



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 1 719 841 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
08.11.2006 Bulletin 2006/45

(51) Int Cl.:
E02D 5/46 (2006.01) E02D 3/12 (2006.01)

(21) Application number: **06007033.1**

(22) Date of filing: **03.04.2006**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI
SK TR**
Designated Extension States:
AL BA HR MK YU

(30) Priority: **08.04.2005 IT PC20050020**

(71) Applicant: **MELEGARI, Cesare**
43015 Noceto PR (IT)

(72) Inventor: **MELEGARI, Cesare**
43015 Noceto PR (IT)

(74) Representative: **Fisauli, Beatrice A. M.**
Con Lor SPA
Via Renato Fucini, 5
20133 Milano (IT)

(54) Method and equipment for constructing micropiles in soil

(57) This invention relates to a method and the corresponding equipment for constructing concrete micropiles of the type used for soil consolidation, which involves the use of a drilling rod which also acts as reinforcement for the pile, and injection of cement grout directly during drilling, the injection being performed from the surface downwards, that includes the following stages:

- soil drilling with a rod consisting of a drilling bar fitted at the tip with a bit equipped with nozzles, and simultaneous high-pressure injection of grout through said nozzles;
- when the bar has fully penetrated into the soil, connection of a second bar by means of a sleeve coupling and continuance of drilling with simultaneous grout injection;
- when the design depth has been reached, detachment of said rod, which is left in the ground to act as reinforcement for the pile thus constructed.

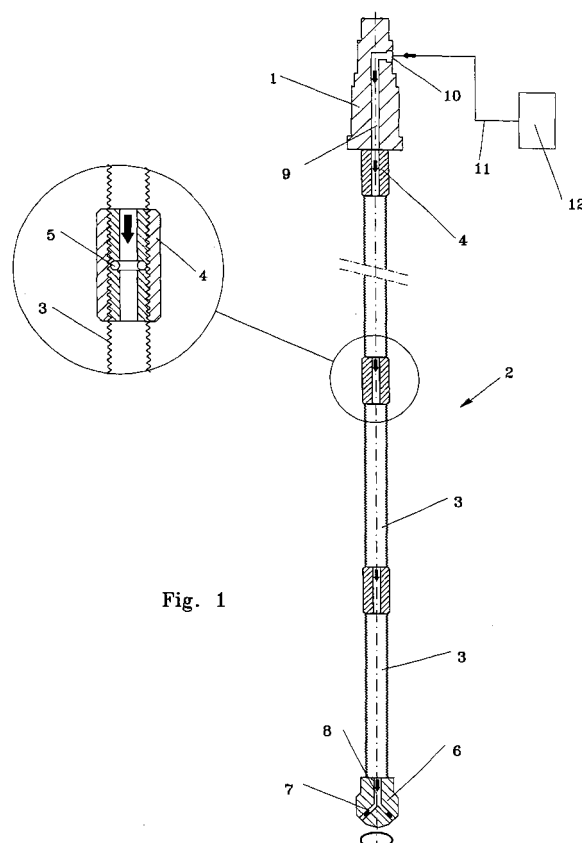


Fig. 1

EP 1 719 841 A1

Description

[0001] This invention relates to a method and the corresponding equipment for constructing concrete micropiles of the type used for soil consolidation, underpinning and the like.

[0002] The method according to the invention involves the use of a drilling rod which also acts as reinforcement for the pile, and injection of cement grout directly during drilling, the injection being performed from the surface downwards, unlike known methods, wherein the grouting stage is performed from the bottom of the hole to the surface. The method according to the invention allows micropiles to be made very quickly, with a considerable cost saving on the end product.

[0003] One of the most effective techniques for stabilising soil, underpinning or performing the work required to increase the load-bearing capacity of soil is to construct micropiles.

[0004] This known technique involves inserting into the ground a reinforced concrete pile a few centimetres in diameter and a few metres long, to stabilise the soil and increase its load-bearing capacity.

[0005] In accordance with the prior art, in order to construct micropiles a hole is drilled with a drilling rod fitted with a bit at the tip; when the design depth is reached the rod is removed, steel reinforcement is inserted in the hole, and the hole is filled with a concrete mix of suitable particle size.

[0006] This is a long, laborious method and, especially in rather loose soil, can involve problems caused by the mobility of this type of soil.

[0007] The present invention, which falls into this sector, relates to a method and the corresponding equipment for constructing micropiles with the technology known as jet-grouting, which involves drilling the soil with a rod fitted, at its tip, with a plurality of nozzles through which a fluid is injected at very high pressure (several hundred bars).

[0008] Said rods consist of bars with a continuous thread, fitted at the tip with a disposable bit equipped with a set of nozzles through which grout is injected during excavations.

[0009] Grout injection therefore takes place simultaneously with drilling, so that when the rod reaches the required depth, the micropile has already been formed and the work can be considered finished.

[0010] This technique also allows the construction of micropiles with a wide base that increases their load-bearing capacity.

[0011] This invention will now be described in detail, by way of example but not of limitation, by reference to the annexed figures wherein:

- figure 1 schematically illustrates a drilling rod according to the invention;
- figure 2 is the cross-section of an area of soil at the start of drilling designed to construct a micropile;

- Figure 3 illustrates the rod according to the invention at a more advanced stage of construction of a micropile.

[0012] As shown in figure 1, number 1 indicates a rotating high-pressure injection head to which the drilling rod according to the invention, indicated as 2, is connected.

[0013] Head 1 is connected to devices of known type which cause it to rotate around its own axis until it causes rod 2 to rotate.

[0014] Rod 2 consists of a set of (self-drilling) steel bars 3, which are of known type in themselves, and which are connected end-to-end via sleeve couplings 4, with the insertion of high-pressure gaskets 5.

[0015] Rod 2 is fitted at its tip with a disposable bit 6, which presents one or more nozzles 7 leading to an axial pipe 8; said pipe 8 communicates with the interior of the drilling rod which, in turn, communicates with a pipe 9 located in the injection head.

[0016] A line 11 designed to feed a grout mixture originating from equipment 12 of known type leads to inlet 10 of pipe 9.

[0017] Two stages of the process are illustrated in figures 2 and 3.

[0018] The equipment, supported by a structure 13, which is only illustrated schematically because it is of known type, is set up at the point to be drilled; the first bar, fitted with a bit at its tip, is mounted on head 11, and drilling begins.

[0019] Head 1, connected to a rotary table or other known apparatus which causes it to rotate around its own axis, causes the rotation of bar 3 with bit 6, which begins to drill the ground (figure 2).

[0020] During excavations, grout is pumped at high pressure into pipe 9 and exits through nozzles 7 in the bit at very high speed and pressure, thus removing and compacting the soil around the rod and creating a hole, shown as 14 in figure 3, which fills with grout as the rod descends.

[0021] As drilling proceeds, other bars are added to the rod and secured with couplings 5, and drilling continues in this way until the design depth is reached.

[0022] If necessary, the rotation of the rod and simultaneous grout injection can be continued for some time, so as to create at the base of the pipe a bulb of larger dimensions which improves interaction with the soil.

[0023] When drilling is over, the rod is disconnected from head 1, which is moved to another point, while the rod remains embedded in the grout which has filled the hole. The interior of the rod is also full of grout, acting as reinforcement for the pile thus constructed.

[0024] As will clearly appear from the description supplied, this technique offers all the advantages of the jet-grouting technology for the production of micropiles, with a high-output process which allows fast, clean operation.

[0025] An expert in the field could devise various modifications and variations, all of which should be deemed

to fall within the ambit of this invention.

60° respectively.

Claims

1. Method for the construction of micropiles in soil, whereby a hole is drilled and filled with grout and steel reinforcement is inserted into said hole, **characterised in that** said method includes simultaneous drilling and grout injection.
5
10
2. Method as claimed in claim 1, **characterised in that** drilling and grout injection are performed from the surface to the bottom of the hole.
15
3. Method as claimed in the preceding claims, **characterised in that** drilling is performed with a rod which acts as reinforcement for the micropile, while grout is injected at high pressure at the same time, along said rod 1, and exits from a nozzle in the bit fitted at the distal extremity of the rod.
20
4. Method for the construction of micropiles, **characterised in that** it includes the following stages:
25

- soil drilling with a rod consisting of a drilling bar fitted at the tip with a bit equipped with nozzles, and simultaneous high-pressure injection of grout through said nozzles;
 - when the bar has fully penetrated into the soil, connection of a second bar by means of a sleeve coupling and continuance of drilling with simultaneous grout injection;
 - when the design depth has been reached, detachment of said rod, which is left in the ground to act as reinforcement for the pile thus constructed.

30
35
5. Equipment for the construction of micropiles with the method as claimed in any of the preceding claims, **characterised in that** it includes a drilling rod fitted at its tip with a bit equipped with one or more outwardly-directed nozzles, and means designed to direct grout at high pressure towards said nozzles, passing inside said rod.
40
45
6. Equipment as claimed in claim 5, **characterised in that** said rod consists of a plurality of self-drilling bars connected via sleeve couplings designed to withstand very high pressures.
50
7. Apparatus as claimed in the preceding claims, **characterised in that** said rod is fitted with a bit equipped with at least one pair of nozzles with different inclinations, for injection of grout.
55
8. Apparatus as claimed in the preceding claims, wherein said nozzles have an inclination of 30° and

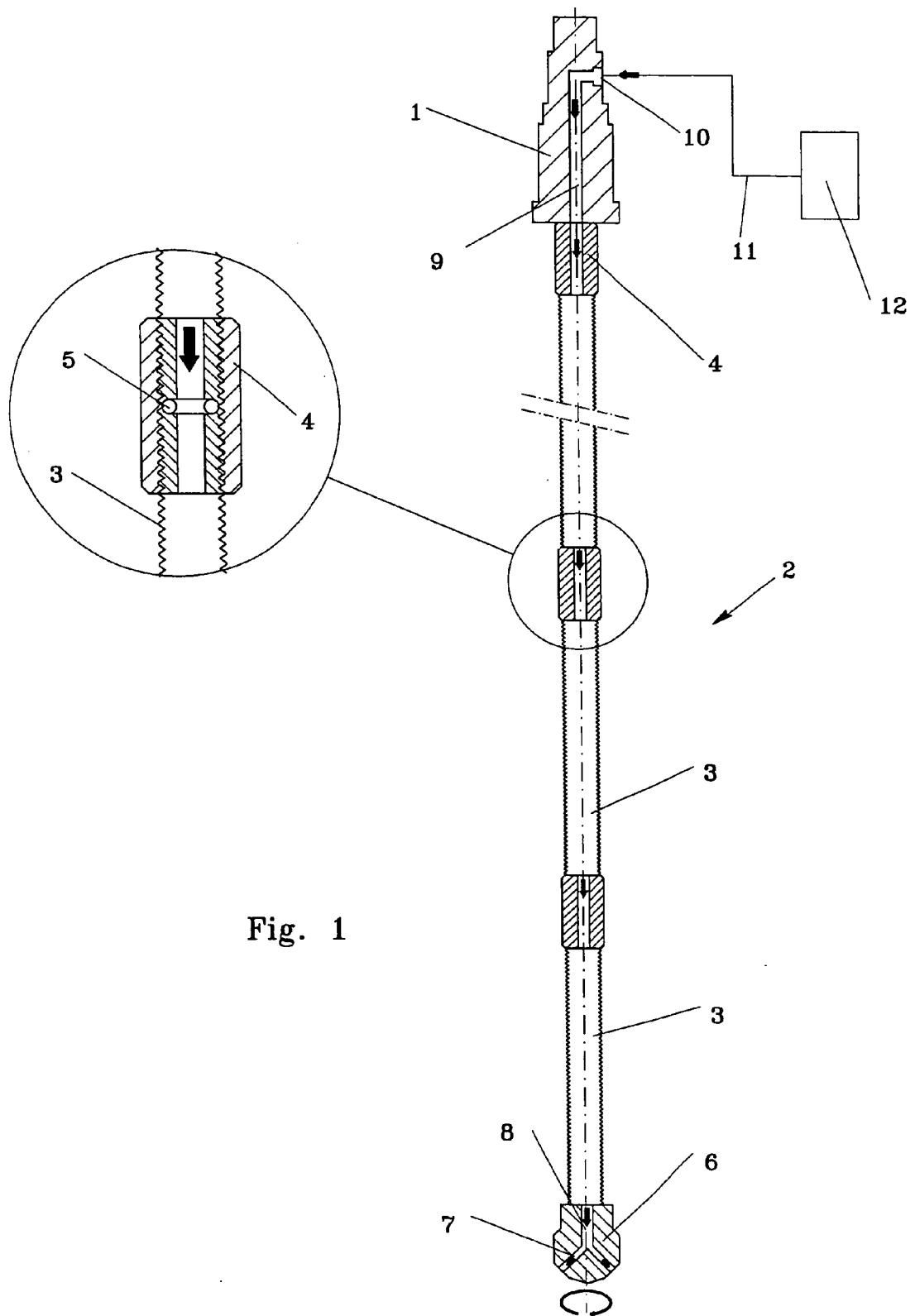


Fig. 1

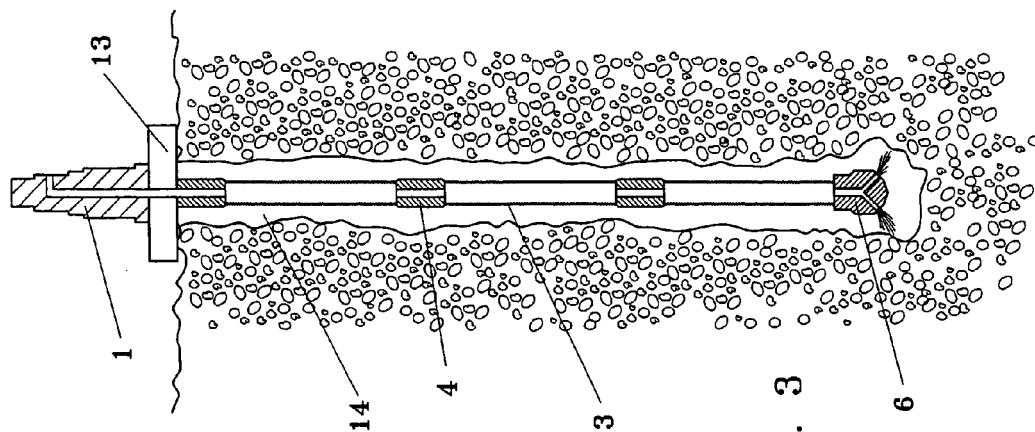


Fig. 3

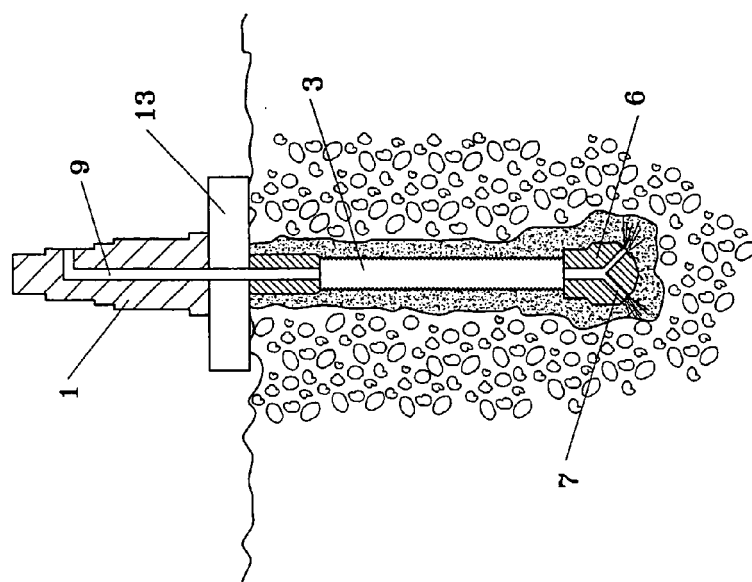


Fig. 2



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 00 7033

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	US 5 256 004 A (GEMMI ET AL) 26 October 1993 (1993-10-26) * column 3, line 52 - column 4, line 37 * -----	1-8	INV. E02D5/46 E02D3/12
A	US 2001/048854 A1 (CARTER ERNEST E) 6 December 2001 (2001-12-06) * the whole document * -----	1-8	
A	US 2002/108752 A1 (MOREY JACQUES ET AL) 15 August 2002 (2002-08-15) * the whole document * -----	1-8	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			E02D
Place of search		Date of completion of the search	Examiner
Munich		12 September 2006	Nilsson, Lars
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

1
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 06 00 7033

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-09-2006

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5256004	A	26-10-1993	NONE	

US 2001048854	A1	06-12-2001	NONE	

US 2002108752	A1	15-08-2002	AT 264952 T	15-05-2004
			DE 60200384 D1	27-05-2004
			DE 60200384 T2	04-05-2005
			DK 1231326 T3	16-08-2004
			EP 1231326 A1	14-08-2002
			ES 2220878 T3	16-12-2004
			FR 2820780 A1	16-08-2002
			HK 1049866 A1	10-09-2004
			PT 1231326 T	31-08-2004
