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(54) **A tool and method of boring and filling the borehole with concrete without removing soil therefrom**

Werkzeug und Verfahren zum Bohren ohne Erdaustrag und Füllen des Bohrloches mit Beton

Outil et méthode de forage sans déchargement de sol et remplissage du trou de forage avec du béton

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(56) References cited:
EP-A- 0 044 817
JP-A- 60 016 614
US-A- 2 168 640
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Description

Field of the invention

[0001] The present invention pertains to the field of soil boring, particularly for constructing foundation piles. More particularly, the invention relates to a tool and method of boring and filling the borehole with concrete without removing soil therefrom.

Background of the invention.

[0002] At present, among the most diffused methods of constructing foundation piles, there are the following:

(a) the method of cast-in-place driven piles;
(b) the method of drilling large diameter piles; end
(c) the auger boring method.

[0003] Method (a) of cast-in-place driven piles makes use of a metal tube, temporarily closed at its bottom end, that is driven into the ground by striking or vibrating. Driving the tube causes the surrounding soil to tamp, thereby improving mechanical characteristics of the soil, particularly bearing capacity. Reinforcement is lowered into the tube and then concrete is cast. The tube is then extracted while struck or vibrated in order to get the concrete to set properly and adhere intimately to the soil.

[0004] The method (b) of drilling large diameter piles employs a large rotating tool that removes and scoops portions of soil. The tool is cyclically extracted from the borehole to discharge soil fragments on the surface and then return to bore. As the soil surrounding the borehole tends to decompress and collapse, it often has to be the supported by a temporary casing or by the buoyancy of water or special impermeabilizing slurry. Being more simple, dry boring is preferred to the slurry method and applied when possible. Reinforcement is lowered into the borehole and then concrete is delivered through a hose from the bottom of the borehole preventing it from mixing with the drilling slurry.

[0005] With auger boring method (c), a screw-like tool long as the desired borehole is screwed into the ground, breaking the soil and making part of it rise to the surface. The soil is partially compressed or decompressed, according to its nature and the boring method. However, the surrounding soil is generally sustained by the soil in the spiral of the concrete is usually pumped through the hollow core of the auger while this is extracted. Care must be taken not to leave gaps between the concrete and the auger to avoid caving in. The reinforcement is sunk into the concrete successively.

[0006] The three above cited methods (a), (b) and (c) have some inconveniences.

[0007] Method (a) of cast-in-place driven piles is characterized by the emission of very high noise and vibrations that render it not suitable for application in urban areas. Generally, for economic reasons, the diameter of these piles never exceeds 1 meter and depth never exceeds 25 meters. The method is quite rapid and the machinery involved is not very sophisticated. Therefore, this method is not very expensive.

[0008] The same remarks made herein above apply also to the auger boring method (c), with the main difference that this method is sufficiently silent and causes no vibrations. There is a practical limit concerning the length of the reinforcement, that cannot exceed 16-18 meters due to difficulties encountered in sinking it in the concrete.

[0009] The method (b) of drilling large diameter piles requires special apparatuses and operators for casting the concrete and eventually make use of Bentonite slurry. However, this method allows to construct piles having a diameter of over 2 meters and a depth of up to 80 meters, owing to the use of telescopic drilling rods, that cannot be used with methods (a) and (c).

[0010] The European Patent Application No. 0 044 817 and the United States Patent No. 2,168,640 describe relevant boring and drilling tools, which are adapted to be mounted to the lower end of a rod string rotating about its longitudinal axis, and comprise a central axle connected to the rod string, and a roller idly mounted respect to the central axle, and having a spindle-shaped side surface tapered at its upper and lower end portions, the central axle having its longitudinal axis coincident with an axis inclined respect to the longitudinal axis, and the lower end portion being fitted with cutting means for disgregating soil.

[0011] The cited boring tools have been able to overcome the aforementioned drawbacks, but they showed their limitations in the penetration capacity, and, first of all, in the strengthening capacity of the carrying out borehole.

Summary of the invention

[0012] It is an object of the present invention to provide mainly vertical and inclined boreholes, maintaining the advantages of compacting the surrounding soil and achieving a good degree of adhesion between this and the concrete or other cast material, overcoming diameter and depth limits of known methods (a) and (c).

[0013] It is another object of the present invention to avoid noise and vibration disturbances to the environment.

[0014] It is another object of the invention to reduce expenses and time for foundation pile construction, by using less operators and a simple jig and fixtures.

[0015] It is a further object of this invention to reduce power consumption by using high efficiency devices.

[0016] In accordance with one aspect of the invention as claimed, these objects are accomplished by the

provision of a boring tool claimed in claim 1.

[0017] According to another aspect of the invention, there is provided a method of constructing concrete foundation piles by using a boring tool mounted to the lower end of a string of rods rotating about their longitudinal axis and advancing in the direction of said longitudinal axis so as to disgregate the soil at the bottom of the borehole by means of cutting means, thereby providing a substantially cylindrical borehole; the method being characterized in that it comprises the steps of:

- widening the side wall of the borehole by rolling the side surface of said boring tool on said wall, thereby compacting the soil surrounding the borehole;
- introducing continuously small amounts of binder in the borehole above said tool, progressively pressing the binder against the side wall of the borehole by means of said boring tool, thereby providing a the borehole with a rigid coating.

[0018] According to another aspect of the invention, concrete is continuously cast in the borehole so as to keep the borehole filled with concrete during boring operations, whereby the side wall of the borehole is prevented form collapsing.

Brief description of the drawings

[0019] In order that the present invention may be well understood there will now be described a few embodiments thereof, given by way of example, reference being made to the accompanying drawings, in which:

FIG. 1	is a partially sectioned view of a first embodiment of the boring tool of this invention;
FIG. 2	is a view to an enlarged scale of a second embodiment of the tool of the invention in operation;
FIG. 3	shows a third embodiment of the boring tool;
FIGS. 4 and 5	show a fourth embodiment of the boring tool of the invention in two different operational arrangements;
FIGS. 6 and 7	show a fifth embodiment of the boring tool of the invention in two different operational arrangements; and
FIG. 8	shows a sixth embodiment of the boring tool.

Detailed description of preferred embodiments.

[0020] With reference initially to FIG. 1, numeral 10 designates overall a boring tool according to the present invention. Tool 10 is securely mounted to the lower end portion of a drilling rod 11 having its longitudinal axis oriented substantially vertical. Rod 11 is the lowest of a rod string (not shown) connected to an equipment located up on the surface for driving the rod string according to a combined movement of rotation and vertical advancement with respect to axis x. Such an equipment, of conventional kind, is not shown herein nor described, as being well known to those skilled in the art.

[0021] Tool 10 comprises a spindle-shaped roller 12 idly mounted to a central cylindrical axle 13, the geometrical axis y of which is suitably inclined with respect to the longitudinal axis x of rod 11. Inclination of cylindrical axle 13 is attained by means of a crank member 14 connecting the lower end portion of rod 11 to the cylindrical axle 13. Roller 12 is spindle-shaped or barrel-shaped, being wider in its median portion 12c and slightly tapered at its upper and lower end portions 12a, 12b, respectively. At its lower end, roller 12 forms a conical bit 15.

[0022] As said, axis y of fusiform member 12 intercepts drilling axis x diagonally, so that when the rod are spinning, the spindle rotates about its own longitudinal axis and rolls on the walls of the borehole, while its longitudinal axis y traces two opposed vertex cones according to a so called nutation movement.

[0023] The sharp bit 15 of the spindle removes the soil by rotating, while its barrel-shaped surface rolls the walls 17 of the borehole. More particularly, the borehole is progressively widened by the lateral surface of the roller. In its downward movement, the borehole is first widened according to the circle described by the lower end portion 12b, and then is further widened as it encounters the larger median portion 12c. Consequently, the soil surrounding the borehole gets compacted.

[0024] The particular shape of crank member 14, the end portions 14a, 14b of which are respectively oriented according to axes x and y, has the following two purposes:

- attain the desired inclination of the axis y of rotation of the roller; and
- move the upper end of the cylindrical axis 13 and roller 12 away from axis x, so that the end portions of roller 12 are located at opposite sides of axis x of rotation of the rod string. This arrangement provides ideal balance of the rotating masses and the forces of reaction of the soil, even by using a single fuse-like roller.

[0025] As will be apparent, the boring tool 10 is of very simple construction.

[0026] With reference to FIG. 2, wherein like numerals are used to designate like parts, there is shown an alternative embodiment wherein, a secondary, substantially cylindrical roller 16 is mounted idle and eccentric to crank member 14'. As shown in the drawings, the longitudinal axis z of eccentric roller 16 is substantially parallel to the boring axis x. Secondary roller 16 has the purpose of carrying out a further action of compacting

the wall 17 of the borehole to improve self-supporting thereof. FIG. 2 shows the effect of the tool on the soil: by rotating and advancing vertically, bit 15 creates a circular groove 18 on the bottom of the borehole, which is widened later by the median and upper portions of roller 12. Finally, secondary roller 16 gives the borehole its definitive diameter.

[0027] According to another embodiment (not shown) of the boring tool of the present invention, there are provided several secondary rollers, fitted above the spindle-shaped roller. Preferably, the secondary rollers are angularly shifted around the boring axis for reasons of balance.

[0028] FIG. 3 shows one of many possibilities of providing the rollers with further boring means, such as bit fins 19, spiral-shaped protrusions, projecting knobs 20, etc., with an aim to improve adherence to the walls of the borehole or enhance disgregating action on the bottom of the borehole.

[0029] With reference to FIGS. 4 and 5, a fourth embodiment of the boring tool provides the conical bit 15 integral with the cylindrical axle 13 about which the roller can rotate. In this embodiment, the roller can also slide lengthwise with respect to axle 13. Particularly, roller 12 is a hollow shell having upper and lower openings 28, 29, communicating through the inside of the shell. Shell 21 is fixedly connected to a central bushing 31 through arms or other rigid connecting members 30. Bushing 31 is free to rotate, with shell 21, about axle 13 and slide along this between upper and lower stopping means 32, 33. Lower stopping means 33 is formed by the upper portion of conical bit 15.

[0030] Rigid connecting members 30 determine a plurality of passages adapted to let a flow enter upper opening 28, pass through the inside of shell 21 and exit through lower opening 29. The shape and arrangement shown of connecting members 30 is purely illustrative. The overall cross section of the connecting members is a small percentage of the whole cross section of shell 21.

[0031] By sliding on axle 13, when a downwardly directed thrust is applied to the tool during boring operations, shell 21 reaches the arrangement shown in FIG. 4, where the roller is urged upwardly abutting its upper stopping means 32 and conical bit 15 closes the lower opening 29.

[0032] When the boring tool is extracted from the borehole, i.e. when a traction force is applied, conical bit 15 retracts within the hollow shell (FIG. 5) opening lower opening 29 and allowing passage of a fluid, such as concrete or similar matter, from the zone of the borehole above the tool to the zone underneath.

[0033] Referring to FIGS. 6 and 7, a further embodiment of the boring tool of this invention is shown wherein the spindle-shaped roller 12 incorporates the bit 15 and is crossed lengthwise by one or more inner passages 23 having lower ports 24. During boring operations, ports 24 are closed by a conical cap 22 covering bit 15 underneath. During the following phase of extraction of the tool (FIG. 7), cap 22 is left at the bottom of the borehole while a fluid (grout) filling the borehole passes from above the tool to underneath through passages 23.

[0034] In a still different embodiment, shown in FIG. 8, the lower ports 24 of passages 23 are each fitted with a closing cover 25. The upper portions 27 of closing covers 25 are hinged to the body of roller 12 so that during boring operations covers 25 seal passages 23 (as shown on the left cross-sectioned side of FIG. 8). As the tool is extracted, covers 25 rotate about hinges 27 and open (position 26, right side of FIG. 8) thereby allowing flow of the material filling the borehole.

[0035] As will be apparent, the passages crossing the various embodiments described and illustrated in FIGS 4 to 8 render the extraction of the boring tool from the borehole easier.

[0036] According to the present invention, the boring tool previously described can be used according to different preferred methods, some of which are described by way of example hereinafter.

[0037] According to a first boring method, herein called "dry boring", the tool 10 is driven vertically against the soil as it spins. The tool perforates the bottom of the borehole and rolls on its walls. As the tool advances, it leaves above itself a cylindrical borehole. As compressed soil is more resistant and less likely to collapse, the dry boring method is destined to be efficient and inexpensive for many kinds of soil. In this case the reinforcement can be lowered down the borehole and casting is carried out as described in the preamble with reference to method (b) of large diameter drilled foundation piles.

[0038] As an alternative to this first method, a second method herein called "coated boring" may be used. This method includes continuous introduction of small amounts of binder material that is progressively compresses by the rollers against the walls. The result is a concrete coating on the walls of the borehole. By using concrete added with an accelerator or other quick setting mixtures, the coating that is formed on the walls renders them steady in a short time and extends possibilities of dry boring.

[0039] A third possible method is "concrete boring", which is ideal with particularly unstable kinds of soil. As the boring proceeds, concrete is continuously poured into the borehole to keep it full. Hydraulic thrust of the concrete prevents the walls from collapsing, while part of the concrete is incorporated into the walls by rolling. Once the tool is extracted, the reinforcement is lowered into the concrete in a manner similar to what is actually done in the cited method (c) of auger boring.

[0040] In comparison with known kinds of boring tools, the roller tool according to the present invention provides a number of advantages:

- rolling friction is drastically reduced with respect to

methods where boring tools undergo sliding friction. As a result, power consumption is cut down and efficiency is improved;

- being rolled, the walls of the bore are less likely to be abraded;
- the areas where the tool contacts the soil are small. As a result, specific pressure is higher.

[0041] Consequently, mechanical characteristics of the soil are improved. The soil does not get decompressed as with drilling. On the contrary, it is compacted as with method (a) of driven piles, where the same effect is achieved by striking. In the case of the present invention, instead, the method involves much less vibration and noise.

[0042] In comparison with a large diameter drilled pile, an economical advantage is connected with elimination of idle time (rising to the surface, dumping, and returning down). With kinds of soil that allow this method (soft cohesive soil), these idle times constitute more than 50% of total working time.

[0043] Another minor advantage is the reduction of site cleaning expenses as well as problems due to the presence of mud on the site.

[0044] With respect to the augered pile and driven pile methods, which are usually limited to depths of 20-30 meters, the provision of the boring of this invention with telescopic rod drilling machines offers the possibility of reaching 50-60 meters of depth and more, where the soil allows it. With respect to the continuous helix method, using a machine having the same dimensions, the methods of this invention can provide boreholes three times deeper. With the same torque available, the borehole diameter can be much larger because lateral friction is considerably reduced and driving power is concentrated on the portion of the tool which is actually excavating. Moreover, there are no difficulties with fitting the reinforcement, where it is possible to carry out the dry boring method.

[0045] The aforesaid "dry boring" and "coated boring" methods provide all the cited advantages for the tool, particularly the great depth that can be reached with telescopic rods, large diameter owing to low friction, reduced costs due to the speed of boring operations, elimination of drilling slurry and relevant apparatuses and operators.

[0046] The "concrete boring" method adds three further advantages:

- it eliminates risks of caving in;
- it eliminates the hose-casting method and the relevant machinery and operators for manoeuvring same;
- it eliminates casting time, as this is carried out simultaneously with the boring.

[0047] Further, it will be appreciated that the upper tapered portion 12a of the roller facilitates introduction of binder into the borehole and renders the final extraction of the tool easier.

[0048] Finally, the tool of this invention is adapted for application to current drilling plants without having to be modified.

Claims

1. A boring tool (10), particularly for use in concrete foundation pile construction, adapted for mounting to the lower end of a rod string (11) rotating about its longitudinal axis (x) and advancing along said axis (x), and comprising: a central axle (13) having its longitudinal axis coincident with an axis (y) inclined with respect to said longitudinal axis (x); and at least one roller (12), which is idly mounted with respect to both said rods (11) and said axle (13), and is rotatable about the axis (y), and has a spindle-shaped side surface tapered at its upper (12a) and lower (12b) end portions to present the shape of a barrel with its maximum diameter in the median portion (12c), the upper (12a) and the lower (12b) end portions being located on opposite sides with respect to said longitudinal axis (x), and the lower (12b) end being fitted with cutting means (15, 19) for disgregating soil and ending with a conical bit (15); the boring tool (10) being charaterized in that it further comprises means of a curved or crank member (14, 14') arranged between said rod (11) and said central axle (13), and having an upper end portion (14a) connected to said rod (11) and a lower end portion (14b), said upper end portion (14a) being oriented as said longitudinal axis (x), said lower end portion (14b) being eccentric with respect to said axes (x) and oriented as said inclined axis (y) to avoid the boring tool (10) removing soil from the borehole.

2. A tool according to claim 1, characterized in that at least one secondary substantially cylindrical roller (16) is mounted to said crank member (14'), said secondary roller having a longitudinal axis (z) spaced apart from said longitudinal axis (x) and substantially parallel thereto.

3. A tool according to claim 1, characterized in that within roller (12) there is provided at least one longitudinal passage (34, 23) communicating with the upper zone of the borehole above the tool and the lower zone under the boring tool (10); said passage being fitted with at least one corresponding sealing means (15, 22, 25) adapted for sealing said passage as the tool is performing boring action and unsealing said passage as the tool is being lifted up through the borehole, whereby a fluid is allowed to flow through said at least one passage from said upper zone to said lower zone.

4. A tool according to claim 3, characterized in that the roller comprises an outer shell (21) slidably mounted to a central axle (13) fixed to said lower rod (11), said axle having a longitudinal axis coincident with said inclined axis (y), said sealing means consisting of a lower bit (15) integral to said central axle (13).

5. A tool according to claim 3, characterized in that said at least one inner passage (23) has a lower port (24) located on said conical bit (15), said sealing means consisting of a separate rigid cap (22) congruent to said bit (15); said cap being adapted for covering said port (24) from underneath during boring operations only and being left in the borehole as the boring tool is extracted from the borehole.

6. A tool according to claim 3, characterized in that said at least one inner passage (23) has a lower port (24) located on said conical bit (15), said sealing means consisting of a closing cover (25) secured (27) to the roller (12) and capable of reaching a first sealing arrangement for sealing said port (24) during boring operations and a second open arrangement as the boring tool is extracted from the borehole.

7. A method of constructing concrete foundation piles by using a boring tool (10) according to any of the preceding claims, said boring tool being mounted to the lower end of a string of rods (11) rotating about their longitudinal axis (x) and advancing in the direction of said longitudinal axis (x) so as to disgregate the soil at the bottom of the borehole by means of cutting means (15, 19), thereby providing a substantially cylindrical borehole; the method being characterized in that it comprises the steps of:

   - widening the side wall (17) of the borehole by rolling the side surface (12) of said boring tool (10) on said wall, thereby compacting the soil surrounding the borehole; and
   - introducing continuously small amounts of binder in the borehole above said tool, progressively pressing the binder against the side wall of the borehole by means of said boring tool (10), thereby providing a the borehole with a rigid coating.

8. A method according to claim 7, wherein concrete is continuously cast in the borehole so as to keep the borehole filled with concrete during boring operations, whereby the side wall of the borehole is prevented form collapsing.

9. A method according to claim 7, characterized in further comprising, during the phase in which the tool is extracted from the borehole, the step of opening at least one longitudinal passage (34, 23) through said tool so as to allow a flow of binder to pass through the tool from the zone above the tool to the zone underneath.

Patentansprüche

1. Bohrgerät (10), insbesondere zur Verwendung beim Betonfundament-Pfahlbau, angepaßt zur Befestigung am unteren Ende eines Stangenstrangs (11), der um seine Längsachse (x) rotiert und entlang dieser Achse (x) vorgetrieben wird, umfassend: eine zentrale Welle (13), deren Längsachse mit einer Achse (y) zusammenfällt, die in Bezug auf die Längsachse (x) geneigt ist, und mindestens eine Walze (12), die in Bezug sowohl auf die Stange (11) und die Welle (13) leerlaufend befestigt und um die Achse (y) verdrehbar ist und eine spindelförmige Seitenoberfläche aufweist, die an ihren oberen (12 a) und unteren (12 b) Endstücken verjüngt ist, um die Form einer Trommel zu ergeben, deren maximaler Durchmesser im Mittelteil (12 c) liegt, wobei die oberen (12 a) und die unteren (12 b) Endstücke an gegenüberliegenden Seiten in Bezug auf die Längsachse (x) angeordnet sind und das untere (12 b) Ende mit Schneidmitteln (15, 19) zum Auflockern von Erdboden ausgestattet ist, und mit einer konischen Bohrerspitze (15) endet, wobei das Bohrgerät (10)
   dadurch gekennzeichnet ist, daß es ferner eine gekrümmtes oder kurbelartiges Teil (14, 14') umfaßt, welches zwischen der Stange (11) und der zentralen Welle (13) angeordnet ist und ein oberes Endstück (14 a), das mit der Stange (11) verbunden ist, und ein unteres Endstück (14 b) aufweist, wobei das obere Endstück (14 a) so wie die Längsachse (x) orientiert ist, das untere Endstück (14 b) bezüglich der Achse (x) exzentrisch ist und so wie die geneigte Achse (y) orientiert ist, um zu vermeiden, daß das Bohrgerät (10) Boden aus dem Bohrloch entfernt.

2. Gerät nach Anspruch 1,
   dadurch gekennzeichnet, daß mindestens eine zweite, im wesentlichen zylindrische Walze (16) am Kurbelteil (14') befestigt ist, wobei die zweite Walze eine Längsachse (z) aufweist, die von der Längsachse (x) räumlich entfernt und im wesentlich parallel dazu ist.

3. Gerät nach Anspruch 1,
   dadurch gekennzeichnet, daß innerhalb der Walze (12) mindestens ein längsseitiger Durchgang (34, 23) vorgegeben ist, der mit der oberen Zone des Bohrlochs oberhalb des Gerätes und der unteren Zone unter dem Bohrgerät (10) in Verbindung steht, und der Durchgang mit zumindest

einem entsprechenden Verschlußmittel (15, 22, 25) ausgestattet ist, welches angepaßt ist, um den Durchgang zu verschließen, wenn das Gerät eine Bohrung durchführt und um den Durchgang offenzuhalten, wenn das Gerät durch das Bohrloch angehoben wird, wobei einer Flüssigkeit erlaubt wird, durch diesen zumindest einen Durchgang aus der oberen Zone zur unteren Zone zu fließen.

4. Werkzeug gemäß Anspruch 3,
dadurch gekennzeichnet, daß die Walze ein äußeres Gehäuse (21) umfaßt, welches verschiebbar auf einer zentralen Welle (13) befestigt ist, die an der unteren Stange (11) fixiert ist, wobei die Welle eine Längsachse aufweist, die mit der geneigten Achse (y) zusammenfällt, und die Verschlußmittel aus einer unteren Bohrerspitze (15) bestehen, die in die zentrale Welle (13) eingebaut ist.

5. Werkzeug gemäß Anspruch 3,
dadurch gekennzeichnet, daß der mindestens eine innere Durchgang (23) eine untere Öffnung (24) aufweist, die auf der konischen Bohrerspitze (15) lokalisiert ist, und die Verschlußmittel aus einer einzelnen festen Kappe (22) bestehen, welche dekkungsgleich mit der Bohrerspitze (15) ist, wobei die Kappe nur dafür vorgesehen ist, während der Bohrvorgänge die Öffnung (24) von unten zu bedecken und in dem Bohrloch zurückgelassen zu werden, wenn das Bohrgerät aus dem Bohrloch herausgezogen wird.

6. Gerät gemäß Anspruch 3,
dadurch gekennzeichnet, daß der mindestens eine innere Durchgang (23) eine untere Öffnung (24) aufweist, die auf der konischen Bohrerspitze (15) lokalisiert ist, und die Verschlußmittel aus einer Verschlußabdechung (25) bestehen, die an der Walze (12) befestigt (27) ist, und in der Lage ist, eine erste Verschlußstellung zum Verschließen der Öffnung (24) während der Bohrvorgänge einzunehmen und eine zweite offene Stellung, wenn das Bohrgerät aus dem Bohrloch herausgezogen wird.

7. Verfahren zum Bau von Betonfundament-Pfählen unter Verwendung eines Bohrgerätes (10) gemäß einem der vorhergehenden Ansprüche, wobei das Bohrgerät am unteren Ende eines Strangs von Stangen (11) befestigt ist, die sich um ihre Längsachse (x) drehen und sich in Richtung der Längsachse (x) vorwärts bewegen, um so den Boden am unteren Ende des Bohrlochs durch Schneidmittel (15, 19) aufzulockern, wobei sie dadurch ein im wesentlichen zylindrisches Bohrloch gewährleisten, und das Verfahren dadurch gekennzeichnet ist, daß es die folgenden Schritte umfaßt:

- Erweitern der Seitenwand (17) des Bohrlochs durch Walzen der seitlichen Oberfläche (12) des Bohrgeräts (10) an der Wand, wobei der das Bohrloch umgebende Boden verfestigt wird;
- kontinuierliches Einführen kleiner Mengen von Bindemittel in das Bohrloch oberhalb des Geräts, fortschreitendes Andrücken des Bindemittels gegen die Seitenwand des Bohrlochs mittels des Bohrgeräts (10), wobei ein Bohrloch mit einer festen Umhüllung gewährleistet wird.

8. Verfahren gemaß Anspruch 7, wobei Beton kontinuierlich in das Bohrloch gegossen wird, um so das Bohrloch während der Bohrvorgänge mit Beton gefüllt zu halten, wodurch vermieden wird, daß die Seitenwand des Bohrlochs kollabiert.

9. Verfahren gemäß Anspruch 7,
dadurch gekennzeichnet, daß es ferner den Schritt umfaßt, während der Phase, in der das Gerät aus dem Bohrloch herausgezogen wird, mindestens einen längsseitigen Durchgang (34, 23) durch das Gerät zu öffnen, um so einem Fluß des Bindemittels zu erlauben, durch das Gerät von der Zone oberhalb des Gerätes zur Zone darunter hindurchzugehen.

Revendications

1. Outil de forage (10), en particulier destiné à être utilisé dans la construction de pilotis de fondement en béton, adapté pour être monté sur l'extrémité inférieure d'un train de tiges (11) tournant autour de son axe longitudinal (x) et avançant le long dudit axe (x), et comprenant : un arbre central (13) ayant son axe longitudinal qui coïncide avec un axe (y) incliné par rapport audit axe longitudinal (x) ; et au moins un rouleau monté de manière libre à la fois par rapport auxdites tiges (11) et audit arbre (13), et est susceptible de tourner autour de l'axe (y), et présente une surface latérale en forme de fuseau amincie au niveau de ses parties d'extrémité supérieure (12a) et inférieure (12b) pour présenter la forme d'un cylindre dont le diamètre maximal se trouve dans la partie médiane (12c), les parties d'extrémité supérieure (12a) et inférieure (12b) étant placées sur des côtés opposés par rapport audit axe longitudinal (x), et l'extrémité inférieure (12b) étant équipée de moyens de coupe (15, 19) pour désagréger le sol et se terminant en un trépan conique (15) ; l'outil de forage (10) étant caractérisé en ce qu'il comprend en outre des moyens constitués d'un élément incurvé ou coudé (14, 14') agencés entre ladite tige (11) et ledit arbre central (13), et ayant une partie d'extrémité supérieure (14a) raccordée à ladite tige (11) et une partie d'extrémité

inférieure (14b), ladite partie d'extrémité supérieure (14a) étant orientée comme ledit axe longitudinal (x), ladite partie d'extrémité inférieure (14b) étant excentrique par rapport auxdits axes (x) et orientée comme ledit axe incline (y) afin d'éviter que l'outil de forage (10) ne retire le sol du trou de forage.

2. Outil selon la revendication 1, caractérisé en ce qu'au moins un rouleau secondaire sensiblement cylindrique (16) est monté sur ledit élément coudé (14'), ledit rouleau secondaire ayant un axe longitudinal (z) écarté dudit axe longitudinal (x) et sensiblement parallèle à celui-ci.

3. Outil selon la revendication 1, caractérisé en ce qu'à l'intérieur du rouleau (12) soit ménagé au moins un passage longitudinal (34, 23) communiquant avec la zone supérieure du trou de forage au-dessus de l'outil et avec la zone inférieure sous l'outil de forage (10) ledit passage étant équipé d'au moins un moyen d'étanchéité correspondant (15, 22, 25) adapté pour rendre étanche ledit passage lorsque l'outil réalise une action de forage et pour supprimer l'étanchéité dudit passage lorsque l'outil est soulevé dans le trou de forage, moyennant quoi un fluide peut s'écouler dans ledit au moins un passage de la zone supérieure à ladite zone inférieure.

4. Outil selon la revendication 3, caractérisé en ce que le rouleau comprend une enveloppe extérieure (21) montée de manière coulissante sur un arbre central (13) fixé sur ladite tige inférieure (11), ledit arbre ayant un axe longitudinal coïncidant avec ledit axe incliné (y), lesdits moyens d'étanchéité se composant d'un trépan inférieur (15) faisant partie intégrante dudit arbre central (13).

5. Outil selon la revendication 3, caractérisé en ce que ledit au moins un passage intérieur (23) présente un orifice inférieur (24) situé sur ledit trépan conique (15), lesdits moyens d'étanchéité se composant d'un capuchon rigide séparé (22) s'adaptant audit trépan (15) ; ledit capuchon étant adapté pour recouvrir ledit orifice (24) par le dessous seulement lors des opérations de forage et étant laissé dans le trou de forage lorsque l'outil de forage est extrait du trou de forage.

6. Outil selon la revendication 3, caractérisé en ce que ledit au moins un passage intérieur (23) présente un orifice inférieur (24) situé sur ledit trépan conique (15), lesdits moyens d'étanchéité se composant d'un capot de fermeture (25) fixé (27) sur le rouleau (12) et pouvant atteindre un premier agencement d'étanchéité afin de rendre étanche ledit orifice (24) lors des opérations de forage et un second agencement ouvert lorsque l'outil de forage est extrait du trou de forage.

7. Procédé de construction de pilotis de fondement en béton en utilisant un outil de forage (10) selon l'une quelconque des revendications précédentes, ledit outil de forage étant monté sur l'extrémité inférieure d'un train de tiges (11) tournant autour de leur axe longitudinal (x) et avançant dans la direction dudit axe longitudinal (x) afin de désagréger le sol au fond du trou de forage au moyen de moyens de coupe (15, 19), creusant ainsi un trou de forage sensiblement cylindrique ; le procédé étant caractérisé en ce qu'il comprend les étapes consistant à :

- élargir la paroi latérale (17) du trou de forage en faisant rouler la surface latérale (12) dudit outil de forage (10) sur ladite paroi, tassant ainsi le sol entourant le trou de forage ; et
- introduire en continu de petites quantités de liant dans le trou de forage au-dessus dudit outil, en pressant progressivement le liant contre la paroi latérale du trou de forage au moyen dudit outil de forage (10), tapissant ainsi le trou de forage d'un revêtement rigide.

8. Procédé selon la revendication 7, dans lequel du béton est coulé en continu dans le trou de forage afin de conserver le trou de forage rempli de béton lors des opérations de forage, moyennant quoi on empêche la paroi latérale du trou de forage de s'effondrer.

9. Procédé selon la revendication 7, caractérisé en ce qu'il comprend en outre, lors de la phase durant laquelle l'outil est extrait du trou de forage, l'étape consistant à ouvrir au moins un passage longitudinal (34, 23) à travers ledit outil afin de permettre à un flux de liant de traverser l'outil de la zone située au-dessus de l'outil jusqu'à la zone située en dessous.

FIG.1

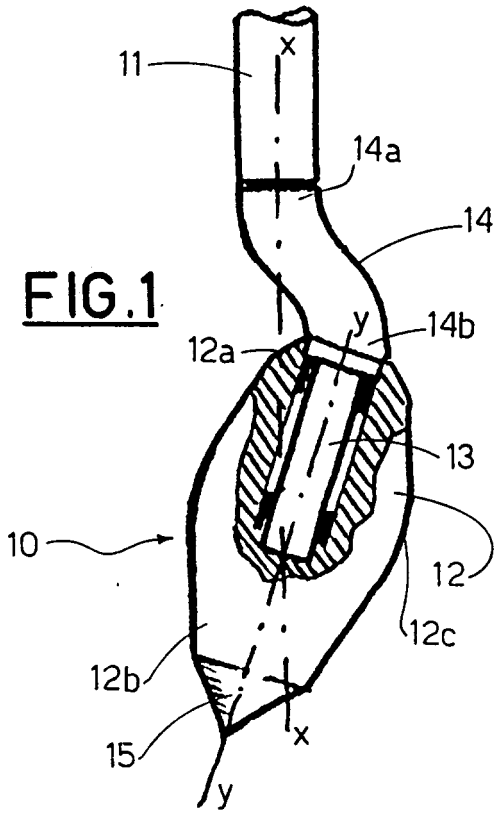


FIG.2

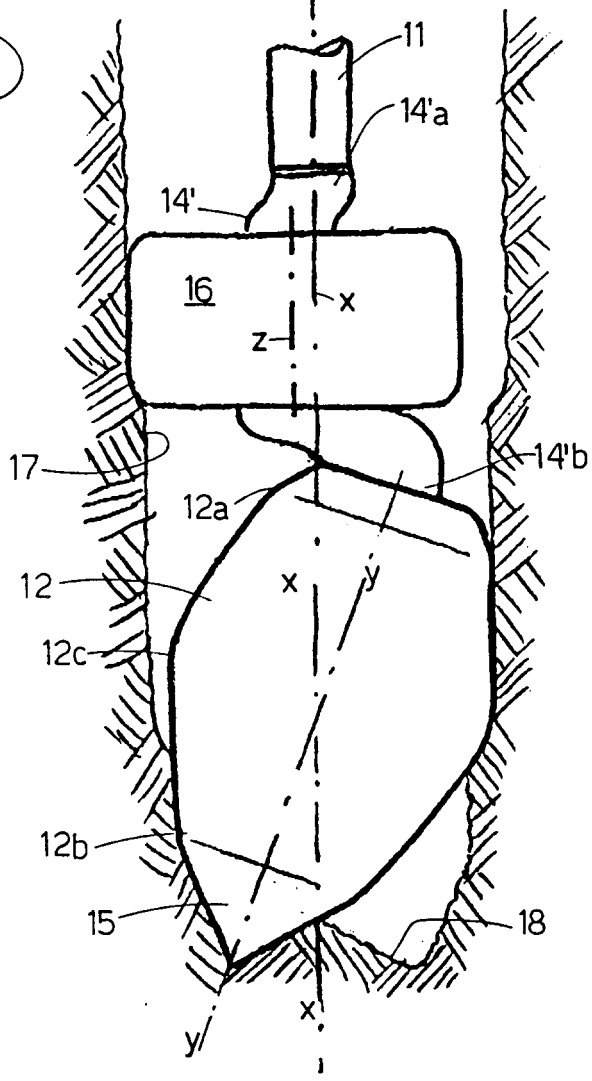


FIG.3

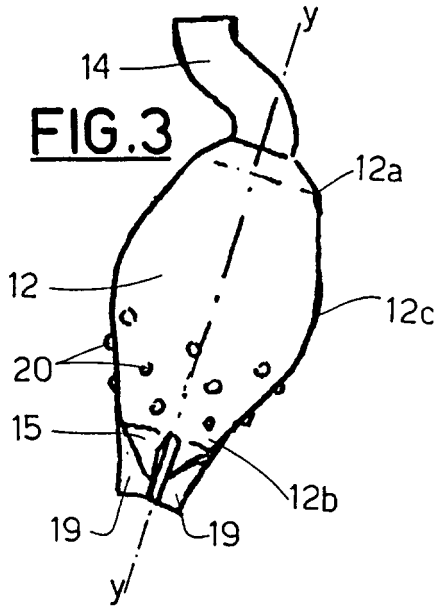
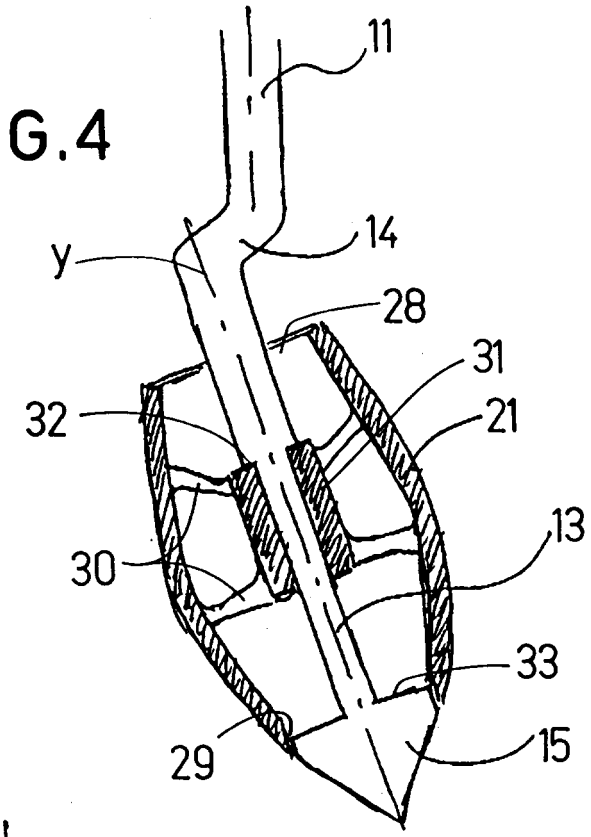


FIG.4



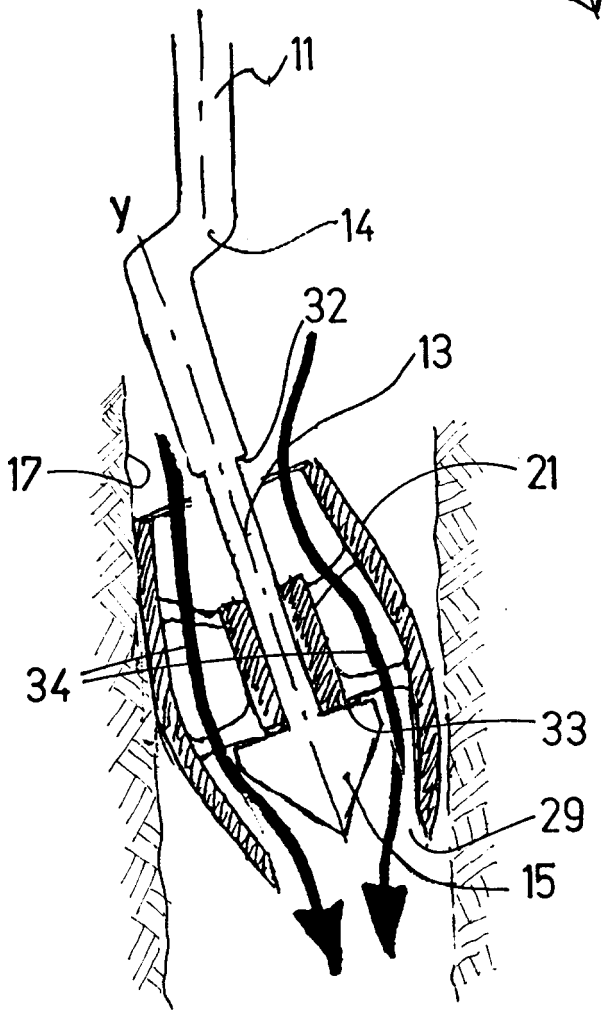


FIG.5

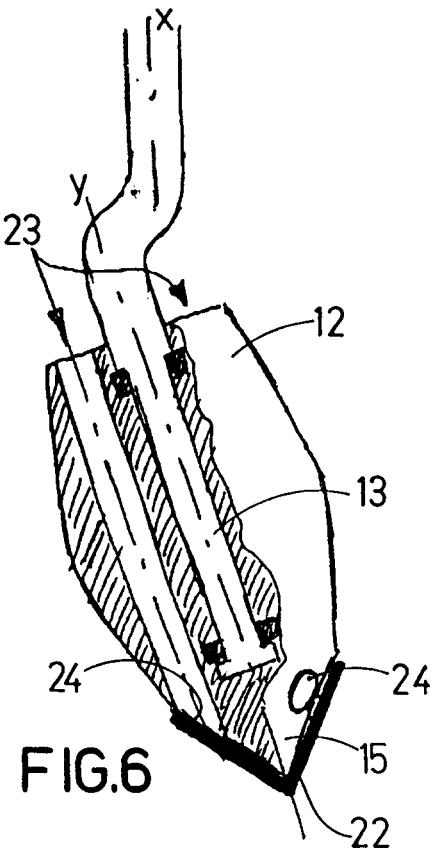


FIG.6

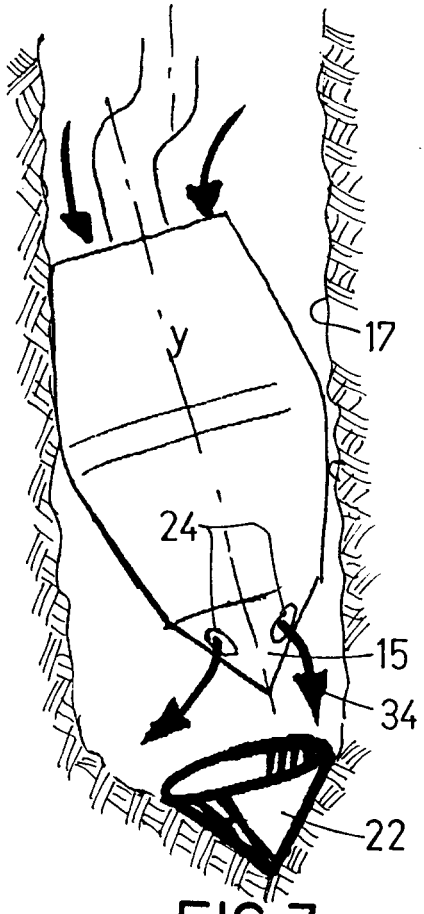


FIG.7

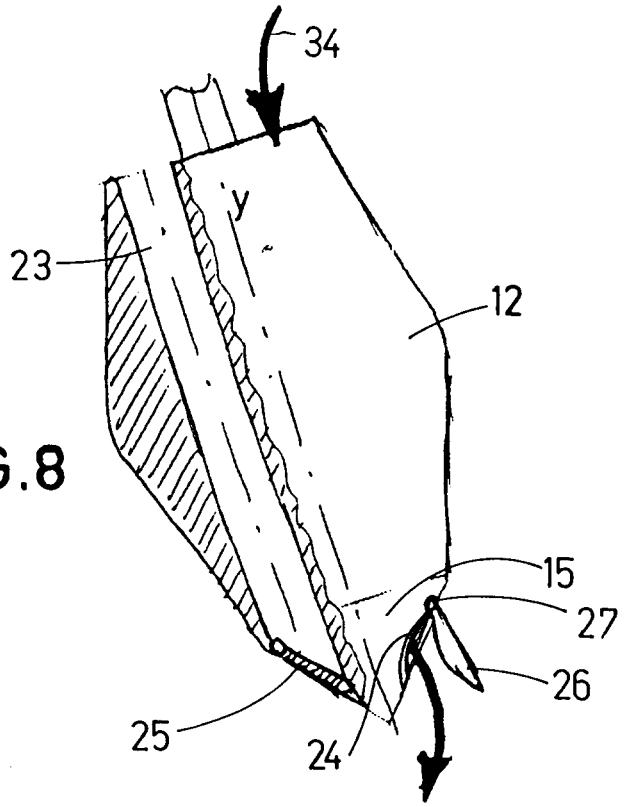


FIG.8