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(54) **Foundation element**

Gründungselement

Elément de fondation

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WO-A1-00/61876 DE-U1- 29 500 713 GB-A- 2 292 408

EP 2 620 552 B1

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Description

[0001] The invention relates to a foundation element for forming a foundation pile for a foundation of a building, as well as to a foundation pile and to a method for forming a foundation pile.

[0002] Foundation piles and methods for installing the same in the ground are generally known.

[0003] DE 295 00 713.3 U1 discloses a support or palisade pole in general.

[0004] GB 2 292 408 A1 discloses a member for penetrating ground.

[0005] WO 00/61876 A1 discloses a building structure with a hollow core, with a fibre layer, in which the hollow core may be filled with concrete.

[0006] According to the prior art foundation elements, use is made of the pressure principle for replacing the foundations of existing buildings. Because the available space is limited in the case of existing buildings, the foundation piles need to be made up of segments. The segments are pressed into the ground one by one. Steel tube segments are used, which are subsequently filled with concrete and possibly provided with reinforcement steel.

[0007] A drawback of the known foundation pile is that the installation thereof is time-consuming, since the steel tube segments that are used need to be precisely welded together so as to be watertight. If the tube segments are not welded watertight, water will penetrate into the tube and that will first have to be sucked dry. Then the tube can be filled with concrete so as to obtain the required strength for the pressure load. Because of this the known foundation pile and the known method are relatively costly.

[0008] Accordingly it is an object of the invention to provide a foundation element that can be installed more quickly, more simply and at lower cost, in particular for replacing the foundations of existing buildings.

[0009] In order to achieve that object, the invention provides a foundation element according to claim 1. According to the invention, the foundation element comprises a foundation body substantially made of a polymer concrete (PC), such as polymer concrete comprising unsaturated polyester resin (UB), polymer concrete comprising methylmethacrylate (MMA), polymer concrete comprising epoxy resin (EB), or another similar or related composite. The polymer concrete or related composite provides excellent resistance to pressure loads, so that it is very suitable material for use as a foundation element. Furthermore, polymer concrete is corrosion resistant. The polymer concrete is furthermore relatively easy to produce, for example as a prefab element. To take up the pressure forces and tensile forces exerted thereon, the foundation element comprises a reinforcement element which extends substantially in a longitudinal direction of the foundation body. In this way damage to the foundation element caused by forces in a direction transversely to the longitudinal direction is prevented.

[0010] The foundation body is furthermore a substan-

tially solid foundation body, so that filling of the interior of the foundation element after installation thereof is no longer needed. The reinforcement element is preferably completely surrounded by the polymer concrete. The reinforcement element may be applied by means of an adhesive, such as a two-component adhesive, or a sealing ring so as to make the reinforcement element resistance to tensile force and watertight.

[0011] The reinforcement element preferably extends substantially over the entire length of the foundation body. It may slightly project from the foundation body near the ends thereof or, on the contrary, terminate at a position spaced a minimal distance from an end of the foundation body. Connecting several foundation elements together thus becomes easier, as will be explained hereinafter.

[0012] In order to be able to take up the pressure forces and the tensile forces as effectively as possible, it is preferred that the reinforcement element and the foundation body are substantially concentric. The reinforcement element is located in the centre of the foundation body in that case.

[0013] The reinforcement element preferably comprises a bar or a tube. The bar is preferably solid. The tube is preferably hollow. The bar or the tube is preferably made of a metal, for example steel or reinforcing steel.

[0014] To make it possible to connect foundation elements together as already described before, it is quite preferable if the reinforcement element is provided with a connecting element at one end thereof, which connecting element is designed to be connectable to a further foundation element, preferably to a further connecting element of a further reinforcement element of said further foundation element.

[0015] Said connecting element may be simply provided with screw thread.

[0016] Additionally it is preferable if at least one end of the foundation element also comprises connecting means designed to be connectable to one end of a further foundation element, preferably two further connecting means at one end of the further foundation element.

[0017] The connecting means can be of very simple construction if the connecting means comprise one or more recesses or protrusions in the end face of the foundation body. The foundation body is in that case preferably constructed so that an end surface at a first end is designed to connect with a close fit to an end surface of a second end of a further foundation body. To contribute to the modular nature of the foundation body, it is preferable if an end surface at a first end is designed to connect with a close fit to an end surface of a second end of the same the foundation body. In this way it becomes possible to use a number of identical foundation elements in constructing a foundation pile.

[0018] The connecting means may in a particularly simple embodiment form part of a male-female connection. For example, the first end face may be constructed as a male coupling, and the second end face may be

constructed as a female coupling.

[0019] In one embodiment, the foundation element may be designed to function as a base for a foundation pile built up of foundation elements.

[0020] It is possible in that case for the foundation element to have a larger cross section near one end than at an opposite end so as to thus form a wider base of the foundation pile.

[0021] In one embodiment, the end having the larger cross section is designed to be drilled or pressed into the ground. Said end may be conical, rectangular, hexagonal or polygonal, pyramidal or helical in shape, depending on the ground structure to be penetrated.

[0022] In another embodiment, the foundation element is provided with a flow tube for transporting a flowable medium therethrough from one end of the foundation element to the other end of the foundation element. Said flowable medium is preferably a medium that can be injected into the ground, for example various types of injection mortar, for forming an injected base.

[0023] It is particular preferable in that regard to use a hollow reinforcement element, in which case the reinforcement element is also designed to function as the flow tube. In this way a compact construction is obtained. Because the hollow reinforcement elements can be connected together, the flow tube can extend along the length of a number of foundation elements.

[0024] In one embodiment the flow tube opens into an injection opening at the other end of the foundation element for injecting the flowable medium into the ground so as to form an injected base for the foundation pile. Such a foundation element can be used for being forced into the ground, after which eventually, once the desired length of the foundation pile is reached, a base can be formed. In this way the foundation pile is fixed in position.

[0025] According to one aspect of the invention, there is provided a foundation pile comprising a number of stacked-together and interconnected foundation elements according to the invention.

[0026] According to one aspect of the invention, there is provided a method for installing a foundation pile in the ground, comprising the steps of providing a first foundation element according to the invention and providing a second foundation element according to the invention. The method comprises the further steps of:

A installing the first foundation element into the ground;

B fixing a second foundation element to the first foundation element so as to form at least part of a foundation pile; as well as

C installing the foundation pile obtained in step B into the ground.

[0027] Said installation can be carried out by using a technique that is suitable for that purpose, for example pressing, driving (ramming) or drilling or a related technique. Combinations of these techniques are also con-

ceivable, if desired. The skilled person will be able to use a suitable technique. In one embodiment, pressing is preferred, however.

[0028] A very advantageous aspect of the invention is the fact that fixing the first foundation element to the second foundation element can take place in a very simple and quick manner. The foundation elements can be glued together, so that the time-consuming welding is no longer necessary. In particular in combination with the embodiment in which the upper end of the first foundation element is designed for being connected to the lower end of the second foundation element in a form-locked manner, a quick and watertight connection can be realised.

[0029] The method may comprise the additional steps of providing one or more further foundation elements according to the invention and fixing said one or more of further foundation elements to the foundation pile being formed.

[0030] As already said before, it is preferable if in step B the first and the second foundation element are glued together by means of an adhesive, such as an epoxy, for example. Other connections are (additionally) also conceivable, however, such as a snap connection, a pin joint, a rotating joint, etc.

[0031] The method may comprise the additional step D of fixing the reinforcement element of the first foundation element to the reinforcement element of the second foundation element. In this way the complete foundation pile is capable of taking up pressure forces and tensile forces.

[0032] The connection can be effected in a simple manner by connecting the reinforcement element of the first foundation element and that of the second foundation element together in step D, using a screw connection.

[0033] In one embodiment of the method, the first foundation element is designed to function as the base of the foundation pile or to be formed into a base (for example by injecting a base).

[0034] The invention will now be explained by way of illustration by means of a description of the appended figures, in which:

Figure 1 is a schematic side view of a first embodiment of a foundation pile comprising foundation elements according to the present invention;

Figure 2 is a schematic side view of a second embodiment of a foundation pile comprising foundation elements according to the present invention.

[0035] Figure 1 schematically shows a foundation pile 1. The foundation pile 1 comprises a number of stacked-together foundation elements 2a-2d. Each foundation element 2a-2d comprises a foundation body 4. Said foundation body is substantially made of a polymer concrete (PC). A suitable polymer concrete is, for example, polymer concrete comprising unsaturated polyester resin (UB), polymer concrete comprising methyl methacrylate (MMA) or polymer concrete comprising epoxy resin (EP).

Other similar or related composites can also be used, of course. The foundation body 4 further comprises a concentrically disposed reinforcement element 5, which extends substantially in a longitudinal direction L of the foundation body 4. The reinforcement element 5 may be a steel tube or bar, for example of reinforcing steel. In the present embodiment, the bar is a solid bar, such that a relatively great strength is obtained. The length of a foundation element forms a fraction of the total length of the foundation pile.

[0036] The foundation element 4 of said polymer concrete, provided with the reinforcement element 5, provides a foundation element 2 which is quite capable of taking up pressure forces and tensile forces being exerted thereon. Because of this the foundation element 2 is suitable for use as part of the foundation pile 2.

[0037] As figure 1 shows, a few foundation elements 2 are stacked together. In order to effect a strong connection, the reinforcement element 5 extends beyond the bottom end of the foundation body 4. Provided at the upper end of the foundation element 4, on the other hand, is a recess, because the reinforcement element extends only as far as a position spaced from the upper end of the foundation body 4. The recess and the projecting reinforcement element 5 of two foundation elements 2a and 2b disposed adjacent to each other makes it easier to connect the two foundation elements together. Said projecting reinforcement element 5 and said recess (together with the end of the reinforcement element 5 in said recess) form connecting elements 71, 72, as it were, which are designed for being connectable to each other. Preferably, the reinforcement elements 5 of two foundation elements 2a and 2b disposed adjacent to each other are connected together upon connection. It is also possible for the connecting elements 71, 72 to be designed so that they can be connected together in a simple manner. Think in this connection of an embodiment in which use is made of screw thread, for example.

[0038] The assembly of the lower two foundation elements 2c, 2d in figure 1 is designed to function as a base for the foundation pile 1 built up of foundation elements 2a-2d. The foundation element 2d has a larger cross-section than the foundation element 2c disposed thereabove. In this way a widened base of the foundation pile 1 is formed. The lowermost foundation element 2d has a shape designed for being drilled or forced into the ground. Its end may be spherical (11), conical (12), rectangular, hexagonal or polygonal, pyramidal or helical, depending on the ground structure to be penetrated.

[0039] With reference now to figure 2, there is described an alternative embodiment of a foundation pile 101. The foundation pile 101 again comprises a number of stacked-together foundation elements 102a-102d. Each foundation element 102a-102d comprises a foundation body 104 substantially made of a polymer concrete (PC), which comprises a concentrically disposed reinforcement element 105. In the present embodiment, the reinforcement element 105 is a tube.

[0040] In this embodiment, too, a few foundation elements 102 are stacked together. In order to effect a strong connection between the foundation elements, use is again made of connecting means 171, 172. Said connecting means comprise the reinforcement element 105, analogous to the situation shown in figure 1, in which a male-female connection between two adjacent foundation elements 102a-102b is provided. Referring to figure 2 again, there is shown that additionally the foundation bodies 104 themselves provide an improved and simplified connection. The foundation body 104 is designed so that an upper end face 181 thereof closely abuts the lower end face 182 of the foundation body 104 disposed thereabove; see the connection between the element 102a and the element 102b. The lower end face 181 is configured as a male connecting part and the upper end face 181 is configured as a female connecting part. Upon placement of the two foundation elements 102 one on top of the other, it is advantageous if the male connecting part is placed on top of the female connecting part, because in this way a self-aligning guide is realised.

[0041] Another difference in comparison with figure 1 is that the reinforcement element 105 is hollow. The reinforcement element 105 can thus function as a flow tube for transporting a flowable medium therethrough from one end of the foundation element to the other end of the foundation element. In figure 2 the reinforcement element 105 is therefore also configured as a flow tube. It is of course conceivable that in addition to the reinforcement element 105 (which may be either hollow or solid), an additional tube is provided as a flow tube, although the dual function leads to a relatively compact foundation element 102. It also applies in that case that in this way the flow tube can extend along the entire length of a number of foundation elements, preferably along the length of the foundation pile, because the hollow reinforcement elements 105 are designed to be connectable to each other.

[0042] The flow tube 105 can be used for forming an injected base 111 at the bottom side of the foundation pile 101. The flowable medium is in that case a medium that can be injected into the ground for forming an injected base 111. Suitable mediums are, for example, various types of injection mortars. The skilled person will be familiar with said mediums.

[0043] Two foundation elements described above can be used for forming a foundation pile in the ground. The general method described below can be used for that purpose.

[0044] First the foundation element 2d, 102c that is to form the base of the foundation pile is installed into the ground by pressing, drilling or ramming or another suitable technique. Said installation takes place over a length such that the upper side 81 of said foundation element will be positioned at approximately the same level as the ground surface. Now a further foundation element 2c, 102b can be fixed on top thereof. Said fixation can take place by means of the connecting means 71, 72, 171,

172, 181, 182. What is a very advantageous in this regard is that the connection between the first foundation element and the second foundation element can be effected in a simple and quick manner. The connecting means may comprise a screw attachment, for example for the reinforcement element 5, 105. The foundation bodies 4, 104 can be glued together. An epoxy can be used for that purpose, for example. Other (additional) connections are also conceivable, however, such as a snap connection, a pin joint, a rotating joint or the like. Once the connection has been realised, the assembly of the foundation pile thus formed can be pressed or driven (rammed) (or otherwise) into the ground, again until the further foundation element 2c, 102b is positioned at approximately the same level as the ground surface. Now another foundation element can again be fixed to the foundation pile and said assembly can also be installed into the ground by pressing, driving (ramming), drilling or otherwise. The aforesaid steps may be repeated, if desired, until the desired length of the foundation pile is realised.

[0045] As regards the embodiment shown in figure 2, the base 111 is yet to be formed. The medium for forming the injected base 111 is introduced into the flow tube 105 from the upper side and will flow downward until the injection outlet 109 is reached. At this location the flowable medium will flow into the ground. After curing, the formation of the base 111 of the foundation pile 101 is complete.

[0046] It is noted that the installation into the ground of the foundation elements as described above can take place in various ways, and that the terms pressing, driving, ramming, drilling or otherwise have merely been used by way of illustration. The invention is not limited to the manner of installing the foundation element into the ground, however.

[0047] The skilled person will appreciate that the invention has been described in the foregoing with reference to a few preferred embodiments, and that various alternatives and/or equivalent embodiments are conceivable within the framework of the invention, which embodiments may fall within the scope defined in the appended claims.

Claims

1. A foundation element (2) comprising a foundation body (4) **characterised in that** the foundation body (4) is substantially made of polymer concrete and which comprises a reinforcement element (5) that extends substantially in a longitudinal direction of the foundation body (4) for absorbing pressure forces and tensile forces exerted on the foundation element (2).
2. A foundation element (2) according to claim 1, wherein the reinforcement element (5) extends substantially along the entire length of the foundation body.

3. A foundation element (2) according to claim 1 or 2, wherein the reinforcement element (5) and the foundation body (4) are substantially concentric.
4. A foundation element (2) according to any one of the preceding claims, wherein the reinforcement element (5) comprises a bar or a tube, preferably made of a metal, for example steel.
5. A foundation element (2) according to any one of the preceding claims, wherein the reinforcement element (5) is provided with a connecting element (71, 72) at one end thereof, for instance wherein the connecting element (71, 72) is provided with screw thread, which connecting element (71, 71) is designed to be connectable to a further foundation element (2), preferably to a further connecting element (71, 72) of a further reinforcement element (5) of the further foundation element (2).
6. A foundation (2) element according to any one of the preceding claims, wherein at least one end of the foundation element (102c) also comprises connecting means (181) designed to be connectable to one end of a further foundation element, preferably to further connecting means (182) at one end of the further foundation element (102b), and in particular wherein the coupling means form part of a male-female-connection.
7. A foundation element according to claim 6, wherein the connecting means comprise one or more recesses (181) or protrusions (182) in the end face of the foundation body.
8. A foundation element according to one or more of the preceding claims, wherein the foundation element is designed to function as a base (2c) for a foundation pile built up of foundation elements.
9. A foundation element according to claim 8, wherein the foundation body (4) has a cross-section that is larger near one end than near an opposite end so as to thus form a widened base of the foundation pile, wherein the end having the larger cross section is designed to be installed into the ground, and wherein in particular said end is conical, rectangular, pyramidal or helical in shape.
10. A foundation element according to one or more of the preceding claims, wherein the foundation element is provided with a flow tube (105) for transporting a flowable medium therethrough from one end of the foundation element to the other end of the foundation element, and in particular wherein the reinforcement element (105) is also designed to function as the flow tube.

11. A foundation element according to claim 11, wherein the flow tube opens into an injection opening (109) at the other end of the foundation element for injecting the flowable medium into the ground so as to form an injected base (111) for the foundation pile (101).
12. A foundation pile (1, 101) **characterised by** a number of stacked-together and interconnected foundation elements (2a-c, 102a-c) according to any one of the preceding claims.
13. A method for installing a foundation pile (1, 101) into the ground, **characterised in that** the method comprises the steps of providing a first foundation element (2c, 102c) according to one of claims 1-11, as well as providing a second foundation element (2b, 102b) according to one of claims 1-7, or 10, wherein the method comprises the further steps of:
- A installing the first foundation element (2c, 102c) into the ground;
- B fixing a second foundation element (2b, 102b) to the first foundation element so as to form at least part of a foundation pile (1, 101); as well as
- C installing the foundation pile obtained in step B into the ground.
14. A method according to claim 13, wherein in step B the first (2c, 102c) and the second foundation element (2b, 102b) are glued together by means of an adhesive.
15. A method according to claim 13 or 14, comprising the additional step D of fixing the reinforcement element (5) of the first foundation element (2c) to the reinforcement element (5) of the second foundation (2b) element, in particular in that they are fixed together by means of a screw connection.

Patentansprüche

1. Gründungselement (2) mit einem Gründungskörper (4), **dadurch gekennzeichnet, dass** der Gründungskörper (4) im Wesentlichen aus Polymerbeton besteht, und das ein Bewehrungselement (5) umfasst, das sich zur Aufnahme von auf das Gründungselement (2) ausgeübten Druckkräften und Zugkräften im Wesentlichen in einer Längsrichtung des Gründungskörpers (4) erstreckt.
2. Gründungselement (2) nach Anspruch 1, wobei das Bewehrungselement (5) sich im Wesentlichen entlang der gesamten Länge des Gründungskörpers erstreckt.
3. Gründungselement (2) nach Anspruch 1 oder 2, wo-

bei das Bewehrungselement (5) und der Gründungskörper (4) im Wesentlichen konzentrisch sind.

4. Gründungselement (2) nach einem der vorhergehenden Ansprüche, wobei das Bewehrungselement (5) einen Stab oder ein Rohr, vorzugsweise aus Metall, zum Beispiel Stahl, umfasst.
5. Gründungselement (2) nach einem der vorhergehenden Ansprüche, wobei das Bewehrungselement (5) an einem Ende mit einem Verbindungselement (71, 72) versehen ist, beispielsweise wobei das Verbindungselement (71, 72) mit einem Schraubengewinde versehen ist, wobei das Verbindungselement (71, 71) so ausgebildet ist, dass es mit einem weiteren Gründungselement (2), vorzugsweise mit einem weiteren Verbindungselement (71, 72) eines weiteren Bewehrungselements (5) des weiteren Gründungselements (2) verbindbar ist.
6. Gründungselement (2) nach einem der vorhergehenden Ansprüche, wobei wenigstens ein Ende des Gründungselements (102c) auch Verbindungsmittel (181) umfasst, die so ausgebildet sind, dass sie mit einem Ende eines weiteren Gründungselements, vorzugsweise mit weiteren Verbindungsmitteln (182) an einem Ende des weiteren Gründungselements (102b), verbindbar sind, und insbesondere wobei die Kopplungsmittel Teil einer Stecker-Buchsen-Verbindung bilden.
7. Gründungselement nach Anspruch 6, wobei die Verbindungsmittel eine(n) oder mehrere Ausnehmungen (181) oder Vorsprünge (182) in der Stirnfläche des Gründungskörpers umfassen.
8. Gründungselement nach einem oder mehreren der vorhergehenden Ansprüche, wobei das Gründungselement so ausgebildet ist, dass es als Basis (2c) für einen aus Gründungselementen aufgebauten Gründungspfahl wirkt.
9. Gründungselement nach Anspruch 8, wobei der Gründungskörper (4) einen Querschnitt aufweist, der nahe einem Ende größer als nahe einem entgegengesetzten Ende ist, um somit eine verbreiterte Basis des Gründungspfahls zu bilden, wobei das Ende, das den größeren Querschnitt aufweist, zum Einbau in den Boden ausgebildet ist, und wobei insbesondere dieses Ende kegelförmig, rechteckförmig, pyramidenförmig oder schraubenförmig ist.
10. Gründungselement nach einem oder mehreren der vorhergehenden Ansprüche, wobei das Gründungselement mit einem Durchflussrohr (105) zum Hindurchfordern eines fließfähigen Mediums von einem Ende des Gründungselements zum anderen Ende des Gründungselements versehen ist, und insbe-

sondere wobei das Bewehrungselement (105) auch so ausgebildet ist, dass es als Durchflussrohr fungiert.

11. Gründungselement nach Anspruch 11, wobei das Durchflussrohr in eine Einspritzöffnung (109) am anderen Ende des Gründungselements mündet, um das fließfähige Medium in den Boden zu spritzen, um so eine gespritzte Basis (111) für den Gründungspfahl (101) zu bilden. 5
12. Gründungspfahl (1, 101), **gekennzeichnet durch** eine Anzahl aufeinander gestapelter und miteinander verbundener Gründungselemente (2a-c, 102a-c) nach einem der vorhergehenden Ansprüche. 10
13. Verfahren zum Einbauen eines Gründungspfahls (1, 101) in den Boden, **dadurch gekennzeichnet, dass** das Verfahren die Schritte umfasst, bei denen ein erstes Gründungselement (2c, 102c) nach einem der Ansprüche 1 bis 11 bereitgestellt wird sowie ein zweites Gründungselement (2b, 102b) nach einem der Ansprüche 1 bis 7 oder 10 bereitgestellt wird, wobei das Verfahren die weiteren Schritte umfasst, bei denen: 20
 - A das erste Gründungselement (2c, 102c) in den Boden eingebaut wird,
 - B ein zweites Gründungselement (2b, 102b) an dem ersten Gründungselement so befestigt wird, dass wenigstens ein Teil eines Gründungspfahls (1, 101) gebildet wird, sowie 30
 - C der in Schritt B erhaltene Gründungspfahl in den Boden eingebaut wird. 35
14. Verfahren nach Anspruch 13, bei dem das erste (2c, 102c) und das zweite Gründungselement (2b, 102b) in Schritt B mittels eines Klebstoffs zusammengeklebt werden. 40
15. Verfahren nach Anspruch 13 oder 14, mit dem zusätzlichen Schritt D, bei dem das Bewehrungselement (5) des ersten Gründungselements (2c) an dem Bewehrungselement (5) des zweiten Gründungselements (2b) befestigt wird, insbesondere dass sie mittels einer Schraubverbindung aneinander befestigt werden. 45

Revendications 50

1. Elément de fondation (2) comprenant un corps de fondation (4), **caractérisé en ce que** le corps de fondation (4) est sensiblement réalisé à partir de béton de résine et qui comprend un élément de renforcement (5) qui s'étend sensiblement dans une direction longitudinale du corps de fondation (4) pour absorber des forces de pression et des forces de trac-

tion exercées sur l'élément de fondation (2).

2. Elément de fondation (2) selon la revendication 1, dans lequel l'élément de renforcement (5) s'étend sensiblement le long de toute la longueur du corps de fondation. 5
3. Elément de fondation (2) selon la revendication 1 ou 2, dans lequel l'élément de renforcement (5) et le corps de fondation (4) sont sensiblement concentriques. 10
4. Elément de fondation (2) selon l'une quelconque des revendications précédentes, dans lequel l'élément de renforcement (5) comprend une barre ou un tube, de préférence réalisé(e) à partir d'un métal, par exemple de l'acier. 15
5. Elément de fondation (2) selon l'une quelconque des revendications précédentes, dans lequel l'élément de renforcement (5) est prévu avec un élément de raccordement (71, 72) au niveau de son extrémité, par exemple, dans lequel l'élément de raccordement (71, 72) est prévu avec un filetage de vis, lequel élément de raccordement (71, 71) est conçu pour pouvoir être raccordé à un autre élément de fondation (2), de préférence à un autre élément de raccordement (71, 72) d'un autre élément de renforcement (5) de l'autre élément de fondation (2). 20
6. Elément de fondation (2) selon l'une quelconque des revendications précédentes, dans lequel au moins une extrémité de l'élément de fondation (102c) comprend également des moyens de raccordement (181) conçus pour pouvoir être raccordés à une extrémité d'un autre élément de fondation, de préférence à d'autres moyens de raccordement (182) au niveau d'une extrémité de l'autre élément de fondation (102b), et en particulier, dans lequel les moyens de couplage forment une partie de raccordement mâle-femelle. 25
7. Elément de fondation selon la revendication 6, dans lequel les moyens de raccordement comprennent un ou plusieurs évidements (181) ou saillies (182) dans la face d'extrémité du corps de fondation. 30
8. Elément de fondation selon une ou plusieurs des revendications précédentes, dans lequel l'élément de fondation est conçu pour fonctionner comme une base (2c) pour un pieu de fondation composé d'éléments de fondation. 35
9. Elément de fondation selon la revendication 8, dans lequel le corps de fondation (4) a une section transversale qui est plus grande à proximité d'une extrémité qu'à proximité d'une extrémité opposée afin de former ainsi une base élargie du pieu de fondation, 40

- dans lequel l'extrémité ayant la plus grande section transversale est conçue pour être installée dans le sol, et dans lequel en particulier, ladite extrémité a une forme conique, rectangulaire, pyramidale ou hélicoïdale. 5
10. Élément de fondation selon une ou plusieurs des revendications précédentes, dans lequel l'élément de fondation est prévu avec un tube d'écoulement (105) pour transporter un milieu liquide à travers ce dernier à partir d'une extrémité de l'élément de fondation vers l'autre extrémité de l'élément de fondation, et en particulier, dans lequel l'élément de renforcement (105) est également conçu pour fonctionner en tant que tube d'écoulement. 10
15
11. Élément de fondation selon la revendication 11, dans lequel le tube d'écoulement s'ouvre dans une ouverture d'injection (109) au niveau de l'autre extrémité de l'élément de fondation pour injecter le milieu liquide dans le sol afin de former une base injectée (111) pour le pieu de fondation (101). 20
12. Pieu de fondation (1, 101) **caractérisé par** un certain nombre d'éléments de fondation empilés ensemble et interconnectés (2a-c, 102a-c) selon l'une quelconque des revendications précédentes. 25
13. Procédé pour installer un pieu de fondation (1, 101) dans le sol, **caractérisé en ce que** le procédé comprend les étapes consistant à prévoir un premier élément de fondation (2c, 102c) selon l'une des revendications 1 à 11, ainsi que prévoir un second élément de fondation (2b, 102b) selon l'une des revendications 1 à 7 ou 10, dans lequel le procédé comprend les étapes supplémentaires consistant à : 30
35
- A. installer le premier élément de fondation (2c, 102c) dans le sol ;
 - B. fixer un second élément de fondation (2b, 102b) sur le premier élément de fondation afin de former au moins une partie d'un pieu de fondation (1, 101) ; ainsi que 40
 - C. installer le pieu de fondation obtenu à l'étape B, dans le sol. 45
14. Procédé selon la revendication 13, dans lequel, à l'étape B, le premier (2c, 102c) et le second élément de fondation (2b, 102) sont collés ensemble au moyen d'une colle. 50
15. Procédé selon la revendication 13 ou 14, comprenant l'étape supplémentaire D consistant à fixer l'élément de renforcement (5) du premier élément de fondation (2c) sur l'élément de renforcement (5) du second élément de fondation (2b), en particulier en ce qu'ils sont fixés ensemble au moyen d'un raccordement de vis. 55

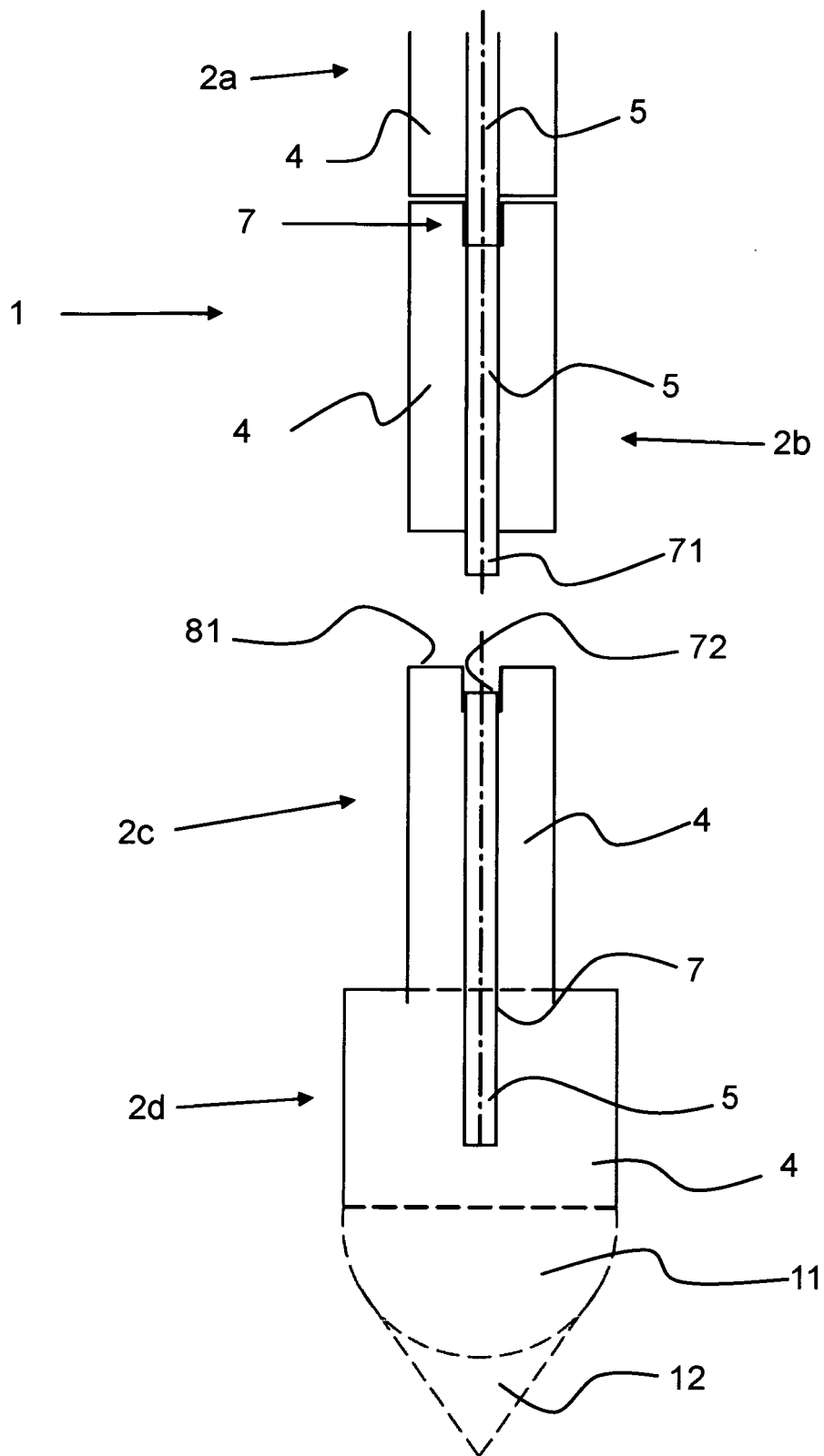


Fig. 1

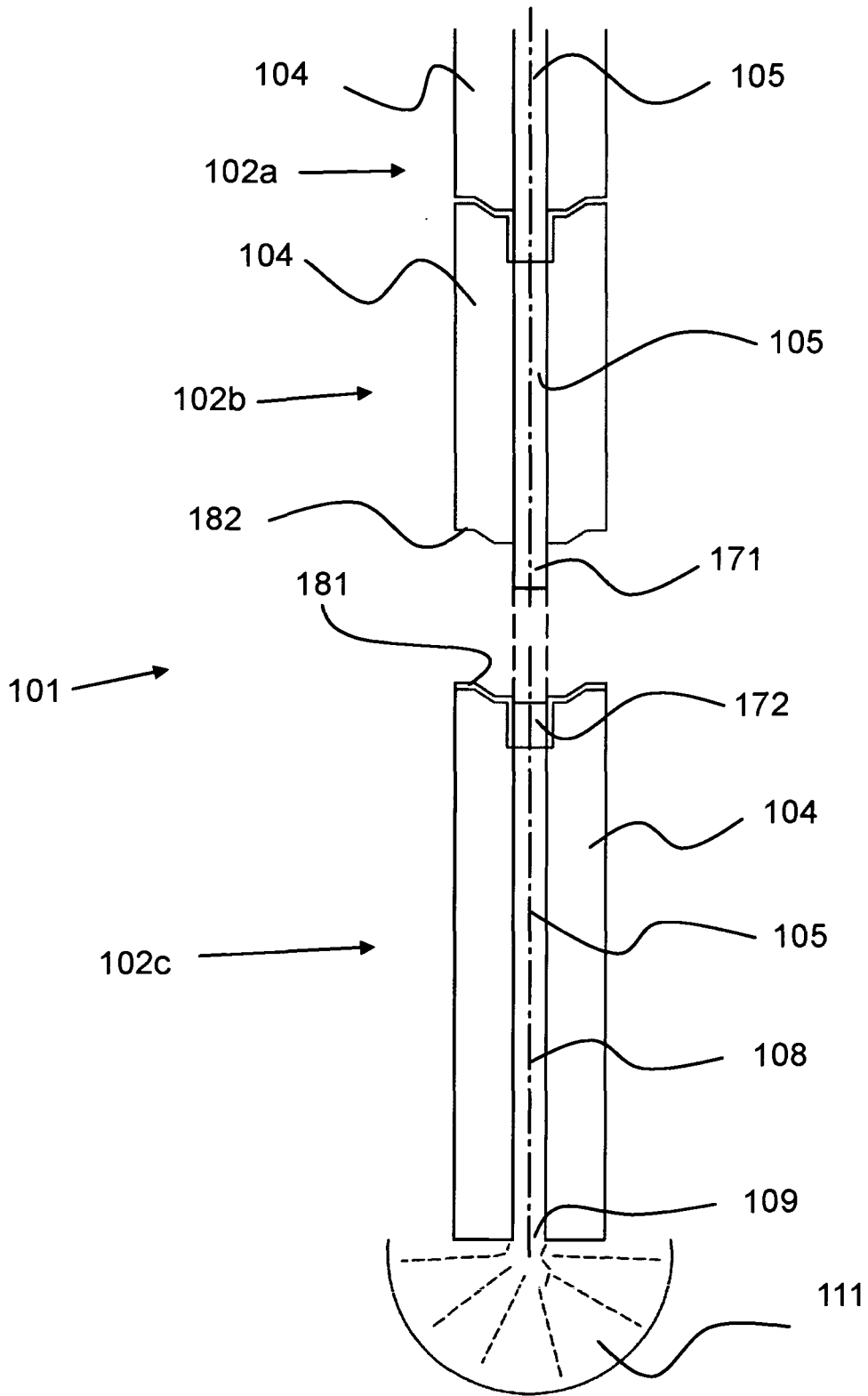


Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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