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(54) **METHOD AND DEVICE FOR TAKING A SOIL SAMPLE FROM AN UNDERWATER BOTTOM**

(57) Described is a device and method for taking a soil sample from an underwater bottom. The device comprises an elongate hollow drill casing and a soil sample holder received in the drill casing and having an internal cavity connecting to an inlet opening provided on an underside of the drill casing. A transverse dimension of the internal cavity of the soil sample holder amounts to at least 200 mm. An underside of the drill casing is driven into the underwater bottom with a drive, whereby the internal cavity of the soil sample holder fills with soil material via the inlet opening. A support frame placed on the underwater bottom positions the drill casing relative to the underwater bottom. The device allows soil samples with a relatively large transverse dimension to be taken, whereby an undisturbed measurement sample of smaller transverse dimension can be taken therefrom. In order to enable driving of the drill casing into the underwater bottom a drive is applied which can produce a driving-in force of at least 500 kN.

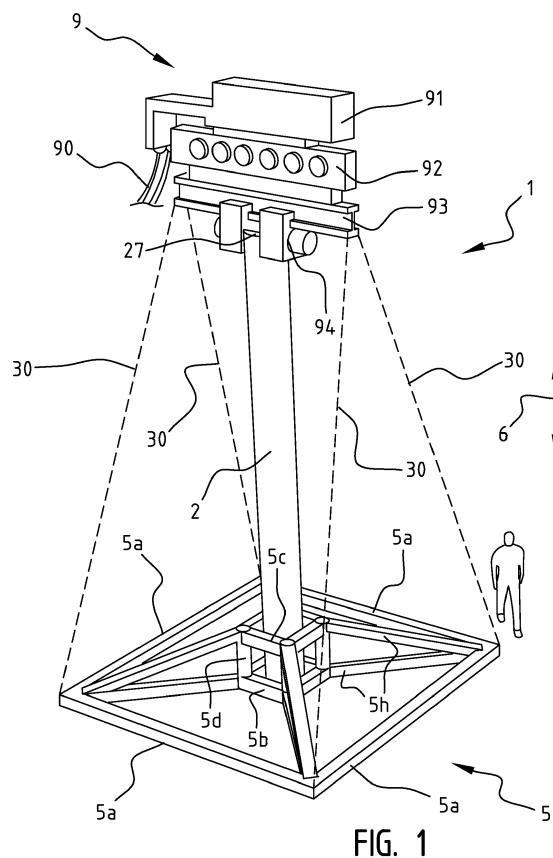


FIG. 1

Description

TECHNICAL FIELD

[0001] The invention relates to a device for taking a soil sample from an underwater bottom. The invention likewise relates to a method for taking a soil sample from an underwater bottom while making use of the device.

PRIOR ART

[0002] For the purpose of placing structures on or in an underwater bottom it is necessary to gain a good insight into the properties of the underwater bottom. This also applies for the design of an excavation or when raising for instance a seabed or riverbed. Soil samples are for this purpose taken from the underwater bottom and then analysed in a laboratory in respect of for instance composition and properties.

[0003] In a number of cases, such as for instance when laying gas pipelines, it is sufficient to gather information about the underwater bottom to a relatively small bottom depth of for instance 4-5 m. In other cases it will be necessary to take soil samples to bottom depths of 70-80 m and more. The underwater bottom can here be at water depths of 1000-2000 m and more.

[0004] Known devices for taking soil samples are able to take samples in relatively soft ground but are not deployable, or deployable to only limited extent, in clay, gravel and rock bottoms. Furthermore, the penetration depth or sampling depth of the known devices is usually limited to 5 to 6 metres. It has further been found difficult to take undisturbed soil samples with the known devices. A taken soil sample is indeed found in many cases to be adversely affected by the sampling itself and the measured properties are not representative of the soil properties. This problem occurs for instance in relatively soft clay and chalk bottoms.

[0005] An object of the present invention is therefore to provide a device and method which at least partially obviate the above stated drawbacks of the prior art.

DESCRIPTION OF THE INVENTION

[0006] The invention provides for this purpose a device as according to claim 1. A device is particularly provided for taking a soil sample from an underwater bottom, comprising an elongate hollow drill casing and a soil sample holder received in the drill casing and having an internal cavity connecting to an inlet opening provided on an underside of the drill casing; a support frame configured for placing on the underwater bottom and for positioning the drill casing relative to the underwater bottom; and a drive for driving the underside of the drill casing into the underwater bottom, whereby the internal cavity of the soil sample holder fills with soil material via the inlet opening; wherein a transverse dimension of the internal cavity of the soil sample holder amounts to at least 200 mm, and

the drive is configured to produce a driving-in force of at least 500 kN. The transverse dimension of the internal cavity of the soil sample holder preferably amounts to at least 250 mm, more preferably at least 300 mm and most preferably at least 350 mm.

[0007] It has been found that a soil sample holder with the claimed dimensions can receive a soil sample, at least a part of which comprises undisturbed soil material. This is particularly a part located a distance from side walls of the soil sample holder. Depending on the soil properties, it is found possible to take an undisturbed soil sub-sample from the soil sample holder with a transverse dimension, preferably a diameter, lying between 100 and 300 mm, preferably between 150 and 250 mm and most preferably between 175 and 225 mm.

[0008] Using the device a method for taking a soil sample from an underwater bottom can be performed according to the invention comprising of placing the support frame with drill casing on an underwater bottom, whereby an underside of the drill casing is positioned relative to the underwater bottom; driving the underside of the drill casing into the underwater bottom by means of the drive, whereby the internal cavity of the soil sample holder fills with soil material via the inlet opening; raising the soil sample holder filled with bottom material; and removing the taken soil sample from the soil sample holder.

[0009] The invention can be readily applied in dredging of underwater bottoms, in land reclamation, but for instance also in underwater mining of minerals or nodules located on or in an underwater bottom. The invention is likewise particularly suitable for taking soil samples in so-called cap rock, wherein a hard upper layer makes access to the underwater bottom more difficult. The invention also provides additional advantages in the case of underwater bottoms consisting of several alternating hard and soft layers.

[0010] In a useful embodiment an undisturbed soil sub-sample of smaller size is taken from the soil sample. Undisturbed is understood to mean the soil material whose properties are substantially not affected or influenced by the sampling itself. 'Substantially' is understood in the context of this application to mean at least 90%, more preferably at least 94% and most preferably at least 98% of the relevant quantity.

[0011] Because of the relatively large transverse dimension of the soil sample holder and encasing drill casing the device is only able to take a soil sample when the drive is configured to produce a driving-in force of at least 500 kN. The drive can in principle be freely chosen. In order to enable sampling of bottoms at relatively great water depths, in an embodiment the drive takes a substantially watertight and pressure-resistant form. In a preferred embodiment the drive produces a driving-in force of at least 600 kN, more preferably of at least 700 kN and most preferably of at least 800 kN.

[0012] A suitable drive can transmit only axial forces and/or in an embodiment comprises a rotational drive which is configured to rotate the drill casing around a

longitudinal axis thereof, if desired in one direction or alternating in two directions of rotation. In order to facilitate penetration of an underside of the drill casing into the underwater bottom the drill casing can be provided on the underside with a cutting body.

[0013] In an embodiment of the invention the drive of the device comprises a vibration drive which is configured to generate vibratory waves propagated at a frequency in a longitudinal direction of the drill casing. Driving of the drill casing provided with a soil sample holder into the underwater bottom is in this way facilitated. The vibration drive is preferably applied in combination with the rotational drive.

[0014] A suitable embodiment of the device according to the invention has a drive in the form of a hydraulic vibratory block engaging on an upper side of the drill casing, wherein the frequency lies between 5 and 100 Hz. A hydraulic vibratory block comprises eccentrics which are driven by hydraulic motors and generate vibrations whereby the drill casing connected to the drive is driven into the soil material.

[0015] Another embodiment comprises a drive in the form of a sonic drilling device engaging on an upper side of the drill casing, wherein the frequency amounts to at least 100 Hz, and preferably lies between 100 and 250 Hz. A sonic drilling device sets the drill casing into vibration with a relatively high frequency. The generated vibrations ensure that a relatively thin soil layer around and in the drill casing is fluidized, whereby the friction between an inner and outer surface of the drill casing and the adjacent soil material is reduced. Driving and raising the drill casing into and out of the underwater bottom are hereby made easier. In this and other embodiments according to the invention it becomes possible to take soil samples of a relatively great length, in particular lengths of 2 to 20 m, more preferably from 5 to 15 m and most preferably from 8 to 12 m.

[0016] A sonic drilling device known per se from for instance US 5,027,908 comprises at least two eccentric weights which have been synchronized and which are driven by hydraulic motors. The movement of the weights set the drill casing into vibration at a sonic frequency. The sonic drive preferably also comprises a rotational drive which is configured to rotate the drill casing around a longitudinal axis thereof, if desired in one direction or alternating in two directions of rotation, wherein rotation in one direction is preferred.

[0017] The drive and/or a drill casing optionally connected to the drive can be arranged in any manner in a support frame placed on the underwater bottom. A suitable embodiment of the device according to the invention comprises hoisting means for suspending the drive and/or the drill casing. The hoisting means, such as for instance a crane optionally placed on a vessel, can likewise be applied to place the support frame on an underwater bottom.

[0018] According to the invention the drill casing provided with a soil sample holder is supported by a support

frame which is configured for placing on the underwater bottom and for positioning the drill casing relative to the underwater bottom. In a suitable embodiment the support frame comprises a framework of mutually connected frame elements which form a base surface and a guide structure for the drill casing lying within the periphery of the base surface. The support frame provided with the drill casing is placed with the base surface on an underwater bottom, wherein the guide structure preferably extends upward from the underwater bottom. The height of the guide structure can be selected within broad limits and depends on, among other factors, the soil properties. In order to enable sufficient support, the base surface of the support frame can be provided with support feet which, if desired, are height-adjustable.

[0019] It becomes possible with the invented device to take undisturbed soil samples. The dimensions of the drill casing, and also of the soil sample holder receivable in the drill casing for this purpose, are relatively large. It is therefore advantageous to characterize the device according to an embodiment in that the drill casing comprises mutually connected shell parts which extend in the longitudinal direction of the drill casing and which can be removed from each other. In removed state a soil sample holder of relatively large dimensions can be easily arranged in a shell part, after which the soil sample holder can be enclosed in the drill casing by connecting the other shell part, or other shell parts, to said shell part.

[0020] In a further improved embodiment the soil sample holder comprises an elongate sample holder guide structure, for instance of a plastic such as PVC. The relatively low density of such a tube and the low friction between the plastic sample holder tube and the drill casing facilitate raising of a sample holder tube filled with a soil sample, certainly when it has a great length.

[0021] The length of such a sample holder tube can be chosen within broad limits but is preferably slightly shorter than the drill casing, preferably 20% shorter, more preferably 10% shorter and most preferably 5% shorter relative to the drill casing length. This allows the drill casing to be provided on an underside thereof with an end piece, such as a cutting body, and/or with a retaining member for the soil material received in the internal cavity.

[0022] The device according to the invention is characterized in an embodiment in that an external transverse dimension of the soil sample holder amounts to at least 200 mm, the soil sample holder has a length lying between 2 and 20 m and the soil sample holder has a wall thickness lying between 5 and 25 mm.

[0023] A further improved embodiment provides a device wherein an internal transverse dimension of the drill casing amounts to at least 370 mm, the drill casing has a length lying between 2 and 20 m and the drill casing has a wall thickness lying between 10 and 30 mm.

[0024] Likewise provided according to the invention is a method for taking a soil sample from an underwater bottom. The method comprises of providing a device according to the invention; preparing the drill casing by plac-

ing the sample holder tube, the cutting body and/or retaining member; placing the drill casing in the support frame whereby an underside of the drill casing can be positioned relative to the underwater bottom; placing the support frame with drill casing on an underwater bottom; driving the underside of the drill casing into the underwater bottom by means of the drive whereby the internal cavity of the soil sample holder fills with soil material via the inlet opening; raising the soil sample holder filled with soil material; and removing the taken soil sample from the soil sample holder, wherein the advantages also become particularly manifest by subsequently taking a soil sample of smaller size from the soil sample. Such a soil sample is generally undisturbed and allows more accurate determination of the properties of the underwater bottom.

[0025] Placing of the support frame with drill casing on the underwater bottom can take place in many ways using a launching device suitable for the purpose. Suitable launching devices comprise for instance a crane placed on a vessel or the underwater bottom, a tiltable frame mounted on the vessel and/or a moon pool with gantry crane provided in the vessel.

[0026] In preferred embodiments of the method according to the invention vibratory waves propagated at a frequency are generated in a longitudinal direction of the drill casing, whereby the drill casing is driven into the underwater bottom, the drill casing is driven into the underwater bottom via a hydraulic vibratory block engaging on an upper side of the drill casing, and at a frequency lying between 5 and 100 Hz; or via a sonic drive engaging on an upper side of the drill casing, and at a frequency of at least 100 Hz, and preferably lying between 100 and 250 Hz.

[0027] The drive with a drill casing attached thereto if desired is suspended in a practical embodiment from hoisting means and subsequently lowered into the support frame in the desired position relative to the underwater bottom.

[0028] Because of the relatively large dimensions it is further advantageous to apply an embodiment of the method in which a soil sample holder is arranged in the drill casing by removing from each other mutually connected shell parts of the drill casing extending in the longitudinal direction of the drill casing, arranging the soil sample holder in a remaining shell part and enclosing the soil sample holder in the drill casing by connecting a removed shell part to the remaining shell part.

[0029] Taking of relatively large soil samples is further facilitated with an embodiment in which an underside of the drill casing is provided with a retaining member for the soil material received in the internal cavity. In an embodiment the retaining member is moved from an open to a closed state and in the closed state has a conical form wherein the top of the cone points in the direction of the internal cavity. The retaining member preferably further forms a substantially closed surface in the closed state.

[0030] The above described device and method according to the invention allow undisturbed soil samples to be taken in a relatively short period of time in relatively soft underwater bottoms, such as for instance a soft clay or limestone bottom, but also in bottoms which are conversely relatively hard, such as for instance a clay, sand or rocky bottom.

BRIEF DESCRIPTION OF THE FIGURES

[0031] The device and method according to the invention will now be further elucidated with reference to the following figures, without the invention otherwise being limited thereto. In the figures:

figure 1 is a schematic perspective view of a device according to an embodiment of the invention;
figure 2 is a schematic perspective view of an embodiment of a drill casing according to the invention;
figure 3 shows a schematic side view and top view of a cutting body with retaining member according to an embodiment of the invention;
figure 4 is a schematic perspective view of a retaining member according to an embodiment of the invention in open and closed state; and finally
figure 5 shows a schematic representation of a number of method steps according to an embodiment of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0032] Referring to figure 1, a device 1 for taking a soil sample from an underwater bottom 3 is shown. Device 1 comprises a steel, elongate, hollow drill casing 2 with an inlet opening 4a which is provided on an underside 2a of the drill casing and along which soil material can be introduced. The external diameter (transverse dimension) of the drill casing shown in figure 1 amounts to 559 mm, while the length amounts to 6 m and the wall thickness to 20 mm.

[0033] The shown device 1 further comprises a support frame 5 which is configured for placing on underwater bottom 3 and for positioning drill casing 2 in a substantially vertical direction 6 relative to underwater bottom 3. Support frame 5 comprises a framework of frame elements (5a, 5b, 5c, 5d, 5h) which are rigidly connected to each other and of which frame elements 5a form a square base surface of 5 m by 5 m. Situated within the periphery of the base surface formed by elements 5a is a guide structure formed by four base elements 5b which form a square bottom surface, and four top elements 5c which form a square top surface. The bottom surface and the top surface are held spaced apart by frame elements 5d running in vertical direction 6. Guide structure (5b, 5c, 5d) is connected rigidly to the base surface by means of inclining frame elements 5h and configured to receive and support a lower part of drill casing 2. The height of guide structure (5b, 5c, 5d) is relatively limited in the

shown embodiment but can if desired extend over a greater height.

[0034] As shown in figure 2, drill casing 2 is provided with a soil sample holder in the form of a likewise elongate, hollow sample holder tube 4 of PVC. An internal cavity of sample holder tube 4 connects to an inlet opening 4a provided on the underside 2a of the drill casing. In the shown embodiment drill casing 2 is constructed from two shell parts (21, 22) mutually connected by means of hinges 23 disposed in longitudinal direction 20 of drill casing 2. Shell parts (21, 22) extend in longitudinal direction 20 of drill casing 2 and can be removed from each other by rotating a shell part 21 around hinges 23 away from the other shell part 22 (figure 2B). In this folded-open situation the sample holder tube 4 can be easily arranged in shell part 22 (figure 2C), after which shell part 21 is moved back in the direction of shell part 22 and secured thereto (figure 2D). In this situation the soil holder tube 4 is enclosed in drill casing 2. The soil sample tube 4 shown in figure 2 has an external diameter (transverse dimension) of 500 mm, a length of about 10 m and a wall thickness of 15 mm. On the upper side 2b the drill casing is closed with a seal 24 which is provided with a non-return valve 25. Arranged on the underside 2a of the drill casing is a cutting body 7 which is provided with a retaining member 8 for soil material received in the internal cavity of soil sample tube 4.

[0035] Referring to figure 3, cutting body 7 comprises a cylindrical sleeve 70 with a transverse dimension fitting onto drill casing 2. Sleeve 70 is provided on the underside with a cutting edge 71, whereby drill casing 2 can penetrate more easily into an underwater bottom. Sleeve 70 is provided on an upper side thereof with attaching means 74 which are arranged in a peripheral direction 73 and with which sleeve 70 can be secured to drill casing 2. Sleeve 70 is provided on the inner side with a retaining member 8, an embodiment of which is shown in figure 4. Retaining member 8 comprises a base ring 80 with which it is attached to an internal peripheral surface of sleeve 70 of cutting body 7. Base ring 80 surrounds an opening 81 which connects to inlet opening 2a of drill casing 2. Retaining member 8 further comprises two shell parts 82 which are connected hingedly (by means of hinge connections 83) to base ring 80 and which, as shown in figure 4B, fit against each other with free edge parts 82a in a closed state so that a substantially closed surface is obtained. In an open state (figure 4A) shell parts 82 are rotated away from each other, thereby creating an opening between the free edge parts 82a which gives access to inlet opening 2a of drill casing 2. When drill casing 2 is driven into underwater bottom 3, shell parts 82 are automatically pressed apart, whereby soil material can enter soil sample tube 4 of drill casing 2 via opening 81. After soil sample tube 4 has been filled, retaining member 8 is moved into the closed state of figure 4B by inter alia the weight of the taken soil sample, and drill casing 2 can be raised.

[0036] In order to drive drill casing 2 with underside 2a

into underwater bottom 3 the device 1 is further provided with a drive which is able to produce a driving-in force of at least 500 kN. In the embodiment shown in figure 1 the drive comprises a vibration drive 9 with which vibratory waves propagated at a frequency lying between 5 and 100 Hz are generated in the longitudinal direction 20 of drill casing 2. The drive comprises a hydraulic vibratory block which engages on upper side 2b of drill casing 2 and which is provided with oil by a hydraulic unit (not shown) with a maximum power of 890 kW, a maximum pressure of 350 bar and a maximum flow rate of 1200 l/min. The hydraulic oil is supplied under pressure via hydraulic conduits 90 connected to vibratory block 9. Vibratory block 9 comprises a housing 91 for the necessary electronics and a housing 92 for hydraulically driven distance. The upper side 2b of drill casing 2 is held firmly by means of clamping cylinders 94 mounted on a transverse beam 93, whereby vibratory block 9 is mounted on drill casing 2. Vibratory block 9 is configured to generate an eccentric moment of 50-100 kgm and vibrations at a frequency of 1500-2200 vpm. The centrifugal force to be produced typically lies between 1500-3500 kN, and in particular between 2000-3000 kN.

[0037] The vibratory block 9 with a drill casing 2 mounted thereon can be hoisted in its entirety, for instance from a vessel, on a hoisting cable 30 using hoisting means, such as a crane, suitable for the purpose (not shown).

[0038] Referring to figure 5, a possible embodiment of the method according to the invention is shown. The assembly of vibratory block 9 and a drill casing 2 mounted thereon (and provided with soil sample tube 4 and cutting body 8) is first attached to a hoisting cable 31 (figure 5A), picked up by the crane (not shown) and lowered with support frame 5, wherein the underside 5a of drill casing 2 is situated inside guide structure (5b, 5c, 5d) of support frame 5 (figure 5B). Support frame 5 is then lowered and placed with the base surface on an underwater bottom 3. Second hoisting cables 30 attached to vibratory block 9 are subsequently connected under a certain tension to the corner points of support frame 5 and the whole is lowered onto underwater bottom 3 (figure 5C). Drill casing 2 is hereby positioned in a substantially vertical position relative to underwater bottom 3. The underside 2a of drill casing 2 is then driven by means of vibratory block 9 into underwater bottom 3, whereby the internal cavity of soil sample tube 4 fills with soil material via inlet opening (2a, 81). As drill casing 2 is moved downward with vibratory block 9, hoisting cables 30 slacken as shown in figure 5D. Once the soil sample tube 4 has been sufficiently filled with soil material, the assembly of vibratory block 9 and drill casing 2 is raised again and soil sample tube 4 is removed from drill casing 2, after which the taken soil sample can be removed from soil sample tube 4. For the purpose of analysis of the soil material an undisturbed soil sample of smaller size is preferably kept from the taken soil sample.

[0039] The skilled person will appreciate that the invention is not limited to the above illustrated exemplary

embodiments of the method and device according to the invention, but that modifications and variations can be made within the scope of protection defined by the appended claims. It will thus be apparent that the method and device according to the invention can also be applied for purposes other than determining soil properties, such as for instance in the mining industry for the purpose of determining the presence of desired materials in the underwater bottom.

Claims

1. Device for taking a soil sample from an underwater bottom, comprising

- an elongate hollow drill casing and a soil sample holder received in the drill casing and having an internal cavity connecting to an inlet opening provided on an underside of the drill casing;
- a support frame configured for placing on the underwater bottom and for positioning the drill casing relative to the underwater bottom; and
- a drive for driving the underside of the drill casing into the underwater bottom, whereby the internal cavity of the soil sample holder fills with soil material via the inlet opening;

wherein a transverse dimension of the internal cavity of the soil sample holder amounts to at least 200 mm, and the drive is configured to produce a driving force of at least 500 kN.

2. Device as claimed in claim 1, wherein the drive comprises a vibration drive which is configured to generate vibratory waves propagated at a frequency in a longitudinal direction of the drill casing.
3. Device as claimed in claim 1 or 2, wherein the drive comprises a hydraulic vibratory block engaging on an upper side of the drill casing, wherein the frequency lies between 5 and 100 Hz.
4. Device as claimed in any of the foregoing claims, wherein the drive comprises a sonic drilling device engaging on an upper side of the drill casing, wherein the frequency amounts to at least 100 Hz, and preferably lies between 100 and 250 Hz.
5. Device as claimed in any of the foregoing claims, further comprising hoisting means for suspending the drive and/or the drill casing.
6. Device as claimed in any of the foregoing claims, wherein the support frame comprises a framework of mutually connected frame elements which form a base surface and a guide structure for the drill casing lying within the periphery of the base surface.

7. Device as claimed in any of the foregoing claims, wherein the drill casing comprises mutually connected shell parts which extend in the longitudinal direction of the drill casing and which can be removed from each other.

8. Device as claimed in any of the foregoing claims, wherein the soil sample holder comprises an elongate sample holder tube with a length shorter than the length of the drill casing.

9. Device as claimed in any of the foregoing claims, wherein an external transverse dimension of the soil sample holder amounts to at least 365 mm, a length lies between 2 and 20 m and a wall thickness lies between 5 and 25 mm, and wherein an internal transverse dimension of the drill casing amounts to at least 370 mm, a length lies between 2 and 20 m and a wall thickness lies between 10 and 30 mm.

10. Device as claimed in any of the foregoing claims, wherein an underside of the drill casing is provided with a retaining member for the soil material received in the internal cavity.

11. Method for taking a soil sample from an underwater bottom, comprising of:

- providing a device as claimed in any of the foregoing claims;
- receiving the drill casing in the support frame;
- lowering the support frame with drill casing in the direction of the underwater bottom;
- placing the support frame on an underwater bottom, whereby an underside of the drill casing is positioned relative to the underwater bottom;
- driving the underside of the drill casing into the underwater bottom by means of the drive, whereby the internal cavity of the soil sample holder fills with soil material via the inlet opening;
- raising the soil sample holder filled with soil material; and
- removing the taken soil sample from the soil sample holder.

12. Method as claimed in claim 11, wherein a soil sub-sample of smaller size is taken from the soil sample.

13. Method as claimed in claim 11 or 12, wherein vibratory waves propagated at a frequency are generated in a longitudinal direction of the drill casing during driving of the drill casing into the underwater bottom.

14. Method as claimed in any of the claims 11-13, wherein the drill casing is driven into the underwater bottom via a hydraulic vibratory block engaging on an upper side of the drill casing, and at a frequency lying between 5 and 100 Hz, and via a sonic drilling device

engaging on an upper side of the drill casing, and at a frequency of at least 100 Hz, and preferably lying between 100 and 250 Hz.

15. Method as claimed in any of the claims 11-14, where- 5
in the drive is suspended from hoisting means and
the drill casing is connected to the drive.
16. Method as claimed in any of the claims 11-15, where- 10
in a soil sample holder is arranged in the drill casing
by removing from each other mutually connected
shell parts of the drill casing extending in the longi-
tudinal direction of the drill casing, arranging the soil
sample holder in a remaining shell part and connect- 15
ing a removed shell part to the remaining shell part.

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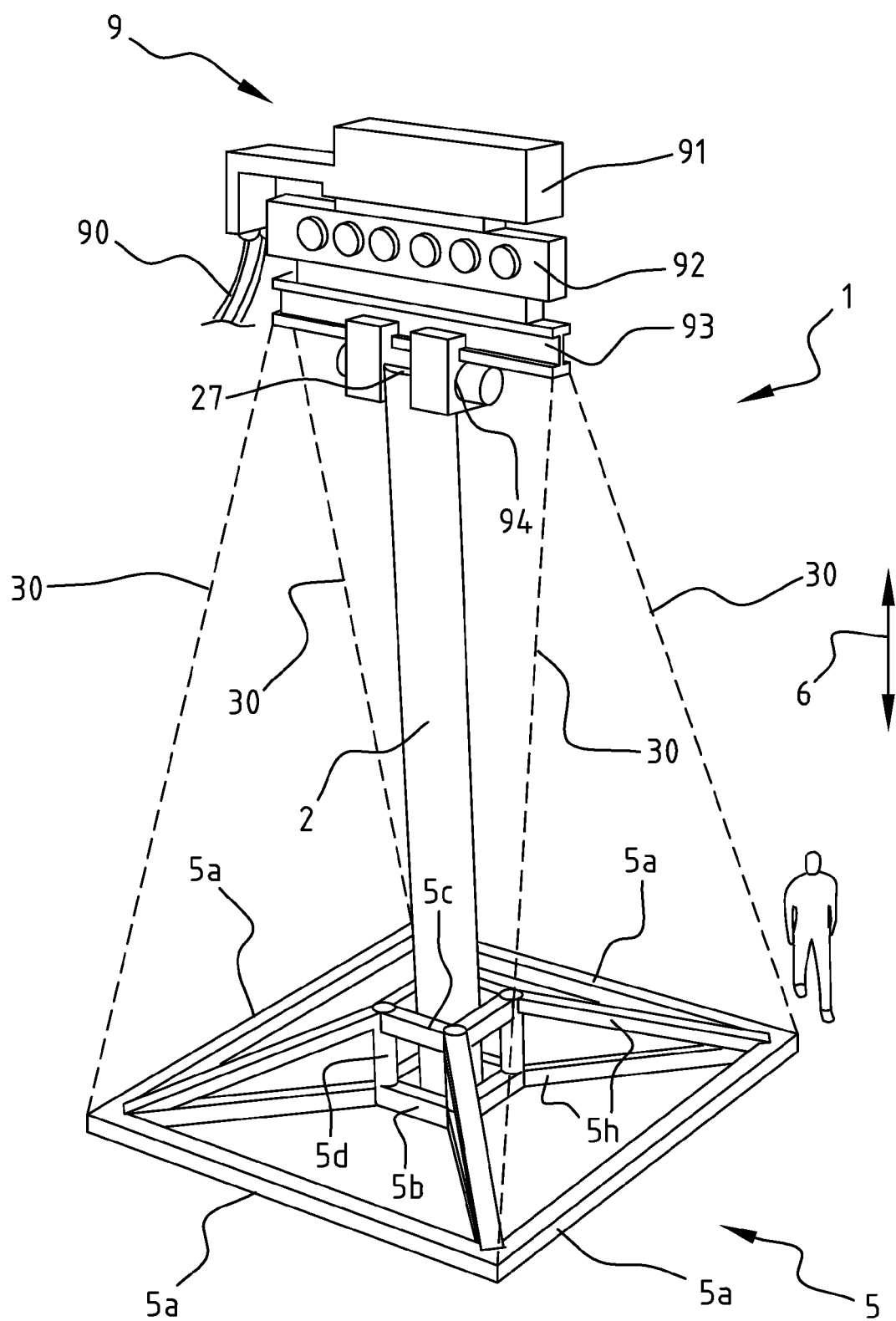
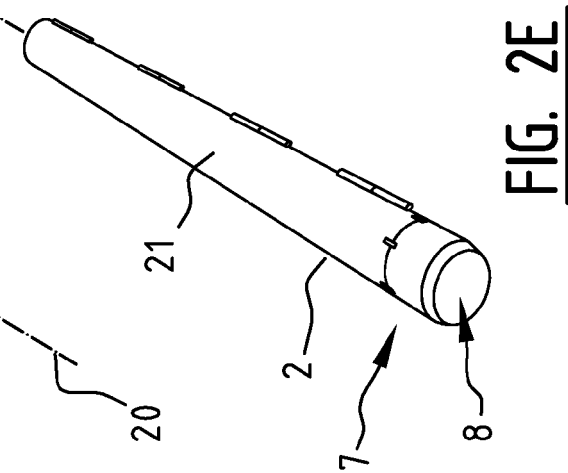
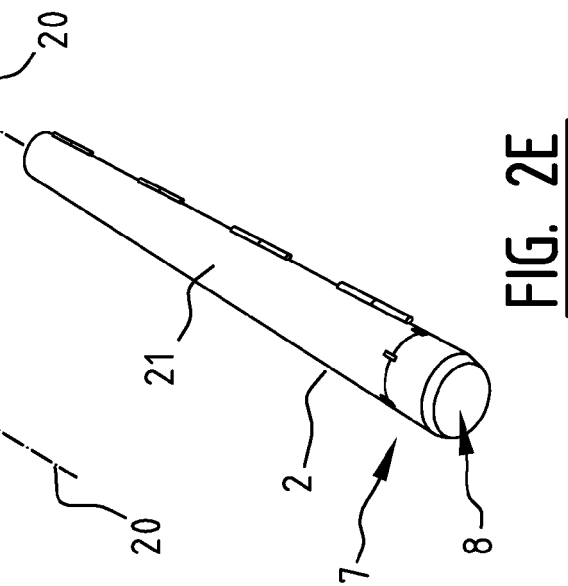
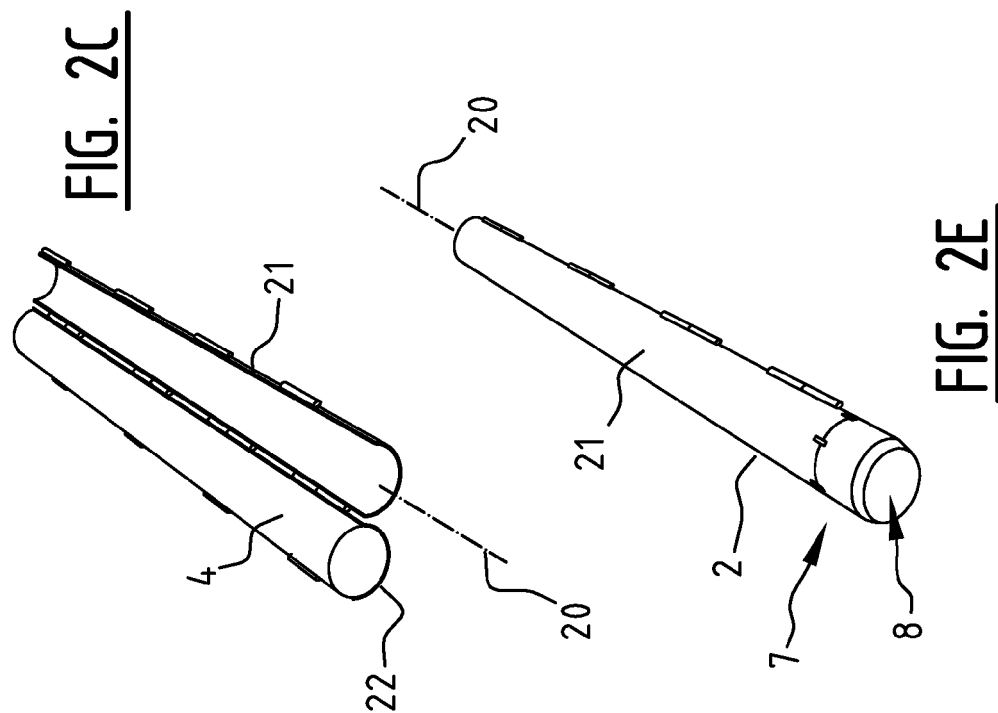
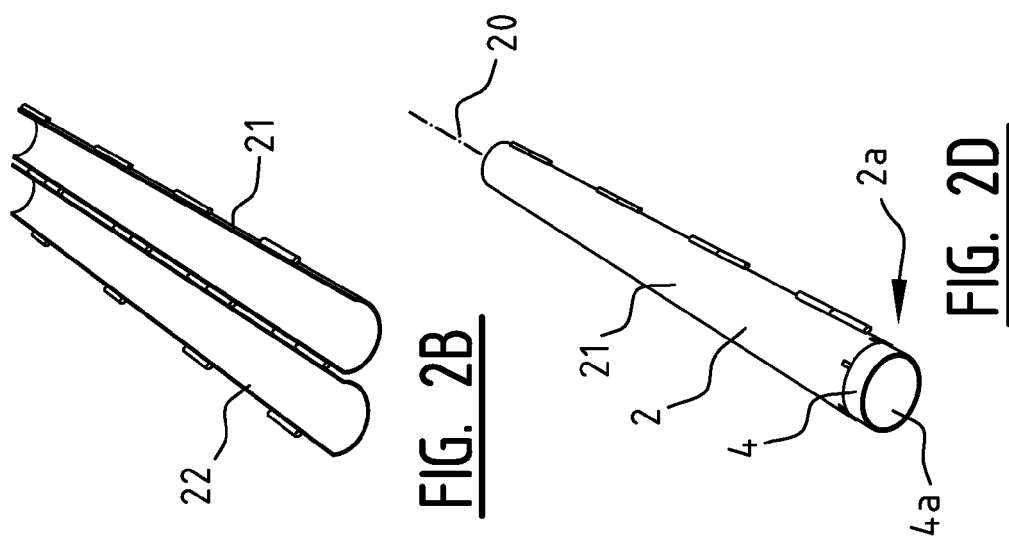
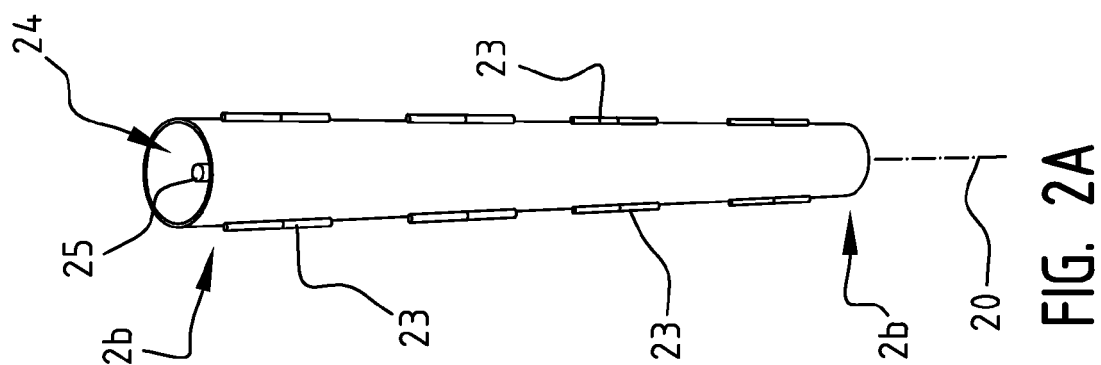


FIG. 1



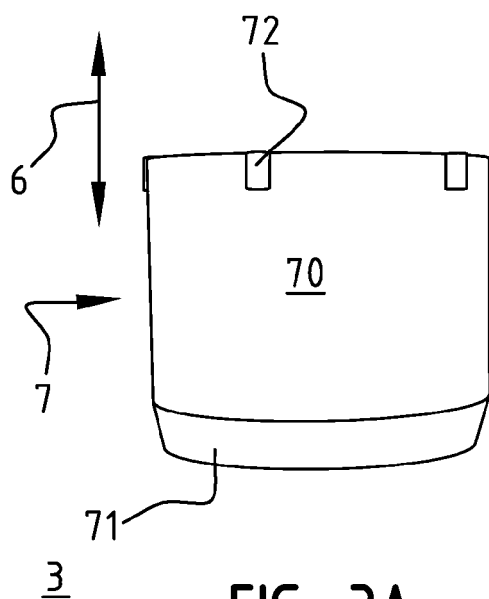


FIG. 3A

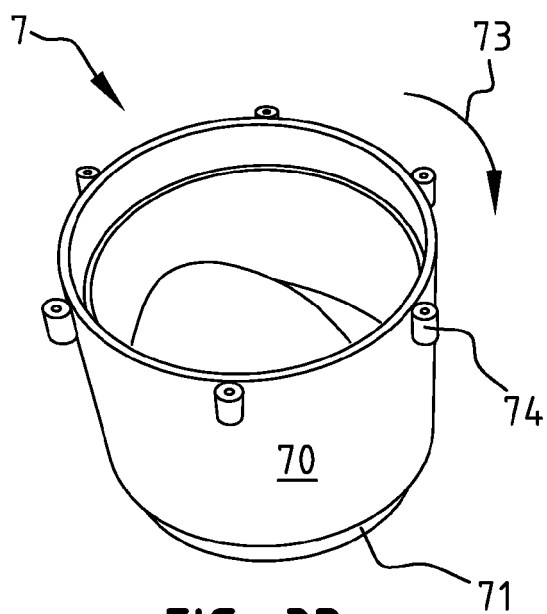


FIG. 3B

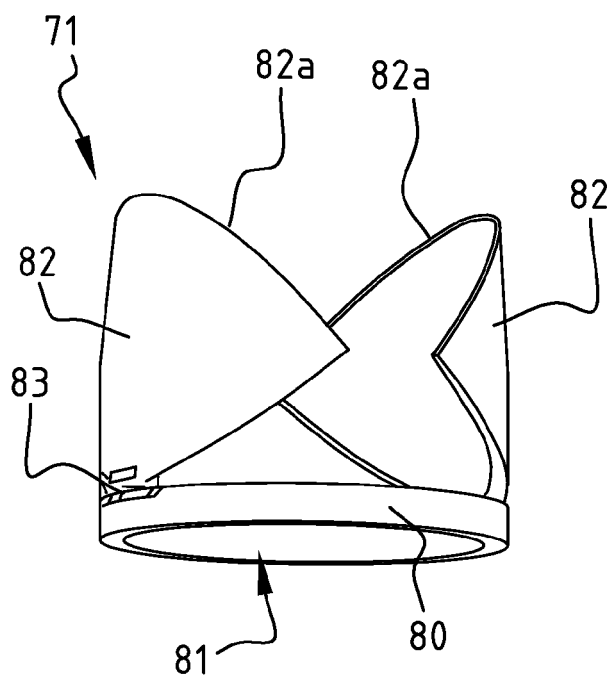


FIG. 4A

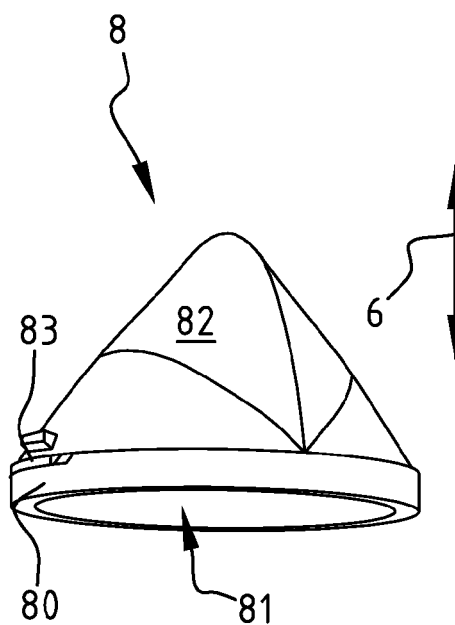
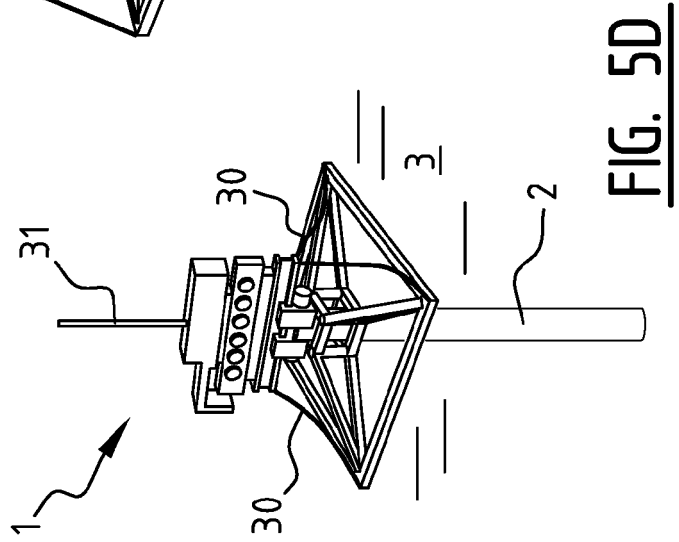
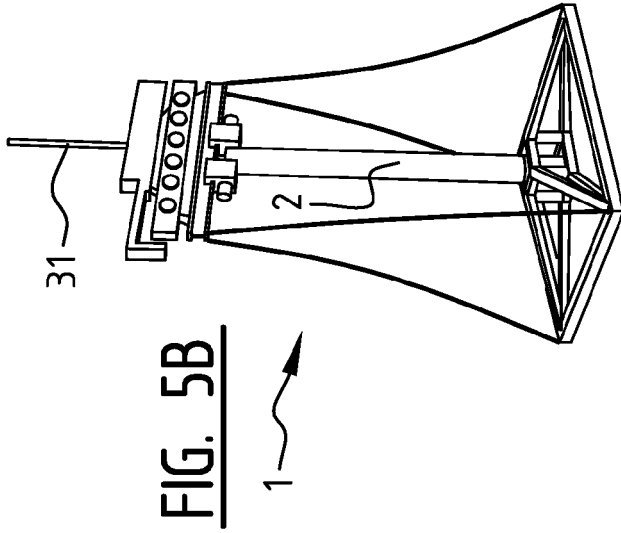
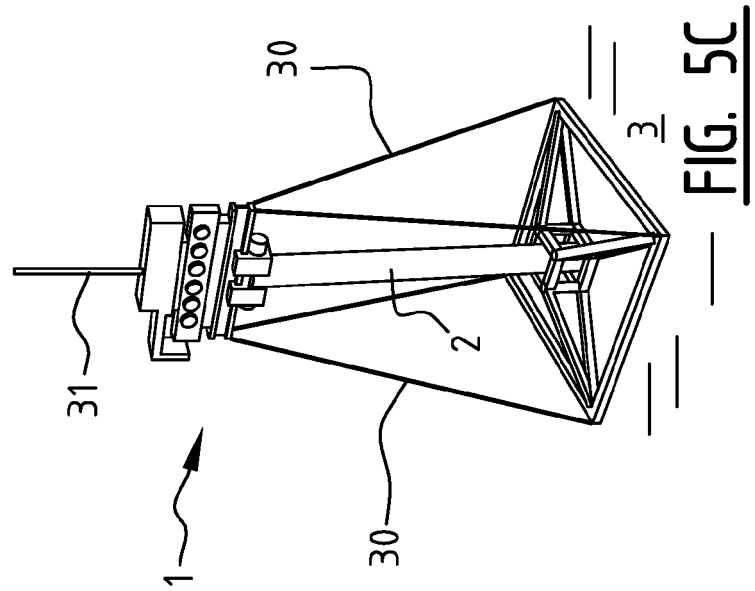
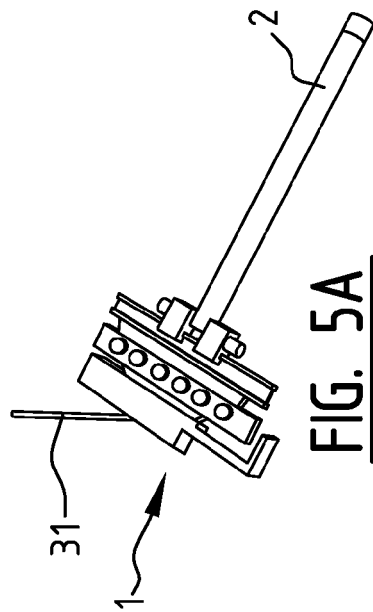


FIG. 4B





EUROPEAN SEARCH REPORT

Application Number
EP 15 17 4730

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	NL 2 005 087 C (DIESEKO GROUP B V [NL]) 17 January 2012 (2012-01-17) * the whole document * -----	1-16	INV. E02D7/18
			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 26 October 2015	Examiner Geiger, Harald
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 15 17 4730

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26-10-2015

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REFERENCES CITED IN THE DESCRIPTION

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