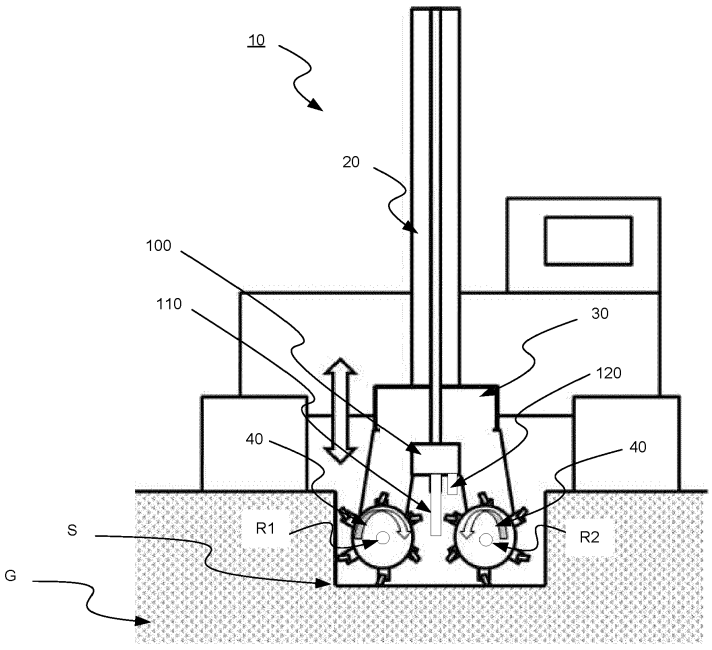

FIG. 1

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Description

Field of the invention

[0001] The invention relates to an injection device for forming a vertical soil retaining wall and/or foundation. The invention further relates to a device for making a vertical soil retaining wall and/or foundation using an injection device.

Background

[0002] Vertical soil retaining walls and/or foundations can have multiple functions, they can for instance be water-retaining, soil-retaining and/or bearing. The soil retaining walls and/or foundations can absorb vertical loads and can also function as sheet piling for excavations in the vicinity of existing structures. Soil retaining walls and/or foundations can further function as quay walls or as walls in for instance tunnels or parking structures.

[0003] Two different types of device are typically used to make such vertical soil retaining walls and/or foundations. Use is on one hand made of a so-called slurry wall device. On the other hand, use is made of a so-called cutter soil mixing (CSM) device. The slurry wall device removes the dislodged soil and fills the formed trench with bentonite suspension for the purpose of supporting the trench walls. Reinforcement is then optionally placed in the bentonite suspension, after which the bentonite suspension is replaced by filling the trench with concrete so that the soil retaining walls and/or foundations are formed. The CSM device forms the soil retaining walls and/or foundations by mechanically mixing the dislodged soil with an injected hydraulic binding agent such as grout in situ during the dislodging. The soil with binding agent mixed in in situ then hardens and forms the soil retaining walls and/or foundations.

[0004] The slurry wall device and the CSM device have a cutting frame. The cutting frame comprises cutting drums provided with cutting elements. The cutting drums are driven rotatingly so that the cutting elements are driven into the ground in turns. During driving into the ground the binding agent is injected at the position of the cutting drums. Air is simultaneously also blown at the position of the cutting drums.

[0005] These devices have the drawback that large cavities, which have an adverse effect on the robustness of the soil retaining wall or foundation, are created in the soil retaining wall or foundation. The binding agent further has a tendency to flow into an air conduit, causing the air conduit to become blocked. Furthermore, the air conduit may be permanently damaged when the binding agent hardens in the air conduit.

Summary of the invention

[0006] Embodiments of the invention have the object of providing a device which makes a vertical soil retaining wall and/or foundation in improved manner.

[0007] According to a first aspect, a device for making a vertical soil retaining wall and/or foundation comprises a frame with a substantially vertically movable outer end. The device further comprises a cutting frame mounted close to the outer end of the frame, wherein the cutting frame is provided with at least one pair of drums which are each rotatable about a respective rotation axis. The rotation axes of the at least one pair of drums lie parallel to each other and at a distance from each other so that the drums, as seen in a plane perpendicularly of the rotation axes, can rotate adjacently of each other for the purpose of dislodging the soil and digging a trench, while the outer end is driven substantially vertically into the ground. The device for making a vertical soil retaining wall and/or foundation further comprises an injection device with at least one first outlet and at least one second outlet which lies higher than the at least one first outlet, as seen in a substantially vertical direction, wherein the injection device is configured to inject binding agent via the at least one first outlet and a gas, for instance air, via the at least one second outlet during driving into the ground, and wherein the injection device is configured to inject binding agent via the at least one second outlet during removal of the cutting frame from the trench. Providing an injection device which injects binding agent at a lower location than the gas during driving into the ground avoids the problem of binding agent flowing into the air conduit. Owing to the separate locations of the first and second outlet, as seen in a height direction, the air further also has a tendency to mix with the binding agent in improved manner, this substantially preventing large cavities which could otherwise result. An improved vertical soil retaining wall and/or foundation is realized in this way.

[0008] The at least one first outlet is preferably configured to inject binding agent at the position of the rotation axes of the at least one pair of drums, and the at least one second outlet is preferably configured to inject binding agent or air above the rotation axes of the at least one pair of drums. The binding agent can be injected both below and above the rotation axes of the at least one pair of drums. The at least one second outlet is more preferably configured to inject binding agent or air above an outer surface of the at least one pair of drums, preferably between the outer surface and a cutting plane of the at least one pair of drums. In this way binding agent is injected above the outer surfaces of the drums during removal of the cutting frame from the trench, so that the binding agent can still be mixed into the wholly vertical soil retaining wall and/or foundation during removal of the cutting frame from the trench. This advantage is based on the insight that if the first outlet were to be used during removal from the trench, the binding agent will come to lie almost directly below the rotation axes of the drums and will therefore not be mixed in properly. By injecting the binding agent via the second outlet, which lies above the rotation axes of the drums, the binding

agent will always come to lie above the drums and will therefore be mixed optimally with the soil during upward movement.

[0009] Further advantages are elucidated in the figure description below.

[0010] The injection device preferably comprises a base body with a first body part and a second body part, which are shape-compatible and together form the injection device. More preferably, at least one of the first body part and the second body part comprises a first inlet and a second inlet, wherein the first inlet is provided to receive binding agent and wherein the second inlet is provided to receive at least one of the binding agent and the gas.

[0011] Preferably, the first inlet is in fluid connection with the at least one first outlet and the second inlet is in fluid connection with the at least one second outlet.

[0012] More preferably, at least one of the first body part and the second body part comprises a recess which forms a channel between the second inlet and the at least one second outlet.

[0013] The injection device preferably comprises a plurality of second outlets, preferably at least two second outlets, wherein the plurality of second outlets are provided distributed along a peripheral wall of at least one of the first body part and the second body part.

[0014] The recess preferably extends between the second inlet and each of the plurality of second outlets.

[0015] A second outlet of the plurality of second outlets is preferably respectively oriented in a direction of one of the drums of the at least one pair of drums.

[0016] The injection device is preferably provided to be mounted on an underside of the cutting frame.

[0017] The injection device preferably further comprises an injection nozzle which is connected to the at least one first outlet, which injection nozzle is configured to extend over at least a part of the distance between a cutting plane of the at least one pair of drums and the rotation axes of the at least one pair of drums. The binding agent can be injected below or above the rotation axes of the at least one pair of drums by controlling the length of the injection nozzle. The injection nozzle more preferably has a plurality of first outlets, preferably at least two first outlets which are respectively oriented in a direction of one of the drums of the at least one pair of drums.

[0018] The at least one second outlet preferably comprises a jet nozzle which increases a flow speed of the medium flowing therethrough, for instance the gas or the binding agent. This allows the binding agent to be injected further outward, as seen relative to a centre of the frame.

[0019] The jet nozzle more preferably has a diameter of at least 2 to 4 mm, preferably at least 4 to 8 mm.

[0020] The at least one second outlet preferably comprises an extension piece which extends at least partially over the distance between the at least one second outlet and the rotation axis of one of the drums. In this way the gas or binding agent is injected closer to the rotation axis of one of the drums, so that an improved mixing with the soil takes place.

[0021] The device for manufacturing a vertical soil retaining wall and/or foundation preferably comprises a gas and binding agent control system, a first conduit and a second conduit, wherein the first conduit is connected to the at least one first outlet and the second conduit is connected to the at least one second outlet, wherein the gas and binding agent control system is configured to feed binding agent via the first conduit and to inject it via the at least one first outlet and a gas via the at least one second outlet during driving into the ground; and to divert the binding agent to the second conduit during removal of the cutting frame from the trench.

[0022] According to a further aspect, an injection device is provided for use with a device for manufacturing a vertical soil retaining wall and/or foundation, wherein the injection device is configured to be coupled to a cutting frame and comprises at least one first outlet and at least one second outlet, wherein the at least one second outlet is intended to lie higher than the at least one first outlet, as seen in a substantially vertical direction, wherein the injection device is configured to inject binding agent via the at least one first outlet and a gas via the at least one second outlet during driving into the ground, and wherein the injection device is configured to inject binding agent via the at least one second outlet during removal of the cutting frame from the trench.

Brief description of the figures

[0023] The above and other advantageous features and objectives of the invention will become more apparent and the invention better understood with reference to the following detailed description when read in combination with the accompanying drawings, in which:

Figure 1 shows a schematic view of a device for making a vertical soil retaining wall and/or foundation using an injection device according to an exemplary embodiment;

Figure 2 shows a front view of a cutting frame with two pairs of drums, wherein an injection device according to an exemplary embodiment is connected to the cutting frame;

Figure 3 shows in greater detail a perspective view of the injection device shown in figure 2, with a base body comprising a first body part and a second body part according to an exemplary embodiment.

Detailed embodiments

[0024] The following detailed description relates to determined specific embodiments. The teaching hereof can however be applied in different ways. The same or similar elements are designated in the drawings with the same reference numerals.

[0025] The present invention will be described with reference to specific embodiments. The invention is however not limited thereto, but solely by the claims.

[0026] As used here, the singular forms "a" and "the" comprise both the singular and plural references, unless clearly indicated otherwise by the context.

[0027] The terms "comprising", "comprises" and "composed of' as used here are synonymous with "including". The terms "comprising", "comprises" and "composed of" when referring to stated components, elements or method steps also comprise embodiments which "consist of" the components, elements or method steps.

[0028] The terms first, second, third and so on are further used in the description and in the claims to distinguish between similar elements and not necessarily to describe a sequential or chronological order, unless this is specified. It will be apparent that the thus used terms are mutually interchangeable under appropriate circumstances and that the embodiments of the invention described here can operate in an order other than described or illustrated here.

[0029] Reference in this specification to "one embodiment", "an embodiment", "some aspects", "an aspect" or "one aspect" means that a determined feature, structure or characteristic described with reference to the embodiment or aspect is included in at least one embodiment of the present invention. The manifestations of the sentences "in one embodiment", "in an embodiment", "some aspects", "an aspect" or "one aspect" in different places in this specification thus do not necessarily all refer to the same embodiment or aspects. As will be apparent to a skilled person in this field, the specific features, structures or characteristics can further be combined in any suitable manner in one or more embodiments or aspects. Although some embodiments or aspects described here comprise some but no other features which are included in other embodiments or aspects, combinations of features of different embodiments or aspects are further intended to fall within the context of the invention and to form different embodiments or aspects, as would be apparent to the skilled person. In the appended claims all features of the claimed embodiments or aspects can for instance be used in any combination.

[0030] The same or similar elements are designated in the drawing with the same reference numerals.

[0031] Figure 1 shows a device 10 for making a vertical soil retaining wall and/or foundation. Vertical soil retaining walls and/or foundations can have multiple functions, they can for instance be water-retaining, soil-retaining and/or bearing. The soil retaining walls and/or foundations can absorb vertical loads and can also function as sheet piling for excavations in the vicinity of existing structures. Soil retaining walls and/or foundations can further function as quay walls or as walls in for instance tunnels or parking structures. The vertical soil retaining wall and/or foundation is typically made in the ground G.

[0032] The device 10 comprises a frame 20 with a substantially vertically movable outer end. The size of the frame 20 substantially determines the maximum depth of the soil retaining wall and/or foundation. The depth of the soil retaining wall and/or foundation can be controlled by controlling the distance over which frame 20 moves.

[0033] The device 10 further comprises a cutting frame 30 which is mounted close to the outer end of frame 20. The cutting frame 30 is provided with at least one pair of drums 40, which are each rotatable about a respective rotation axis. An outer surface of each of the drums 40 is preferably provided along the periphery thereof with at least one row with a plurality of cutter holders extending from the outer surface in a substantially radial direction, wherein each cutter holder comprises at least one cutting element extending away from the outer surface. The cutting element has a stop surface which forms an angle with a centre line which intersects the rotation axis of the corresponding drum and a centre of the corresponding cutter holder at the position of the outer surface. The at least one pair of drums 40 are rotatingly driveable for the purpose of dislodging soil while the outer end is driven into the ground. A plurality of pairs of drums 40 can also be provided, for instance two pairs of drums as shown in figure 2. A first drum of one of the plurality of pairs of drums here lies in line with a first drum of another pair of drums. The rotation axes R1, R2 of the at least one pair of drums 40 lie parallel to each other and at a distance from each other so that the drums 40, as seen in a plane perpendicularly of the rotation axes, can rotate adjacently of each other for the purpose of dislodging the soil and digging a trench S, while the outer end of frame 20 is driven substantially vertically into the ground G. The distance between the rotation axes R1, R2 and the diameters of the drums substantially determines a first width dimension of the trench S. A longitudinal length of the drums substantially determines a second width dimension of the trench S.

[0034] The device 10 for making a vertical soil retaining wall and/or foundation further comprises an injection device 100 with at least one first outlet 110 and at least one second outlet 120 which lies higher than the at least one first outlet 110, as seen in a substantially vertical direction. A plurality of first outlets 110 and/or a plurality of second outlets 120 can be provided, as will be further elucidated with reference to figure 2. Injection device 100 is configured to inject binding agent via the at least one first outlet 110 and a gas, for instance air, via the at least one second outlet 120 during driving into the ground. Providing an injection device 100 which injects binding agent at a lower location than the gas during driving into the ground avoids the problem of binding agent flowing into the air conduit. The injection device 100 is further configured to inject binding agent via the at least one second outlet 120 during removal of the cutting frame from the trench S, i.e. by moving the outer end of frame 20 upward. Owing to the separate locations of the first and second outlet, as seen in a height direction, the air further also has a tendency to mix with the binding agent in improved manner, this substantially preventing large cavities which could otherwise result.

[0035] Figure 2 shows a front view of a cutting frame 30 with two pairs of drums 40. The second pair of drums 40 is limited only by the orientation of the view. Figure 2 shows an injection device 100 according to an exemplary embodiment which is connectable to the cutting frame 30. The shown injection device 100 will be further elucidated with reference to figure 3.

[0036] In order to realize an optimal mixing of the binding agent and the dislodged soil the at least one first outlet 110 is preferably configured to inject binding agent at the position of the rotation axes R1, R2 of the at least one pair of drums 40 during driving into the ground of cutting frame 120. The binding agent can be injected both below and above the rotation axes of the at least one pair of drums. The height of the rotation axes R1, R2 is illustrated with the broken line extending between the two rotation axes R1 and R2. The binding agent can be injected just below or above the rotation axes of the at least one pair of drums by controlling the length of the injection nozzle. This improves the mixing further, subject to the direction of movement of the frame. In this way the binding agent can be injected via the at least one first outlet 110 in an area extending between a position immediately below the clearing plates to a position below the rotation axes of the drums. Clearing plates are plates extending between the teeth of the drums so that soil which may be found to have become stuck between the teeth can be removed. These clearing plates are per se known to the skilled person. The at least one second outlet 120 is further configured to inject binding agent or air above the rotation axes of the at least one pair of drums. More specifically, the at least one second outlet 120 is configured to blow air above the rotation axes R1, R2 of the drums 40 during driving into the ground. The first outlet 110 preferably has a throughfeed opening area of between 400 and 1250 mm^2. The second outlet 120 preferably has a throughfeed opening area of a maximum of 450 mm^2, for instance 400 mm^2.The at least one second outlet is further configured to inject binding agent above the rotation axes R1, R2 of the drums 40 during removal of cutting frame 30 from the trench. In this way binding agent is injected at the position of an upper segment of drums 40 during removal of cutting frame 30 from the trench, so that the binding agent can still be mixed into the wholly vertical soil retaining wall and/or foundation during removal of cutting frame 30 from the trench. This advantage is based on the insight that if the first outlet 110 were to be used during removal from the trench, the binding agent will come to lie almost directly below the rotation axes of the drums and will therefore not be mixed in properly. By injecting the binding agent via the second outlet 120, which lies above the rotation axes of the drums, the binding agent will in each case come to lie above the drums and will therefore be mixed optimally with the soil during upward movement. The at least one second outlet 120 is more preferably configured to inject binding agent or air above an outer surface of the at least one pair of drums 40. The outer surface is designated with reference numeral 41. Still more preferably, the at least one second outlet 120 is configured to inject binding agent or air between outer surface 41 and a cutting plane of the at least one pair of drums 40. The highest point of the cutting plane of the drums relative to the rotation axes R1, R2 is illustrated with reference numeral 42.In this way the mixing of the binding agent with the dislodged soil is further improved.

[0037] As shown in figure 2, it is preferred for the injection device 100 to be mounted on a lower outer end of cutting frame 30. The injection device 100 will be further elucidated with reference to figure 3.

[0038] Figure 3 shows an exemplary embodiment of the injection device 100 with a base body having a first body part 101 and a second body part 102. The first body part 101 and a second body part 102 are shape-compatible and together form the injection device. In the shown exemplary embodiment according to figure 2 the first body part is an upper body part lying against the cutting frame. The second body part is a lower body part which is directed downward.

[0039] At least one of the first body part 101 and the second body part 102 comprises a first inlet 103 and a second inlet 104, wherein the first inlet is provided to receive binding agent and wherein the second inlet is provided to receive at least one of the binding agent and the gas. The figure shows that the first body part 101 comprises the first inlet 103. It is further shown that the second body part 102 can also comprise a portion of the first inlet 103, for instance a throughfeed opening extending through the second body part 102. The first inlet 103 is in fluid connection with the at least one first outlet 110, for instance using an injection nozzle as shown in figure 2. This injection nozzle is configured to extend over at least a part of the distance between a cutting plane 42 of the at least one pair of drums and the rotation axes R1, R2 of the at least one pair of drums 40. The injection nozzle more preferably has a plurality of first outlets 110, preferably at least two first outlets which are respectively oriented in a direction of one of the drums of the at least one pair of drums. The second inlet 104 is in fluid connection with the at least one second outlet. The gas can thus flow via the second inlet 104 to the second outlet 120 during driving into the ground of the cutting frame.

[0040] More preferably, at least one of the first body part 101 and the second body part 102 comprises a recess which forms a channel 105 between the second inlet 104 and the at least one second outlet 120. The channel 105 guides the binding agent or the gas from the second inlet to the at least one second outlet 120. Figure 3 shows that the recess is provided in the second body part 102. It will be apparent that the recess can also be provided in the first body part 101, or that both body parts comprise a partial recess which are mutually shape-compatible, so forming channel 105. The first body part 101 here further also functions as closure of the recess. Figure 3 shows that the first body part 101 also has a second inlet 104 which debouches in the second body

part 102. More specifically, second inlet 104 debouches in the recess 105 formed in second body part 102.

[0041] Injection device 100 preferably comprises a plurality of second outlets, for instance at least two second outlets. Figure 4 shows four second outlets 120. It is preferred for a respective second outlet 120 to be provided per drum. The plurality of second outlets 120 are arranged distributed along a peripheral wall of at least one of the first body part and the second body part, this being the second body part 102 in the shown exemplary embodiment. In such an embodiment it is preferred for the plurality of second outlets 120 to each be directed toward a respective drum. The at least one second outlet 120 preferably comprises a jet nozzle which increases a flow speed of the medium flowing therethrough, for instance the gas or the binding agent. This reduces the cavities formed in the binding agent by the gas. The jet nozzle more preferably has a diameter of at least 2 to 4 mm, preferably at least 4 to 8 mm.

[0042] The skilled person will appreciate on the basis of the above description that the invention can be embodied in different ways and on the basis of different principles. The invention is not limited here to the above described embodiments. The above described embodiments and the figures are purely illustrative and serve only to increase understanding of the invention. The invention is not therefore limited to the embodiments described herein, but is defined in the claims.

Claims

1. A device (10) for making a vertical soil retaining wall and/or foundation, comprising:

   - a frame (20) with a substantially vertically movable outer end;
   - a cutting frame (30) which is mounted close to the outer end of the frame, wherein the cutting frame is provided with at least one pair of drums (40) which are each rotatable about a respective rotation axis, wherein the rotation axes of the at least one pair of drums (40) lie parallel to each other and at a distance from each other so that the drums, as seen in a plane perpendicularly of the rotation axes, can rotate adjacently of each other for the purpose of dislodging the soil and digging a trench, while the outer end is driven substantially vertically into the ground;
   - an injection device (100) with at least one first outlet (110) and at least one second outlet (120) which lies higher than the at least one first outlet (110), as seen in a substantially vertical direction, wherein the injection device is configured to inject binding agent via the at least one first outlet and a gas via the at least one second outlet during driving into the ground, and wherein the injection device is configured to inject binding agent via the at least one second outlet (120) during removal of the cutting frame from the trench.

2. The device (10) according to the foregoing claim, wherein the at least one first outlet (110) is configured to inject binding agent at the position of the rotation axes (R1, R2) of the at least one pair of drums (40), and wherein the at least one second outlet (120) is configured to inject binding agent or air above the rotation axes of the at least one pair of drums.

3. The device (10) according to the foregoing claim, wherein the at least one second outlet is configured to inject binding agent or air above an outer surface (41) of the at least one pair of drums, preferably between the outer surface and a cutting plane (42) of the at least one pair of drums.

4. The device (10) according to any one of the foregoing claims, wherein the injection device (100) comprises a base body with a first body part (101) and a second body part (102), which are shape-compatible and together form the injection device.

5. The device (10) according to the foregoing claim, wherein at least one of the first body part and the second body part comprises a first inlet (103) and a second inlet (104), wherein the first inlet is provided to receive binding agent, and wherein the second inlet is provided to receive at least one of the binding agent and the gas, wherein the first inlet is preferably in fluid connection with the at least one first outlet (110) and wherein the second inlet is preferably in liquid connection with the at least one second outlet (120).

6. The device (10) according to the foregoing claim, wherein at least one of the first body part (101) and the second body part (102) comprises a recess (105) which forms a channel between the second inlet and the at least one second outlet (120).

7. The device (10) according to any one of the foregoing claims 4-6, wherein the injection device comprises a plurality of second outlets (120), preferably at least two second outlets, wherein the plurality of second outlets are provided distributed along a peripheral wall of at least one of the first body part and the second body part.

8. The device (10) according to the foregoing claims 6-7, wherein the recess (106) extends between the second inlet (104) and each of the plurality of second outlets.

9. The device (10) according to any one of the foregoing claims 7-8, wherein a second outlet of the plurality

of second outlets is respectively oriented in a direction of one of the drums of the at least one pair of drums.

10. The device (10) according to any one of the foregoing claims 5-9, wherein the injection device is provided to be mounted on an underside of the cutting frame (30).

11. The device (10) according to any one of the foregoing claims 5-10, wherein the injection device (100) further comprises an injection nozzle comprising the at least one first outlet (120), which injection nozzle is connected to the first outlet and is configured to extend over at least a part of the distance between a cutting plane (42) of the at least one pair of drums and the rotation axes (R1, R2) of the at least one pair of drums (40).

12. The device (10) according to the foregoing claim, wherein the injection nozzle has a plurality of first outlets, preferably at least two first outlets which are respectively oriented in a direction of one of the drums of the at least one pair of drums.

13. The device (10) according to any one of the foregoing claims, wherein the at least one second outlet comprises a jet nozzle which increases a flow speed of the medium flowing therethrough, for instance the gas or the binding agent, wherein the jet nozzle preferably has a diameter of at least 2 to 4 mm, preferably at least 4 to 8 mm.

14. The device (10) according to any one of the foregoing claims, further comprising a gas and binding agent control system, a first conduit and a second conduit, wherein the first conduit is connected to the at least one first outlet and the second conduit is connected to the at least one second outlet, wherein the gas and binding agent control system is configured to feed binding agent via the first conduit and to inject it via the at least one first outlet and a gas via the at least one second outlet during driving into the ground; and to divert the binding agent to the second conduit during removal of the cutting frame from the trench.

15. An injection device for use with a device for manufacturing a vertical soil retaining wall and/or foundation according to any one of the foregoing claims, wherein the injection device (100) is configured to be coupled to a cutting frame and comprises at least one first outlet (110) and at least one second outlet (120), wherein the at least one second outlet is intended to lie higher than the at least one first outlet (110), as seen in a substantially vertical direction, wherein the injection device is configured to inject binding agent via the at least one first outlet and a gas via the at least one second outlet during driving into the ground, and wherein the injection device is configured to inject binding agent via the at least one second outlet (120) during removal of the cutting frame from the trench.

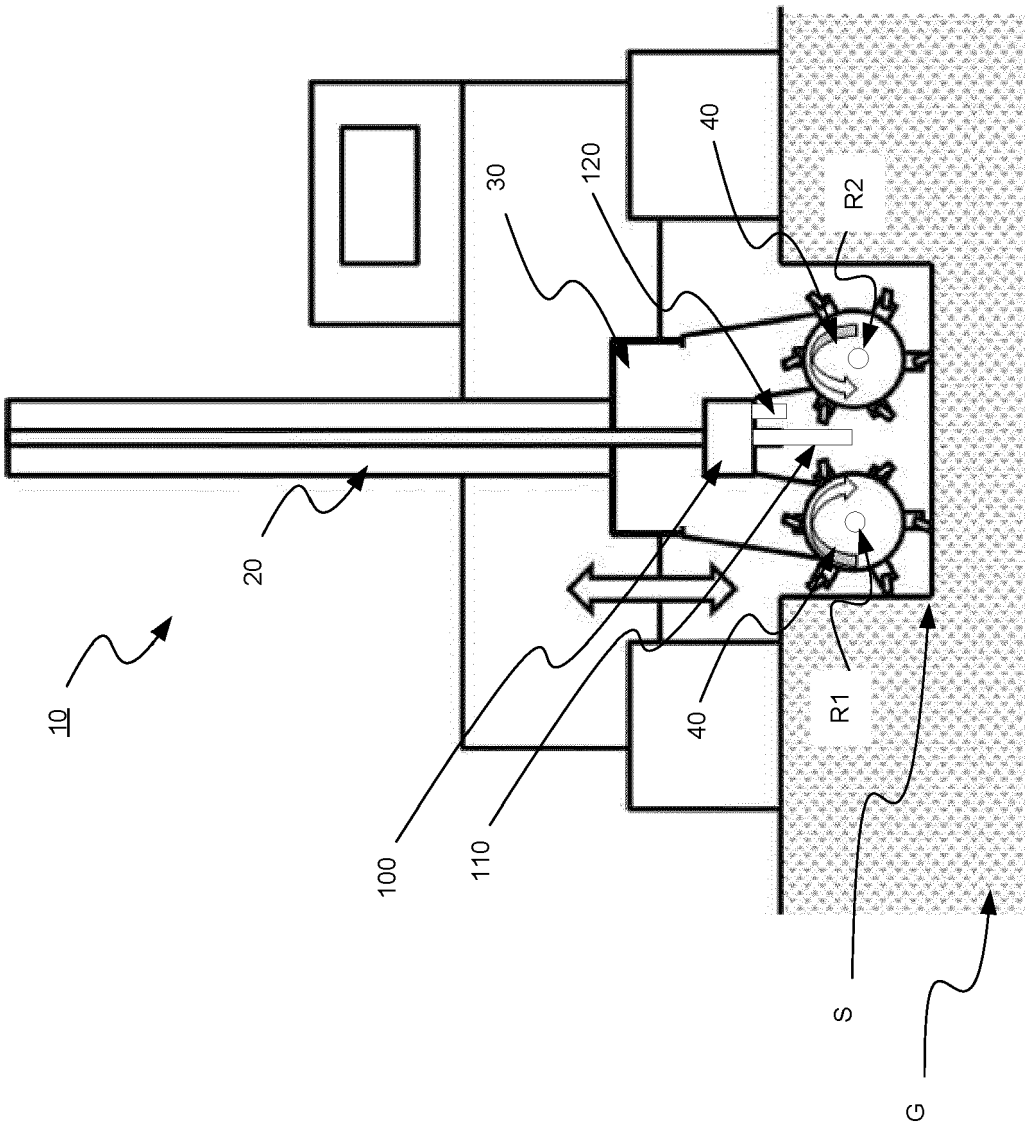

FIG. 1

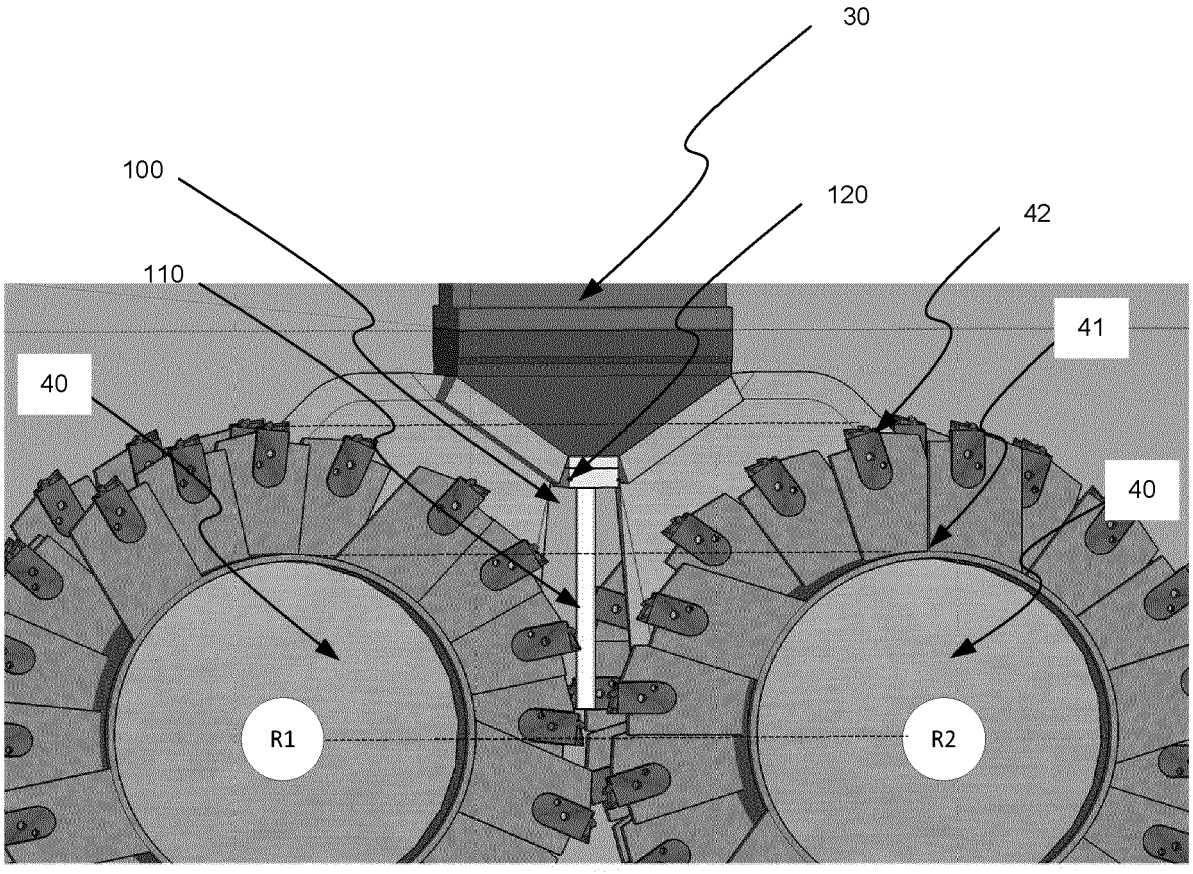

FIG. 2

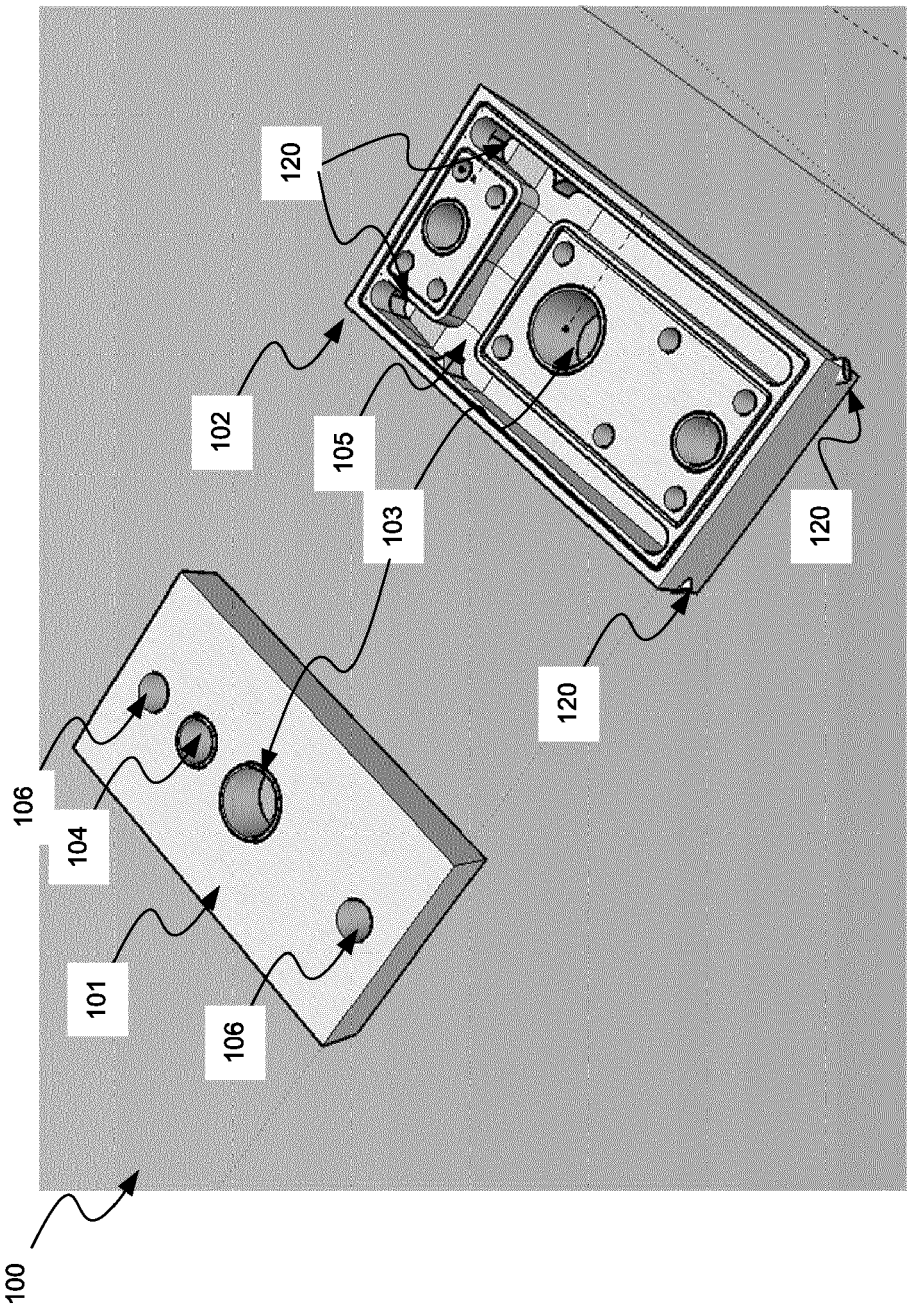

FIG. 3

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 24 17 4768

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 7 476 057 B2 (BAUER MASCHINEN GMBH [DE]) 13 January 2009 (2009-01-13) * column 5 - column 7; claim 1; figures 1, 2 *	1-15	INV. E02F3/18 E02F3/20 E02F3/47 E02F5/08 E02F5/10 E02F5/12 E02F3/24 E02F9/28 E02F5/02
A	CN 108 487 235 A (JIANGSU KEHONG GEOTECHNICAL ENG CO LTD) 4 September 2018 (2018-09-04) * figure 1 and corresponding text. figuur 1 en bijbehorende tekst *	1-15	
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Place of search	Date of completion of the search	Examiner
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