

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number:

**0 186 921
A1**

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 85201964.5

(51) Int. Cl.⁴: E02D 19/18

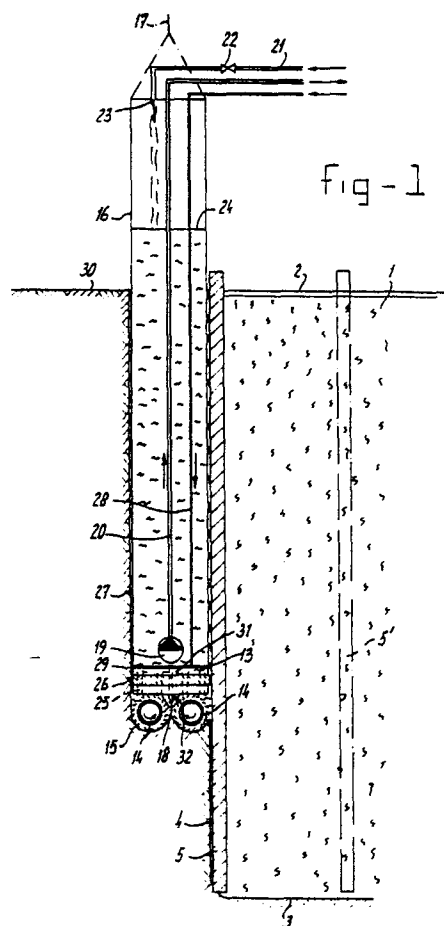
(22) Date of filing: 25.11.85

(30) Priority: 29.11.84 NL 8403641

(43) Date of publication of application:
09.07.86 Bulletin 86/28(84) Designated Contracting States:
BE DE GB NL(71) Applicant: HOLLANDSCHE BETON GROEP N.V.
489, Generaal Spoorlaan
NL-2285 TA Rijswijk(NL)(72) Inventor: Brons, Karel Frederik
Dillenburglaan 7
NL-2252 KX Voorschoten(NL)
Inventor: Kool, Anthonie Frederik
Tiendweg 13
NL-4235 VW Tienhoven(NL)(74) Representative: van der Beek, George Frans et al
Nederlandsch Octrooibureau Johan de Wittlaan 15
P.O. Box 29720
NL-2502 LS 's-Gravenhage(NL)

(54) Device for the construction of a vertical channel in the soil.

(57) The invention deals the manufacturing of a wall in the soil by digging a channel (2) which is filled with bentonite (1) prior to being filled with concrete which channel by means of a former (5), which fits closely against the side walls (12) of the channel, is separated in an upstream portion filled with bentonite and a downstream portion filled with water and containing the ground mill (14) for cutting the soil and a pump (19) for removing water and soil, preferably two formers (5,5') are used which in turn are placed forwardly with the advancement of the channel, each former (5,5') having inflatable seals (10), moreover a tube (16) can be provided above the ground mill (14) and with a water column (24) above it.



EP 0 186 921 A1

Device for the construction of a vertical channel in the soil

The invention relates to a method for the digging of a vertical channel in the soil, the channel being filled with a heavy fluid, in particular with bentonite, during the construction and as the construction progresses, and the digging itself taking place by means of a ground mill, the loosened soil being removed from the channel by pumping out of it a mixture of soil and fluid.

A method of this type is generally known. In this connection the bentonite filling serves to keep the channel stable, i.e. to prevent the channel walls falling inwards. Here we are dealing with the construction of channels to a depth of 10 to 100 metres, which channels are later filled with concrete. In the known method the ground mill operates in the space filled with bentonite because the bentonite filling flows freely out of the channel section already constructed into the area in which the ground mill is operating. The soil loosened by means of the ground mill has to be removed by means of a pump and this pump pumps a mixture of soil and bentonite. This mixture has to be separated again into its components, but this separation requires a rest period of several days and an expensive installation. This means that a relatively large amount of bentonite is needed and bentonite is a relatively expensive fluid.

The object of the invention is to provide a method by which it is possible to construct the channel in a more efficient manner to save considerably on bentonite.

This object is primarily achieved according to the invention in that the part of the channel already constructed and filled with bentonite is separated from the part still to be constructed and during the construction thereof by placing in the channel, in the direction of advance at or near the end of the channel already constructed, a former which fits closely in a sealing manner against the side walls of the channel and the space above the ground mill, which is separated from the part of the channel already constructed by the former, is kept filled with water so that the mixture to be removed therefrom consists of soil and water. The invention achieves the result that the space in which the ground mill operates and the space of the channel which has already been constructed and is filled with bentonite, are kept separated from each other and the ground mill only operates in a water filled space from which the mixture of soil and water can be pumped away in an expedient manner. In this process the separation of soil and water, necessary *inter alia*, does not present any problem. Large installations in which the separation of soil and bentonite has to take place are therefore no longer necessary, while there is also a saving in bentonite and the mixture of soil and water is easier to pump and therefore also requires less energy. After a new channel section has been constructed with the ground mill, the water above the ground mill can be removed and the space made available filled with bentonite, after which the ground mill is removed. The water can also be displaced by supplying bentonite and removing the ground mill at a suitable moment. After filling with bentonite, the former can be withdrawn and clamped again between the side walls of the channel at the new front end obtained, after which the ground mill is positioned in front of the former, from the point of view of direction of advance of the channel to be made, and a new channel section is made, with simultaneous supply of water and removal of soil and water mixture.

According to the invention it is also possible to operate with at least two formers which are positioned at a distance from each other, which distance is at least equal to the length of the working area of the ground mill and the former

disposed upstream, from the point of view of the direction of movement, after the positioning of the former adjacent to the working area of the ground mill is withdrawn and after the removal of the ground mill is placed at the downstream end of the new channel section then made by means of the ground mill. By this means the result is achieved that one former, and in particular the former positioned near the ground mill, can be left in position at any rate until the second former has been positioned in the front of the channel section just constructed.

In addition it is possible, in particular if more than two formers are used, to keep the section filled with bentonite separated from the section to be filled with concrete by means of a former of this type, the separating former being withdrawn at the correct time. Adhesion of this second former to the concrete can be prevented by the application of means preventing the adhesion or by withdrawing before adhesion can occur. As a result of this the quantity of bentonite required can be restricted further.

In the known method a ground mill is used which is attached to a frame and which usually consists of oppositely rotating knives which are driven by hydraulic motors. This frame is suspended in a lifting device for controlling or for lowering and raising.

According to the invention a tube can now be positioned on this frame of the ground mill which in horizontal cross-section has a length and width corresponding to the working length and working width of the ground mill and which carries an expandable seal above the ground mill, which tube is provided with an inlet for water and with a drainage pump with pressurised pipe for the mixture of soil and water and furthermore an inlet is present for the supplying of bentonite to the space between the tube and above the seal. This tube contains the water filling and is separated from the soil, i.e. channel wall, by a thin bentonite layer. The seal between the bottom end of the tube and working area of the ground mill ensures that the bentonite is kept separated from the soil, which is loosened and from the water which forms a mixture with the soil so that there is no risk that bentonite is also removed with the soil-water mixture.

Preferably the tube has a height which is such that the tube projects at all times above the ground level. As a result of this it is possible to ensure a water overpressure with respect to the bentonite.

According to the invention the space filled with bentonite above the seal can further be provided with a pressure sensor and the space filled with water beneath the seal can be provided with a pressure sensor, which pressure sensors control the water supply to the tube in a manner such that the water column provides an overpressure with respect to the bentonite column. There is then certainty that bentonite cannot be removed with the water-soil mixture.

The former or formers consist according to the invention preferably of a tube which is provided with expandable side walls, in particular inflatable side walls.

The invention will now be explained in more detail by reference to the drawings.

Figure 1 shows diagrammatically a method and device according to the invention in side view.

Figure 2 is a plan view of Figure 1, but on a larger scale.

The drawings show a channel 2 filled with bentonite 1 having a floor 3 and a front wall 4.

At the position of the front wall the channel is closed off by means of a former 5 which is shown on a larger scale in Figure 2. This former consists of a metal tube 6 of rectangular cross-section with tubular reinforcing ribs 7 at the corners and clamps 8 and 9 respectively on the front and back wall for attaching a rubber seal 10 which is closed at the extremities and which can be inflated, as shown at 11, and then rests against the side wall 12 of the already constructed channel.

Figure 2 shows one seal in the inflated condition and one in the uninflated condition.

In the direction in which the channel has to be constructed a ground mill is engaged in front of the former in digging out a further section of the channel. This ground mill has a frame 13 to which ground mills 14 are attached in a manner known per se and which can be rotated around horizontal axes and are provided with cutting knives 15. These ground mills are driven by hydraulic motors which are not shown.

The frame of the ground mill is attached to a rising tube 16 of rectangular cross-section, which frame is suspended at 17 on a lifting device not shown.

Between the ground mills 14 is located the suction nozzle 18 of a suction pipe which is connected by means of a dredger pump 19 to the pressurised pipe 20.

Water can be supplied at 23 to the tube 16 via the pipe 21 with stopcock 22. The fluid from this water content is indicated at 24. The frame 13 is provided with passage channels 25 through which the water in the tube can reach the ground mills, can mix with the loosened soil, after which the mixture of soil and water can be removed via the suction opening 18 and double-action pump 19 through the pressurised pipe 20.

At 26 the frame 13 carries a circumferential inflatable sealing ring 26' which is constructed in a manner such that it can slide along the walls of the channel already made and along the front face 9 of the former 5.

In the space between the outside wall of the tube 16 and the walls of the channel there is a relatively thin layer of bentonite 27 which is supplied via the pipe 28, 29.

Figure 1 shows that the tube 16 projects above the ground level 30 and that the fluid column in the tube is higher than the bentonite column which is situated between the outside wall of the tube and the walls of the channel in the space 27.

As a result of this it is possible to produce an over-pressure which ensures that bentonite remains above the seal 26' and cannot leak downwards past it.

At 31 there is situated at the outside edge of the tube a pressure sensor which measures the pressure of the bentonite column. At 32, below the sealing ring 26, there is situated a pressure sensor which measures the pressure of the water column. Both measurements can be used in a manner known per se for controlling the stopcock 22 in the water supply pipe 21. As a result of this it is possible to ensure that the water column always has sufficient over-pressure.

Operation with two formers is conceivable as is shown by means of dotted lines in Figure 1 by 5'. This second former can be used as a protection for the region situated upstream, for example if it is already desired to provide a concrete filling there or if it is desired to remove the bentonite and replace it by soil after a provision has been made therein, viz. the provision for which the channel was made. This might be a watertight shield.

After the ground mill has constructed a new section, the ground mill has to be brought up again. In order to ensure that the walls of the section just constructed remain stable, it is advantageous to remove the water from the tube 16, for example by means of the pump 19, and then, while the tube with ground mill is being brought up, during which the seal 26 is withdrawn, to supply bentonite either via the supply pipe 28 or via another pipe not shown directly into the tube, in which case the bentonite then flows via the channels 25 through into the space beneath the tube with mill which is moving upwards.

If the former 5' has now been drawn up at the correct time, then it can immediately be placed in the channel filled with bentonite immediately after the removal of the tube with mill.

Claims

1. Method for the digging of a vertical channel (2) in the soil, the channel (2) being filled with a heavy fluid, in particular with bentonite (1), during the construction and as construction progresses, and the digging itself taking place by means of a ground mill (14), the loosened soil being removed from the channel by pumping out of it a mixture of soil and fluid, characterized in that the part of the channel already constructed and filled with bentonite (1) is separated from the part still to be constructed and during the construction thereof by placing in the channel (2), in the near direction of advance at or near the end of the channel (2) already constructed, a former (5) which fits closely in a sealing manner against the side walls (12) of the channel (2) and the space above the ground mill, which is separated from the part of the channel already constructed by the former (5), is kept filled with water so that the mixture to be removed therefrom consists of soil and water.
2. Method according to claim 1, characterized in that at least two formers (5,5') are used at a distance from each other, which distance is at least to the length of the working area of the ground mill (14) and the former (5') disposed upstream, from the point of view of the directional movement, after the positioning of a former (5) adjacent to the working area of the ground mill (14) is withdrawn and after the removal of the ground mill is placed at the downstream end of the new channel section then made by means of the ground mill.
3. Device for the carrying out of the method of claim 1 or 2, the ground mill (14) being attached to a frame (13) which is suspended on a lifting device (17), characterized in that a tube (16) is placed on the frame (13) of the ground mill, which in horizontal cross-section has a length and width corresponding to the working length and working width of the ground mill (14) and which carries an expandable seal (26) above the ground mill, which tube is provided with an inlet (23) for water and with a drainage pump (19) with pressurised pipe (20) for the mixture of soil and water and furthermore an inlet (28) is present for the supply of bentonite to the space between the tube and above the seal (26).
4. Device according to claim 3, characterized in that the tube has a height which is such that the tube (16) projects at all times above the ground level.
5. Device according to claim 4, characterized in that the space filled with bentonite between tube (16) and channel

wall situated just above the seal (26) is provided with a pressure sensor, the space below the seal filled with water is also provided with a pressure sensor and both pressure sensors control the water supply to the tube in a manner such that the water column (24) above the bottom of the seal provides an overpressure with respect to the bentonite column above the seal.

6. Device according to one or more of the preceding claims, characterized in that the former or formers (5,5') consist of a tube with expandable, in particular, inflatable, side walls (10).

5

10

15

20

25

30

35

40

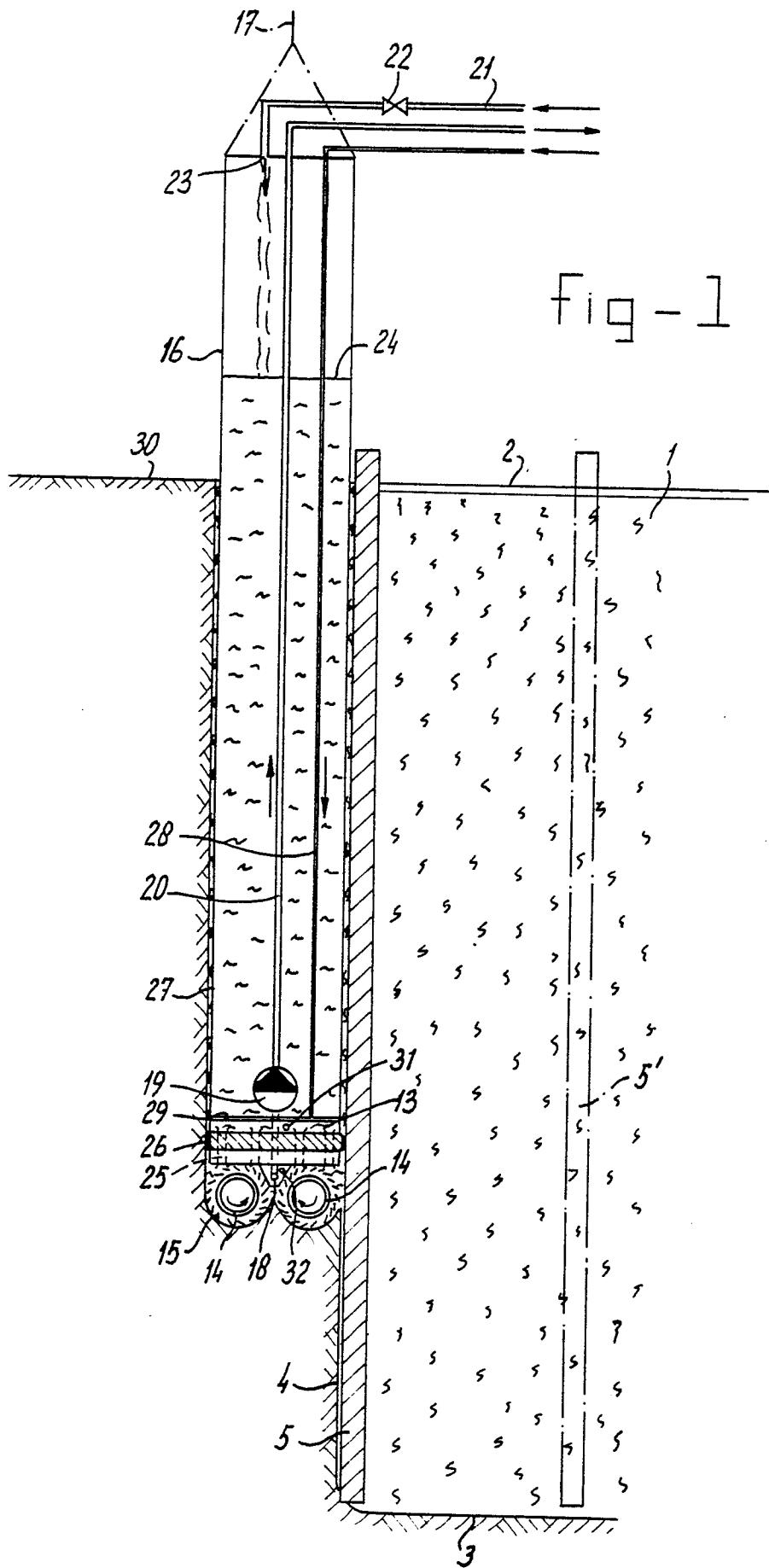
45

50

55

60

65





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	US-A-4 379 658 (SCHMEDNECHT) * Column 2, lines 56-68; column 3; column 4, lines 1-12; figures 1-3 *	1,3	E 02 D 19/18
Y	--- DE-B-1 634 262 (BADE) * Whole document *	1,3	
A	--- US-A-3 564 855 (MÖRNER) * Figures 1a,1b,2 *	6	
A	--- FR-A-1 532 666 (WIRTH) * Description; figures 1-3 *	1,3	
A	--- FR-A-2 429 047 (SOLMARINE) * Description *	5	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			E 02 D E 02 F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 07-03-1986	Examiner HANNAART J.P.
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	