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(12) # EUROPEAN PATENT SPECIFICATION

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

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DE-B-1 634 262
FR-A-1 532 666
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Description

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 (see e.g. DE—B—1634262). 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 considserably 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 the 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 end 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 former is provided for fitting closely in a sealing manner against the side walls of the channel and a tube is 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 the channel wall 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 the 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 body of water 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 overpressure 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 overpressure.

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 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, comprising a ground mill (14) attached to a frame (13) which is suspended on a lifting device (17), characterized in that a former (5) is provided for fitting closely in a sealing manner against the side walls of the channel, and 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 pressurized 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 the channel wall 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 (31), the space below the seal filled with water is also provided with a pressure sensor (32) and both pressure sensors are used to 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 (6) with expandable, in particular, inflatable, side walls (10).

Patentansprüche

1. Verfahren zum Ausheben eines vertikalen Kanals (2) aus dem Boden, wobei der Kanal (2) während der Bauarbeit, und während der Bau fortschreitet, mit einer schweren Flüssigkeit insbesondere mit Bentonit (2) gefüllt ist, und wobei das Ausheben selbst mit Hilfe einer Bodenfräse (14) erfolgt und der gelockerte Boden aus dem Kanal durch Herauspumpen einer Mischung von Erde und Flüssigkeit entfernt wird, dadurch gekennzeichnet, dass derjenige Teil des Kanals, der bereits gebaut und mit Bentonit (1) gefüllt ist, von dem noch zu bauenden Teil und während der Bauarbeit an demselben getrennt wird, indem man im Kanal (2) in Vortriebsrichtung bei oder nahe dem Ende des bereits gebauten Kanals (2) eine Spundwand (5) angeordnet, die sich in abdichtender Weise an die Seitenwandungen (12) des Kanals (2) angrenzend anfügt, und man den Raum über der Bodenfräse, der durch die Spundwand (5) vom bereits gebauten Teil des Kanals getrennt ist, mit Wasser gefüllt hält, so dass die daraus zu entfernende Mischung aus Erde und Wasser besteht.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, dass man mindestens zwei im Abstand voneinander angeordnete Spundwände (5, 5') verwendet, wobei dieser Abstand mindestens die Länge des Arbeitsbereiches der Bodenfräse (14) beträgt, und man die in Richtung des Arbeitfortschritts betrachtet stromaufwärts angeordnete Spundwand (5') nach dem Einsetzen einer Spundwand (5) angrenzend an den Arbeitsbereich der Bodenfräse (14) entfernt und nach dem Entfernen der Bodenfräse (14) am stromabwärts gelegenen Ende des neuen Kanalabschnittes anordnet, der dann mit Hilfe der Bodenfräse hergestellt wird.

3. Vorrichtung zur Durchführung des Verfahrens nach Anspruch 1 oder 2, umfassend eine Bodenfräse (14), die an einem Rahmen (13) befestigt ist, der an einer Hebevorrichtung (17) angehängt ist, dadurch gekennzeichnet, dass eine Spundwand (5) vorgesehen ist, die in abdichtender Weise an die Seitenwandungen des Kanals angrenzend angefügt ist, und dass auf dem Rahmen (13) der Bodenfräse ein Rohr (16) angeordnet ist, dessen horizontaler Querschnitt eine Länge und Breite aufweist, die der Arbeitslänge und Arbeitsbreite der Bodenfräse (14) entsprechen, und das über der Bodenfräse eine ausdehnbare Dichtung (26) trägt, wobei das Rohr mit einem Einlass (23) für Wasser und mit einer Drainagepumpe (19) mit einem Druckrohr (20) für die Mischung aus Erde und Flüssigkeit versehen ist, und ausserdem ein Einlass (28) für die Zufuhr von Bentonit zum Raum zwischen dem Rohr und der Kanalwandung oberhalb der Dichtung (26) vorhanden ist.

4. Vorrichtung nach Anspruch 3, dadurch gekennzeichnet, dass das Rohr eine solche Höhe aufweist, dass das Rohr (16) jederzeit über der Bodenhöhe hervorragt.

5. Vorrichtung nach Anspruch 4, dadurch

gekennzeichnet, dass der mit Bentonit gefüllte Raum zwischen dem Rohr (16) und der unmittelbar über der Dichtung (26) gelegenen Kanalwandung mit einem Druckfühler (31) versehen ist, der mit Wasser gefüllte Raum unterhalb der Dichtung ebenfalls mit einem Druckfühler (32) versehen ist, und beide Druckfühler auf solche Weise zur Steuerung der Wasserzufuhr zum Rohr verwendet werden, dass die Wassersäule (24) über dem Unterteil der Dichtung in bezug auf die Bentonitsäule über der Dichtung einen Überdruck erzeugt.

6. Vorrichtung nach einem oder mehreren der vorangehenden Ansprüche, dadurch gekennzeichnet, dass die Spundwand oder Spundwände (5, 5') aus einem Rohr (6) mit ausdehnbaren, insbesondere aufblasbaren Seitenwandungen (10) bestehen.

Revendications

1. Procédé pour creuser un canal vertical (2) dans le sol, le canal (2) étant rempli de fluide lourd, en particulier de bentonite (1) pendant la construction et pendant que la construction progresse, le creusement lui-même étant effectué au moyen d'une fraise de sol (14), le sol dégagé étant extrait du canal par pompage d'un mélange de sol et de fluide hors du canal, caractérisé en ce que la partie du canal déjà construite et remplie de bentonite (1) est séparée de la partie encore à construire et pendant la construction de celle-ci en plaçant, dans le canal (2) dans la direction d'avance à ou près de l'extrémité du canal (2) déjà construit, une palplanche (5) qui s'adapte étroitement de manière étanche contre les parois latérales (12) du canal (2), et que l'espace situé au-dessus de la fraise de sol et qui est séparé par la palplanche (5) de la partie déjà construite du canal est maintenu remplie d'eau de sorte que le mélange à en extraire est constitué de sol et d'eau.

2. Procédé selon la revendication 1, caractérisé en ce que l'on utilise au moins deux palplanches (5, 5') à distance l'une de l'autre, cette distance étant au moins la largeur de la zone de travail de la fraise de sol (14), et que la palplanche (5') placée en amont du point de vue de la direction du mouvement est retirée après la mise en place d'une palplanche (5) adjacente à la zone de travail de la fraise de sol (14) et, après que l'on ait retiré la fraise de sol, placée à l'extrémité aval de la nouvelle section de canal alors réalisée au moyen de la fraise de sol.

3. Dispositif pour mettre en oeuvre le procédé de la revendication 1 ou 2, comportant une fraise de sol (14) fixée à un cadre (13) qui est suspendu à un engin de levage (17), caractérisé en ce que l'on prévoit une palplanche (5) qui s'adapte étroitement de façon étanche contre les parois latérales du canal et qu'un tube (16) est disposé sur le cadre (13) de la fraise de sol, tube dont la section horizontale présente une longueur et une largeur qui correspondent à la longueur de travail et à la largeur de travail de la fraise de sol (14) et qui porte un joint expansible (26) au-dessus de la fraise de sol, ce tube étant pourvu d'une entrée d'eau (23) et d'une pompe de drainage (19) munie d'un tube sous pression (20) destiné au mélange de sol et d'eau, et qu'en outre il est prévu une entrée (28) pour l'apport de bentonite à l'espace situé entre le tube et la paroi du canal située au-dessus du joint (26).

4. Dispositif selon la revendication 3, caractérisé en ce que le tube présente une hauteur telle que le tube (16) dépasse en tous temps au-dessus du niveau du sol.

5. Dispositif selon la revendication 4, caractérisé en ce que l'espace rempli de bentonite situé entre le tube (16) et la paroi du canal située juste au-dessus du joint (26) est pourvu d'un senseur de pression (31), l'espace rempli d'eau situé au-dessous du joint est lui aussi pourvu d'un senseur de pression (32) et les deux senseurs de pression sont utilisés pour commander l'amenée d'eau au tube de manière telle que la colonne d'eau (24) située au-dessus du fond du joint crée une surpression par rapport à la colonne de bentonite située au-dessus du joint.

6. Dispositif selon une ou plusieurs des revendications précédentes, caractérisé en ce que le ou les palplanches (5, 5') sont constituées d'un tube (6) muni de parois latérales (10) expansible et en particulier gonflables.

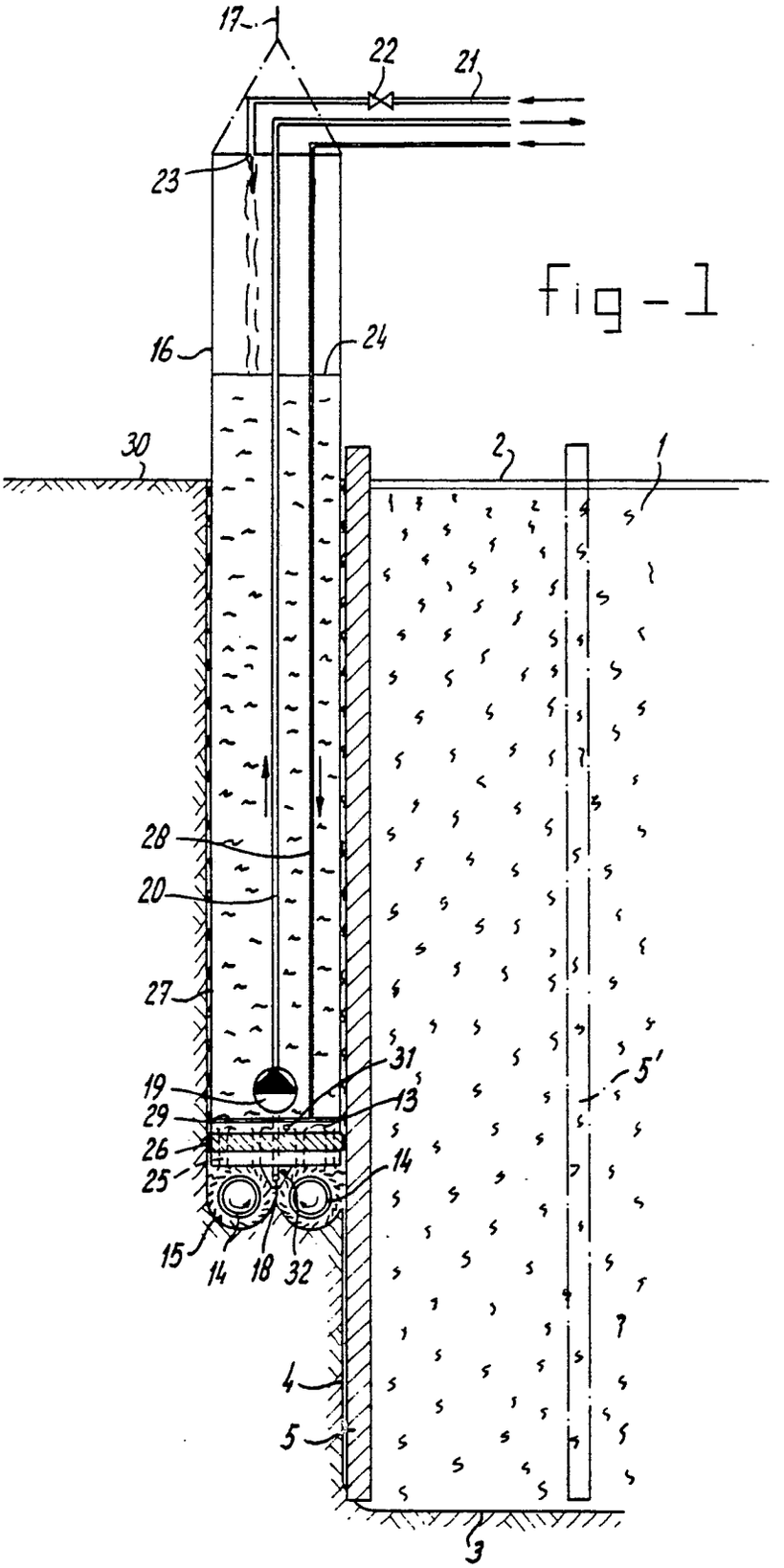

fig-1

Fig-2