

**Method and device for inserting a column of stabilizing
material into the ground**

The invention relates to a method as indicated
in the preamble of claim 1.

Such a method is known from US-A-4,126,007.

The column casings used in said known method,
5 particularly the guiding surfaces of the closing means,
are strongly loaded and therefor become quickly defective.
This causes the operations to be delayed. Particularly for
operations on the water such a delay is undesired because
of the expensive equipment used and the high operating
10 costs.

The invention provides an improved method having
the characteristic feature of claim 1.

The penetrating forces which are transferred from
the shaft, over the bottom edge, to the ground are bypas-
15 sed through the bottom edge, whereby the guiding surfaces
of the bearings of the closing means are not or only
slightly loaded. The method according to the invention
will be performed in a more efficient manner in comparison
with the known methods.

20 A preferred embodiment of the invention is per-
formed according to claim 2. By this method the position
of the column of stabilizing material relative to the
fixed leading edge is exactly determined in normally
inaccessible locations under water.

25 The invention also relates to a device for
performing this method.

The invention will now be elucidated in the
following figure description of a number of examples of
the invention. In the drawings:

30 figures 1a, 1b and 1c show the method according
to the invention in three steps,

figure 2 is a perspective view of a preferred
embodiment of the method according to the invention, and

figures 3, 4 and 5 are partially broken away perspective views of embodiments of column casings according to the invention.

According to figures 1a-1c a device comprising a column casing 65 with a shaft 84, an inlet 74, an opening or closing bottom end 70 and a leading edge 8, a possible or typical driving means 66, for example a hammer or a vibrator, and a lifting device (not shown) is used for the creation of a stabilizing column 76 in the bottom 64 under water 63 according to the invention in three successive steps. The driving means working as a vibrator or hammer 66 creates penetrating forces with an essentially longitudinal component. Through conduits 69 water under pressure is directed for fluidising the bottom 64. When the column casing 65 has penetrated deep enough into the bottom (fig. 1b) it will be filled with stabilizing material 72, said stabilizing material is for example gravel, cement, crushed stone or other granular materials possible as mixtures with a binding agent, which is supplied by a funneled inlet or hopper 73 via a transport mechanism (71), for example a crane. An continuous supply, for instance by means of conveying belts is also possible. The vibration means 75 compacts the stabilizing material 72. Thereafter the closing means are opened and the column casing is removed upwards (by mechanical means) (fig. 1c), whereby the space which became available in the bottom 64 is taken up by the stabilizing material 72 forming a stabilizing column 76. The stabilizing column 76 will improve the general soil stability, the supporting ability and/or the drainage of the bottom 63.

The penetrating forces are being transferred to the bottom by the vibrator 66 through the shaft 84 and the leading edge 8 of the bottom end 70, whereby the guiding surfaces of the bearings of the closing means are being bypassed. This causes the closing means to be less susceptible to wear and tear, whereby the method according to the invention is more efficient. The column casing 65 may

be reliably used repeatedly without breakdowns/failure.

The method of figure 2 is particularly suitable for inserting the stabilizing column into the ground 64 under water 63, for instance in river mouths, at sea or in the case of marine construction. The position of the stabilizing column in the ground 64 is determined starting from a fixed base 60, which is supported on the ground 64 by means of legs 62, this base is designed for:

- a) a stable platform unaffected by sea state (swell, current and wind);
 - b) fixed starting point, guide and reference point;
 - c) a level, vertical alignment means and horizontal reference level for depth, tide and volume measurements;
- and is therefor a preferred embodiment of the invention for marine applications. The lifting device 53 is placed on the base or on a floating platform 68.

In figures 3-5 three bottom ends are shown, said bottom ends are connected to a part of the shaft of the column casing according to the invention.

The bottom end 1 comprises two outlets, which are closed off by means of the closing means 3. The closing means comprise two flaps 4, 5, each being connected to the shaft 2 by means of a hinge 6, 7. The flaps 4, 5 are controllable by means of chains 9, 10. The chains 9, 10 are preferably partly protected by the inner wall 13 and will close or open the valves 4, 5 for instance by means of a ratchet device. Conducts 16 deliver water under pressure, said water flowing out in nozzles 17, 18 and 19, to facilitate the movement of the column casing in and/or out of the ground. The bottom end 1 is tapered downwards and is provided with a leading edge 8.

The V-shaped bottom end with the leading edge defines possibly an included angle of less than 75 degrees.

The penetration forces F , exerted by the ground by way of reaction forces on the bottom end, are particularly being captured by the strong chisel shaped bottom

piece 8, which is firmly connected to the shaft 2 and to a strong vibration plate 15, said plate absorbing and transferring the vibration energy and therefor also acting as a tuning fork. The guiding means of the hinges 6, 7 of the valves 4, 5 are thus being bypassed by transferring the forces F from the leading edge 8 to the remainder of the column case 65, so that the hinges 6, 7 cannot easily fail. The wedge-shaped leading edge 8 is on both sides provided with a recess 80 for receiving the underedges 81 of the flaps 4, 5.

The embodiment of figure 4 corresponds to the embodiment of figure 1, with the exception that the flaps 4', 5' are positioned on a common central hinge 20, this hinge 20 being situated under the flaps. The strong leading edge 8' is fixedly connected to the chisel support 21. The hinge 20, particularly the guiding surfaces thereof, are positioned in the "shade" of the strong chisel-shaped leading edge 8'.

The embodiment of figure 5 comprises a bottom piece 52 also functioning as a valve, which in the bearings can slide axially between the closed position of figure 5, in which the bottom piece 52 seals up against a concentric ring 59 of the bottom piece 50. This upper concentric ring is firmly connected to the shaft 51, and an open position (not shown), in which the bottom part 52 is moved downwards relative to the top piece 59. Apart from the gravity the control means 49 also control the pressure exerted on the spring 54 protected by the sleeve 55 and as a result also the position of the bottom piece 52. The shaft 53 is maintained in axial alignment by the radial stabilizing arms 56. Conduits 57, 58 on the outer profile of the shaft 51 deliver water under pressure due to these closing means. This embodiment is particularly suitable under water.

CLAIMS

1. Method for inserting at least one stabilizing column into the ground by means of a column casing comprising a shaft with at least one top end provided with an inlet for stabilizing material and a downward tapering
5 bottom end comprising at least one outlet for stabilizing material, said outlet being provided with closing means moveable between an open position and a closed position and being housed by means of bearings, said column casing being put into the ground under exertion of penetrating
10 forces at the top end thereof, said forces being exerted through the shaft and the bottom end till they reach the ground lying beneath the column casing, the stabilizing material being put into the ground by means of the column casing with the closing means maintained in the open
15 position, while the column casing is pulled out of the ground, characterized in that the penetration forces are being transferred from the shaft, bypassing the guiding surfaces of the bearings of the closing means, to the leading edge of the bottom end and from this bottom end to
20 the ground lying thereunder.

2. Method according to claim 1, characterized in that the position of the column casing is determined relative to a fixed base previously disposed in water.

3. Device for performing the method according to
25 claim 1, comprising a column casing essentially consisting of a shaft with at least one top end provided with an inlet for stabilizing material and the bottom end provided with at least one outlet for stabilizing material, said outlet being provided with closing means moveable between
30 an open position and a closed position and being housed in bearings, driving means operating on the top end of the



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column casing for driving the column casing into the ground and lifting means operating on the top end of the column casing, characterized in that the bottom end comprises a base which is firmly connected to the shaft.

5 4. Device for performing the method according to claim 1, comprising a column casing essentially consisting of a shaft with at least one top end provided with an inlet for stabilizing material and a tapered bottom end provided with at least one outlet for stabilizing materi-
10 al, said outlet being provided with closing means moveable between an open position and a closed position and being housed in bearings, driving means operating on the top end of the column casing for driving the column casing into the ground and lifting means operating on the top end of
15 the column casing, characterized in that the closing means are constituted by a base functioning as a valve, which can slide axially in the bearings between a closed position, in which it seals upwardly against the concentric ring of the base, which is firmly connected to the shaft, and
20 an open position, in which the base is moved downward relative to the concentric ring.

5. Device according to claim 3 or 4, characterized by at least one driving means connected to the base and extending in an axial direction, said vibration means
25 being coupled to the driving means.

6. Device according to claim 3, characterized by closing means essentially consisting of two pivotable valves arranged opposite one another, the base extending therebetween in diametrical direction, said base comprising an essentially wedge shaped profile, having a recess
30 on both sides for receiving a bottom flange of a valve.

