(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 870 874 A1

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**14.10.1998 Bulletin 1998/42**

(51) Int Cl.[6]: **E02B 11/02**

(21) Application number: **98201069.6**

(22) Date of filing: **08.04.1998**

(84) Designated Contracting States:
**AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE**
Designated Extension States:
**AL LT LV MK RO SI**

(30) Priority: **09.04.1997 BE 9700325**

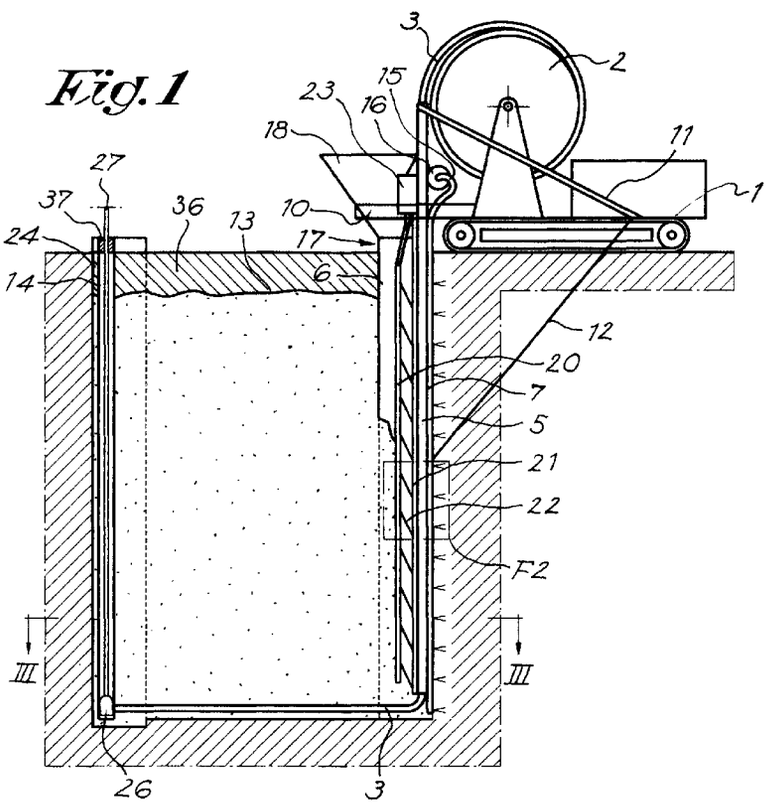
(71) Applicant: **BEHEERSMAATSCHAPPIJ VERSTRAETEN B.V.**
**4500 AB Oostburg (NL)**

(72) Inventor: **Verstraeten, Alexander J.**
**8300 Knokke (BE)**

(74) Representative: **Debrabandere, René**
**Bureau De Rycker nv**
**Arenbergstraat 13**
**2000 Antwerpen (BE)**

## (54) Method and device for putting a drain pipe almost horizontally in the ground

(57) Method for putting a drain pipe (3) almost horizontally in the ground, whereby a plough (4) is moved through the ground so as to form a ditch (13) and whereby the drain pipe (3) is put in the ditch (13) and draining material is pressed in the ditch (13) while this ditch (13) is being formed, characterized in that the ditch (13) is filled with drainage material over a height which is significantly larger than the width of the ditch (13), such that a water guiding screen is formed above the drain pipe (3).




EP 0 870 874 A1

## Description

The present invention concerns a method and device for putting a drain pipe almost horizontally in the ground, whereby a plough is moved through the ground so as to form a ditch, and whereby the drain pipe is put in the ditch and draining material is pressed in the ditch while this ditch is being formed by the plough.

Horizontal drain pipes are used in large pipeline works, whereby the pipeline is put 5 to 6 m deep, in order to lower the groundwater level.

Such horizontal drain pipes are also used for soil consolidation.

In order to provide these drain pipes, chain ditch diggers are often used which dig a ditch of about 30 cm wide, in which the drain pipe is placed. Immediately thereafter, the ditch is filled with sand.

The sand in the ditch absorbs large amounts of water from the environment.

However, with such chain ditch diggers, the drain pipe cannot be placed at a large depth, in particular not deeper than 8 m, for example 18 to 20 m deep.

For a ditch which is 8 m deep and at least 30 cm wide, made with a chain ditch digger, at least 2.4 $m^3$ sand per running metre are required, which may cause problems to supply the sand, in particular over the weak clay layers which need to be consolidated.

Moreover, the same amount of soil per running metre which is to be removed or spread was excavated by the chain ditch digger.

Thus, providing a drain pipe with such a device is time-consuming and, as a consequence, expensive.

However, the ditch to provide the drain pipe in must not be very wide. A few centimetres will do.

That is why, in order to provide a drain pipe horizontally in the ground, use is already made of a plough which makes a very narrow groove in the ground in which the drain pipe is provided while said groove is being formed, after which drainage material, usually sand, is pressed in the groove.

Such a method is described in CH-A-486.607.

Compressed air or water under pressure are supplied to a closed funnel with powdered material such as sand, which funnel is connected to a ring-shaped chamber surrounding the drain pipe at the bottom of the ditch and provided with a number of mouth pieces directed towards the back via a flexible pipe.

In this manner, a casing of powdered material is formed around the drain pipe in the ditch. However, this casing has a very limited height which is about equal to the width of the ditch which is significantly wider than the drain pipe, so that it is relatively difficult to draw the plough, which has for a result that no deep ditches can be formed.

When the ditch is further filled afterwards with ordinary soil, there will be more ordinary soil above the drainage material than that there is drainage material above the drain pipe, so that the draining effect is restricted.

Also, this method cannot be used for ditches of very large depths, for example of 8 m or more.

Moreover, it is not possible to fill the ditch up to a large height according to the above-described manner, and certainly not to bring the draining material under pressure and thus in a relatively compact manner up to almost the ground surface.

The present invention aims a method for putting a drain pipe almost horizontally in the ground which excludes the above-mentioned and other disadvantages and which makes it possible to provide a drain pipe almost horizontally at a large depth in a simple and fast manner and nevertheless obtain a good drainage.

This aim is reached according to the invention as the ditch is filled with drainage material over a height which is significantly larger than the width of the ditch, such that a water guiding screen is formed above the drain pipe.

The formed ditch can be quite narrow and nevertheless be filled with sand or other drainage material. The formed screen of sand or other drainage material serves to supply water to the drain pipe and to thus obtain the above-mentioned good drainage.

The drainage material can be pressed in the ditch both mechanically by means of a push mechanism and pneumatically or hydraulically by means of fluid under pressure, whereby drainage material is supplied under hydraulic or pneumatic pressure in the ditch at different heights.

Preferably, fluid under pressure is squirted in front of the plough in order to loosen the soil in front of the plough and to reduce the forces on the plough.

The present invention also concerns a device which is suitable for applying the above-mentioned method.

Thus, the present invention concerns a device for putting a drain pipe horizontally in the ground, which device contains a plough, means to move this plough in the ground, means to provide the drain pipe in the ditch formed by the plough and means to provide drainage material under pressure above the drain pipe in the ditch formed by the plough, whereby the latter means contain means to provide the drainage material under pressure over a height which is significantly larger than the width of the ditch.

According to a particular embodiment, the latter means include a push mechanism which may contain a push element and means to move this push element back and forth.

According to another embodiment, the above-mentioned means contain pipes for the drainage material reaching up to different levels, means to supply drainage material to these pipes and means to pneumatically or hydraulically exert pressure on the drainage material in these pipes.

Under the lower end of each pipe can be provided one or several deflectors directed slantingly backwards.

On its front side, the plough may contain a high-

pressure pipeline directed from top to bottom which is provided with nozzles directed to the front, and means to supply fluid under pressure to these nozzles.

In order to better explain the characteristics of the invention, the two following preferred embodiments of a method and a device according to the invention are described as an example only without being limitative in any way, with reference to the accompanying drawings, in which:

figure 1 schematically represents a side view of a device for putting a drain pipe almost horizontally in the ground according to the invention, during the application of the method according to the invention;
figure 2 represents the part which is indicated by F2 in figure 1 to a larger scale;
figure 3 shows a section according to line III-III in figure 1, but with a pressure mechanism in another position;
figure 4 shows a section analogous to that in figure 3, but with reference to another position of a push element;
figure 5 schematically represents a part of a side view analogous to that in figure 1, but with reference to another embodiment of the device according to the invention;
figure 6 schematically represents the application of a vacuum consolidation of the soil after a drain pipe according to the invention has been put in the ground.

The device represented in figures 1 to 4 contains a caterpillar tractor 1 upon which a reel 2 is provided on one end upon which the drain pipe 3 is wound.

On the same end, a plough 4 is provided on the tractor 1 which consists of a vertical pipe 5 upon which two parallel walls 6 are fixed on the back side and upon which a high-pressure pipeline 7 provided with nozzles 8 is connected by two sidepieces 9 on the front side.

The width of this plough 4 is only slightly larger than the diameter of the drain pipe 3, namely only a few centimetres. The depth of the plough 4 is significantly larger and amounts to a few metres, even more than 8 m, and it is for example 18 to 20 m.

This plough 4 can be moved up and down in a guide 10 fixed on the above-mentioned back end of the tractor 1.

Said plough 4 is strutted on top by means of a prop 11 which is fixed to the top end of the plough 4 on the one hand and to the front side of the tractor 1 on the other hand.

The bottom side of the plough 4 can be connected to the front side of the tractor 1 or to a second tractor by means of a cable 12.

The top end of the pipe 5 is situated at the height of the shaft of the reel 2. The part of the drain pipe 3 which is wound off the reel 2, extends through this pipe 5 and then backward, under the end of this pipe 5 and between the walls 6 over the bottom of the ditch 13 formed by the plough 4.

The end of this drain pipe 3 is fixed to the bottom end of an additional vertical pipe 14 which sticks in the ground where the ditch 13 begins.

The high-pressure pipeline 7 is a pipe with a smaller diameter than the pipe 5 which goes somewhat deeper than this pipe 5. The top end of this high-pressure pipeline 7 is connected to a high-pressure hose 15 which is connected to a high-pressure pump 16.

The device contains means 17 to provide sand under pressure in the ditch 13.

These means 17 contain a funnel 18 on the one hand provided on the back side of the tractor 1, behind the plough 4 and which opens with its lower end in the space between the two walls 6, and a push mechanism 19 on the other hand to mechanically push the freshly supplied sand backward.

In the example represented in figures 1 to 4, the latter push mechanism 19 consists of a push element 20 which is provided such that it can be moved between the walls 6 and means to move this push element 20 back and forth in relation to the plough 4. These means consist of a support 21 placed against the pipe 5 and preferably fixed to it, for example by means of welding, arms 22 which are hinge-mounted to the support 21 and which are hinge-mounted to the push element 20, and a push cylinder 23 to rotate the arms 22.

Since, when the arms 22 are rotated, the push element 20 also moves in the vertical direction, the push cylinder 23 will be provided between the top side of the pipe 5 and the top end of the push element 20. Naturally, the push cylinder 23 is connected to an oil source under pressure via a control mechanism.

Providing the drain pipe 3 at a relatively large depth in the ground is simple and as follows.

Before the plough 4 is provided in the ground, an end of the drain pipe 3 is provided through the pipe 5 and fixed to the lower end of the additional pipe 14.

The whole is put in the ground.

In weak layers, this can be done by squirting a hole in the soil in front of it by means of fluid under pressure.

A manner which is always applicable consists in putting a rectangular box profile 24 in the ground in which the additional pipe 14 and the plough 4 fit and of which the front side 24A can be removed, as is represented in figures 3 and 4. This box profile is hereby preferably filled with water.

When this box profile 24 is provided at a sufficiently large depth, the front side 24A is pulled out of the ground, and the pipe 14 and the plough 4 are lowered in it.

The plough 4 is moved forward through the soil by the tractor 1, but also due to the movement of the push element 20 which lunges out on the ground or on the already provided sand during its backward movement. In weak ground, the back-and-forth movement of the

push element 20 alone may be sufficient to move the plough 4 forward.

Of course, this forward movement is made significantly easier by squirting fluid under pressure through the nozzles 8. As a fluid can be used water or air or a mixture thereof. This squirting can be carried out intermittently.

The pipe 14 remains in place, i.e. where the ditch 13 begins.

As soon as the plough 14 has moved forward, the remaining part of the box profile 24 is pulled out of the ground for possible re-use.

During the forward movement of the plough 4, the push element 20 is successively pushed backward by means of the pressure cylinder 23, as is represented in figure 3, and quickly moved forward. Figure 4 represents this push element 20 in its foremost position against the support 21.

Each time the push element 20 is moved into this foremost position, a space 25 is created on its back side between the walls 6, between this push element 20 and the already compressed sand, in which space 25 the lower end of the funnel 18 opens. This funnel 18 is filled with dry dune sand which falls in said space 25 due to the gravitational force and which is compressed during the next backward movement of the push element 20.

In this way, sand is pressed in the ditch 13 so that a water guiding screen, namely a sand screen, is formed above the drain pipe 3 which, as the plough 4 moves forward, is wound off the reel 2 and always ends up with a longer part on the bottom of the ditch 13, preferably at a small distance from the ground surface.

Afterwards, the ditch 13 can be further filled with soil, preferably soil which is not permeable to air, in particular clay or bentonite.

Water caught in the drain pipe 3 can be removed via the additional pipe 14. To this end, a pump 26 can be provided at the bottom in this pipe 14 with a pressure pipe 27 extending through the pipe 14 to the top of the ground surface.

According to a variant of the above-mentioned embodiment, the arms 22 can be replaced by pressure cylinders or even the entire system consisting of the push element 20, support 21 and arms 22 can be replaced by inflatable bellows and means to blow up these bellows and make them deflate again.

In order to facilitate the movement of the plough 4, instead of or apart from a high-pressure pipeline 7 with nozzles 8, means can be provided to make the plough 4 vibrate, so that a fluidization of the soil in front of the plough 4 can be obtained thanks to this vibration.

The embodiment of the device represented in figure 5 differs from the above-described device in that the means 17 to provide sand under pressure in the formed ditch 13 do not contain a push mechanism 19, but pneumatic means.

These means 17, depending on the depth, contain two or several, for example three vertical sand pipes or pipes 28 erected between the walls 6 of the plough 4 and reaching up to different depths in the ground.

To the bottom end of each of these sand pipes 28 are fixed one or several deflectors 29 directed slantingly to the bottom and to the back into which said sand pipes 28 open. The deflectors 29 thus extend between the walls 6 up to almost the back end of these walls 6. Between the bottom edge of a deflector 29 and the accompanying sand pipe 29 is provided a horizontal partition 30.

The top ends of these sand pipes 28 open in a chamber 31 above the guide 10.

Onto this chamber 31 are connected a screw pump 32 on the one hand and a compressed air line 33 on the other hand.

The compressed air line 33 is connected to an air receiver which is not represented in figure 5, whereas the screw pump 32 is connected to a funnel 34 erected on top of a moveable storage tank 35 mounted on caterpillars.

During the forward movement of the plough 4, sand is pumped in the chamber 31 by the screw pump 32. This sand is squirted under pressure through the sand pipes 28 in the ground behind the pipe 5, by means of the compressed air which is blown in the chamber 31 via the compressed air line 33, and pushed backward by the deflectors 29.

Thus, also in this embodiment is formed a sand screen with compressed sand behind the plough 4 and above the drain pipe 3 provided on the bottom of the ditch 13.

The above-described device and method are particularly suitable for the vacuum consolidation of soil, which is known as such.

To this end, an air-tight layer 36 of for example one metre thick must be provided above the sand screen in the ditch 13, and the top ends of the pipe 14 and of the drain pipe 3 must be sealed by means of seals 37 and 38 as represented in figure 6.

The pressure pipe 27 is connected to the bottom side of a vacuum tank 39 in which is created an underpressure by a vacuum pump 40 erected on top.

A suction pipe 41 connected to the top side of the vacuum tank 39 opens in the additional pipe 14 on the one hand and in the end of the drain pipe 3 protruding above the ground on the other hand.

In the bottom of the vacuum tank 39 is erected a water pump 42 with a non-return valve onto which a delivery hose 43 is connected.

The medium, in particular water which is collected in the drain pipe 3, is pumped through the pump 26 to the vacuum tank 39, whereby the vacuum helps to collect this medium in the vacuum tank 39. Thus, the water level in the ditch 13 is kept low, for example at a depth of 15 m.

Via the suction pipe 41 is created an underpressure in the sand in the ditch 13. Water situated in the surrounding soil will quickly flow towards this ditch 13 and

be pumped up, so that the soil is quickly consolidated.

With the above-described devices, it is possible to put a drain pipe almost horizontally in the ground in a fast and simple manner and to simultaneously provide a sand screen over it.

Instead of sand, another drainage material can be provided in the ditch 13.

The present invention is by no means limited to the above-described embodiments represented in the accompanying drawings; on the contrary, such a method and device for putting a drain pipe almost horizontally in the ground can be made in all sorts of variants while still remaining within the scope of the invention.

## Claims

1. Method for putting a drain pipe (3) almost horizontally in the ground, whereby a plough (4) is moved through the ground so as to form a ditch (13) and whereby the drain pipe (3) is put in the ditch (13) and draining material is pressed in the ditch (13) while this ditch (13) is being formed, characterized in that the ditch (13) is filled with drainage material over a height which is significantly larger than the width of the ditch (13), such that a water guiding screen is formed above the drain pipe (3).

2. Method according to claim 1, characterized in that the drainage material is pressed in the ditch (13) in a mechanical manner by means of a push mechanism (19).

3. Method according to claim 1, characterized in that the drainage material is pressed in the ditch (13) in a pneumatic or hydraulic manner by means of fluid under pressure, whereby drainage material is supplied under hydraulic or pneumatic pressure in the ditch (13) at different heights.

4. Method according to any of the preceding claims, characterized in that fluid under pressure is squirted in front of the plough (4) so as to loosen the soil.

5. Method according to any of the preceding claims, characterized in that the ditch (13) reaches up to a distance from the bottom surface and is further filled with material which is impermeable to air, such as for example clay or bentonite.

6. Method according to any of the preceding claims, characterized in that the drain pipe (3) is connected with one end to an additional pipe (14), in that this additional pipe (14) is put in the ground together with the plough (4), in that this pipe (14) remains in place while the plough (4) is being moved forward, after which medium collected in the drain pipe (3) is discharged via this pipe (14).

7. Method according to claim 6, characterized in that after the drain pipe (3) has been put in the ground, medium is pumped up via a pump (26) situated at the bottom of the additional pipe (14) and a pressure pipe (27) into a vacuum tank (39) which is also connected to this pipe (14) and the end of the drain pipe (3) protruding above the ground via a suction pipe (41), so that an underpressure is created via the drain pipe (3) in the drainage material situated on top of it in the ditch (13).

8. Method according to any of the preceding claims, characterized in that, in order to put the plough (4) in the ground, a box profile (24) with removable front wall (24A) is first put in the ground in which the plough (4) is then placed, whereby after the front wall (24A) has been removed from the ground, the plough (4) is moved forward, after which also the rest of the box profile (24) can be removed from the ground.

9. Device for putting a drain pipe (3) almost horizontally in the ground, characterized in that it contains a plough (4), means (1, 17) to move this plough (4) in the ground, means to provide the drain pipe (3) in the ditch (13) formed by the plough (4) and means (17) to provide drainage material under pressure above the drain pipe (3) in the ditch (13) formed by the plough (4), characterized in that the means to provide drainage material under pressure contain means to provide the drainage material under pressure over a height which is significantly larger than the width of the ditch.

10. Device according to claim 9, characterized in that the means (17) for providing drainage material under pressure include a push mechanism (19).

11. Device according to claim 10, characterized in that this push mechanism (19) contains a push element (20) and means to move this push element (20) back and forth.

12. Device according to claim 9, characterized in that the means (17) for providing drainage material under pressure contain pipes (28) for drainage material reaching up to different levels, means (32) to supply drainage material to these pipes (28) and means (33) to pneumatically or hydraulically exert pressure on the drainage material in these pipes (28).

13. Device according to claim 12, characterized in that under the lower end of each pipe (28) is provided at least one deflector (29) directed slantingly backwards.

14. Device according to any of claims 9 to 13, charac-

terized in that, on its front side, the plough (4) contains a high-pressure pipeline (7) directed from top to bottom which is provided with nozzles (8) directed to the front and means to supply fluid under pressure to these nozzles (8).

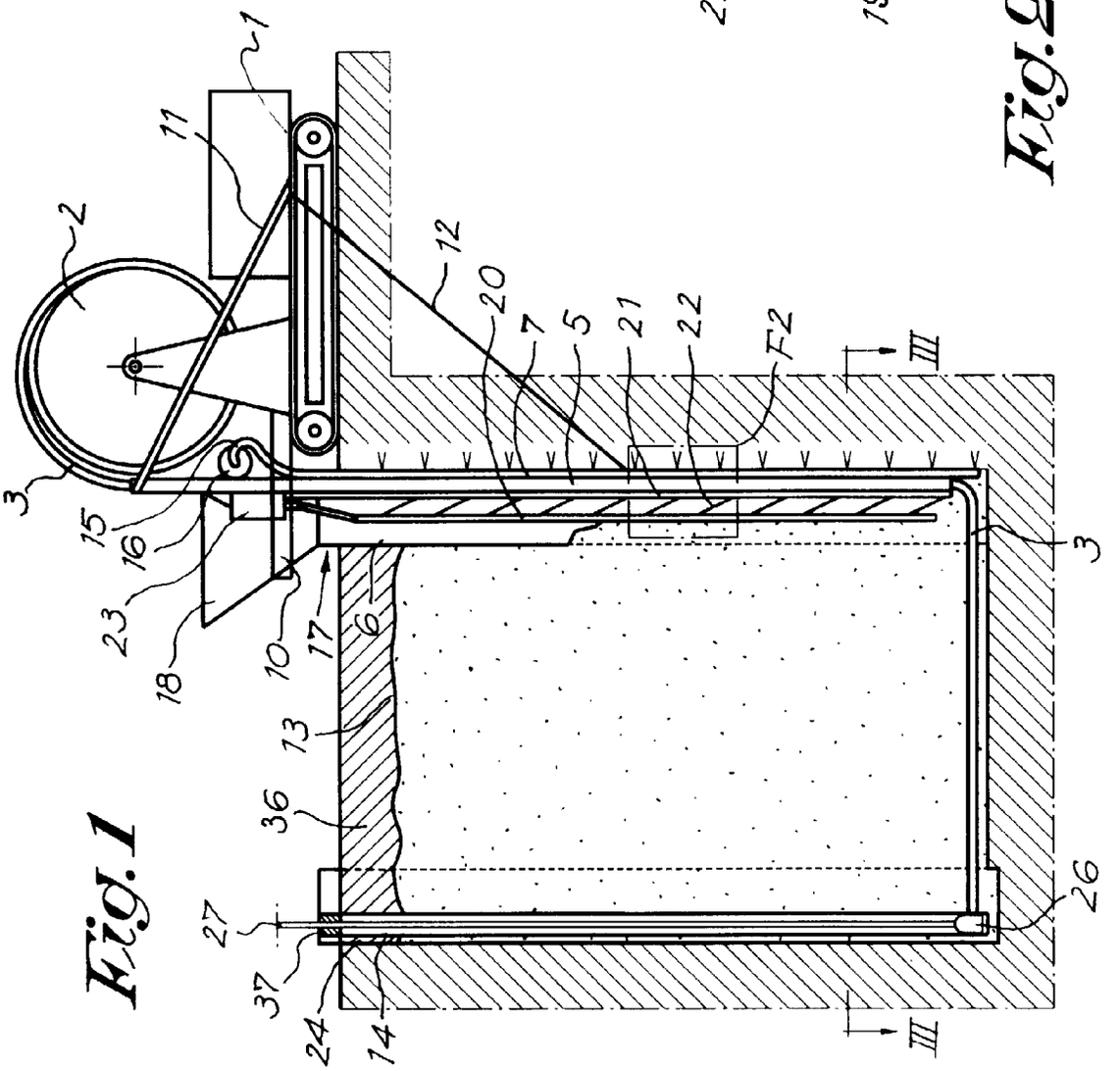

1
11
2
12
20
7
5
21
22
F2
III
3
15
16
23
18
10
17
6
13
36
27
37
24
14
26

Fig.1

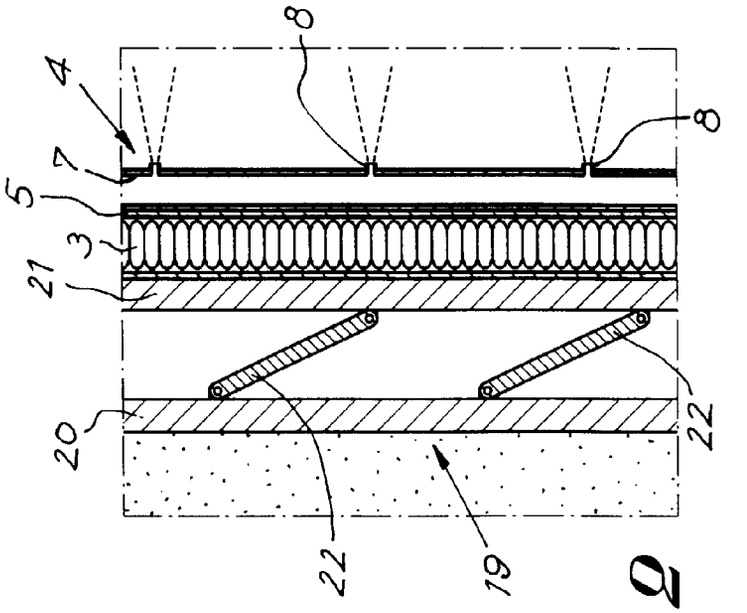

8
4
8
7
5
3
21
20
22
22
19

Fig.2

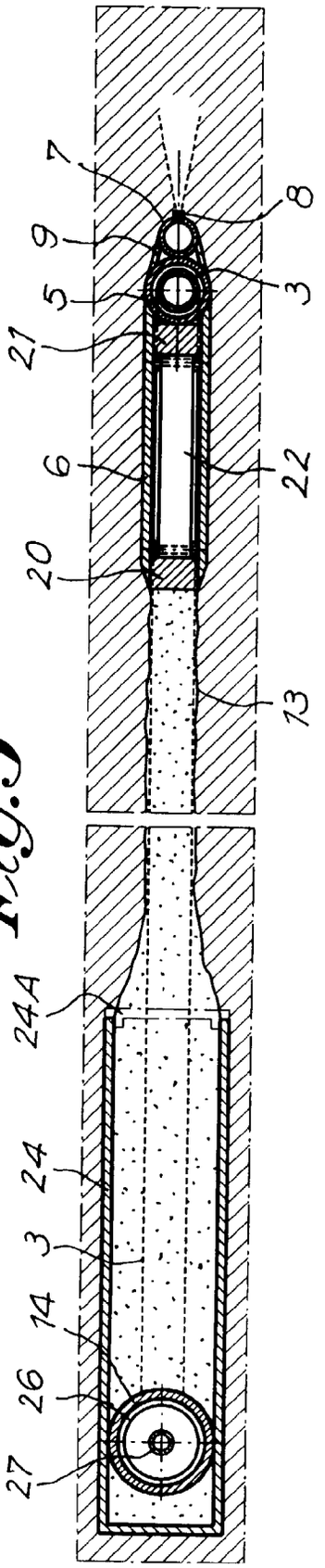

7
8
9
3
5
21
6
22
20
13
24A
24
3
14
26
27

Fig.3

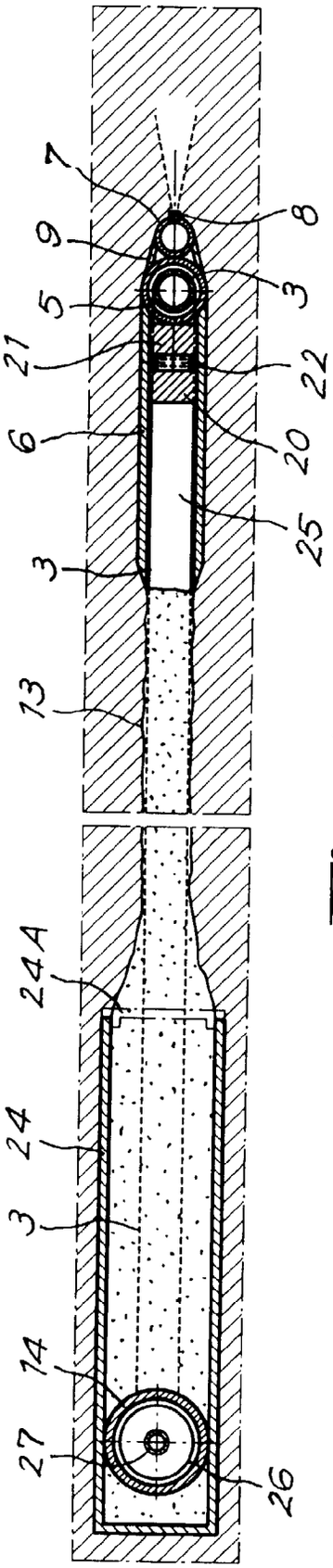

7
8
9
3
5
21
22
6
20
25
3
13
24A
24
3
14
27
26

Fig.4

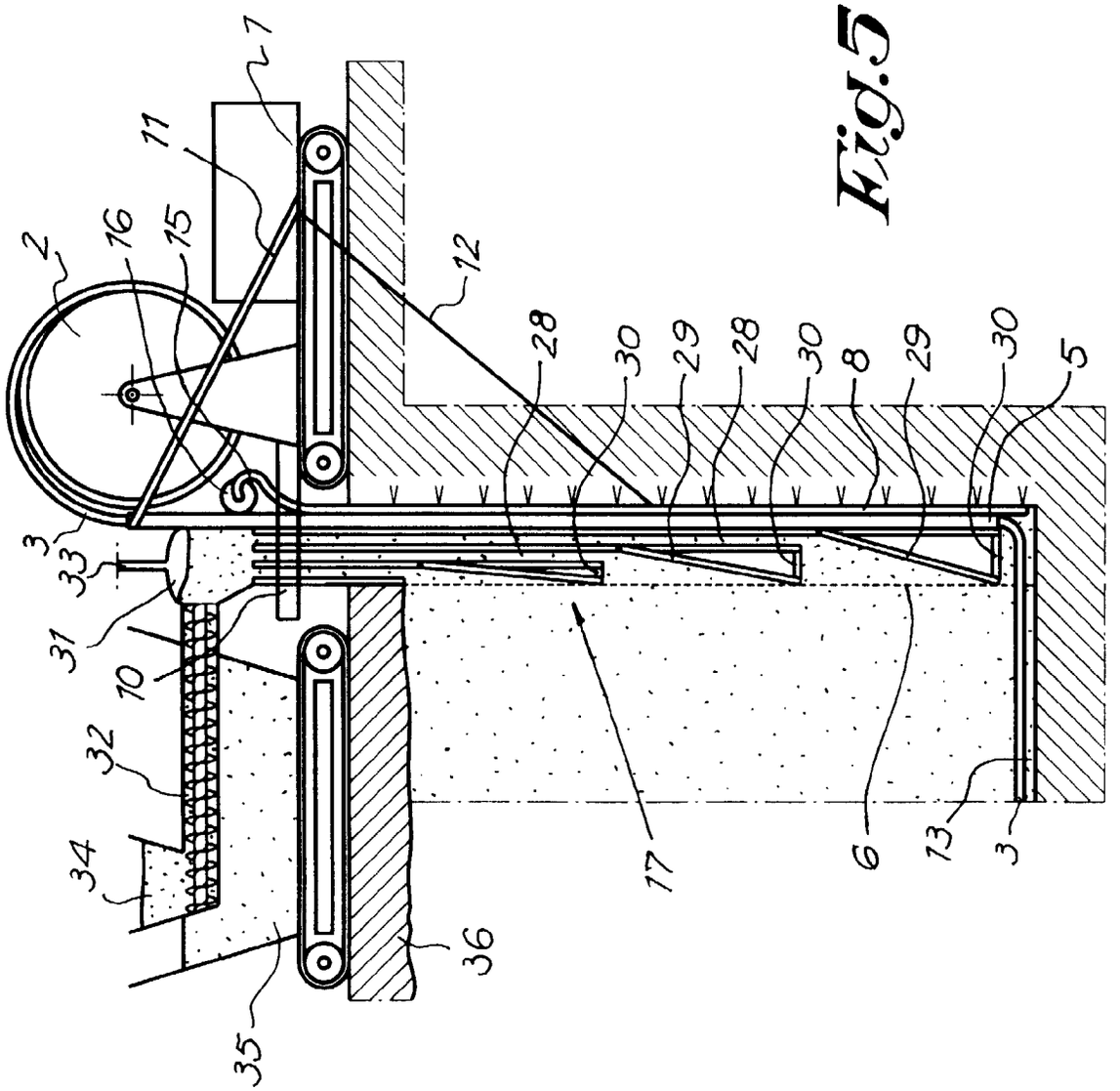



Fig.5

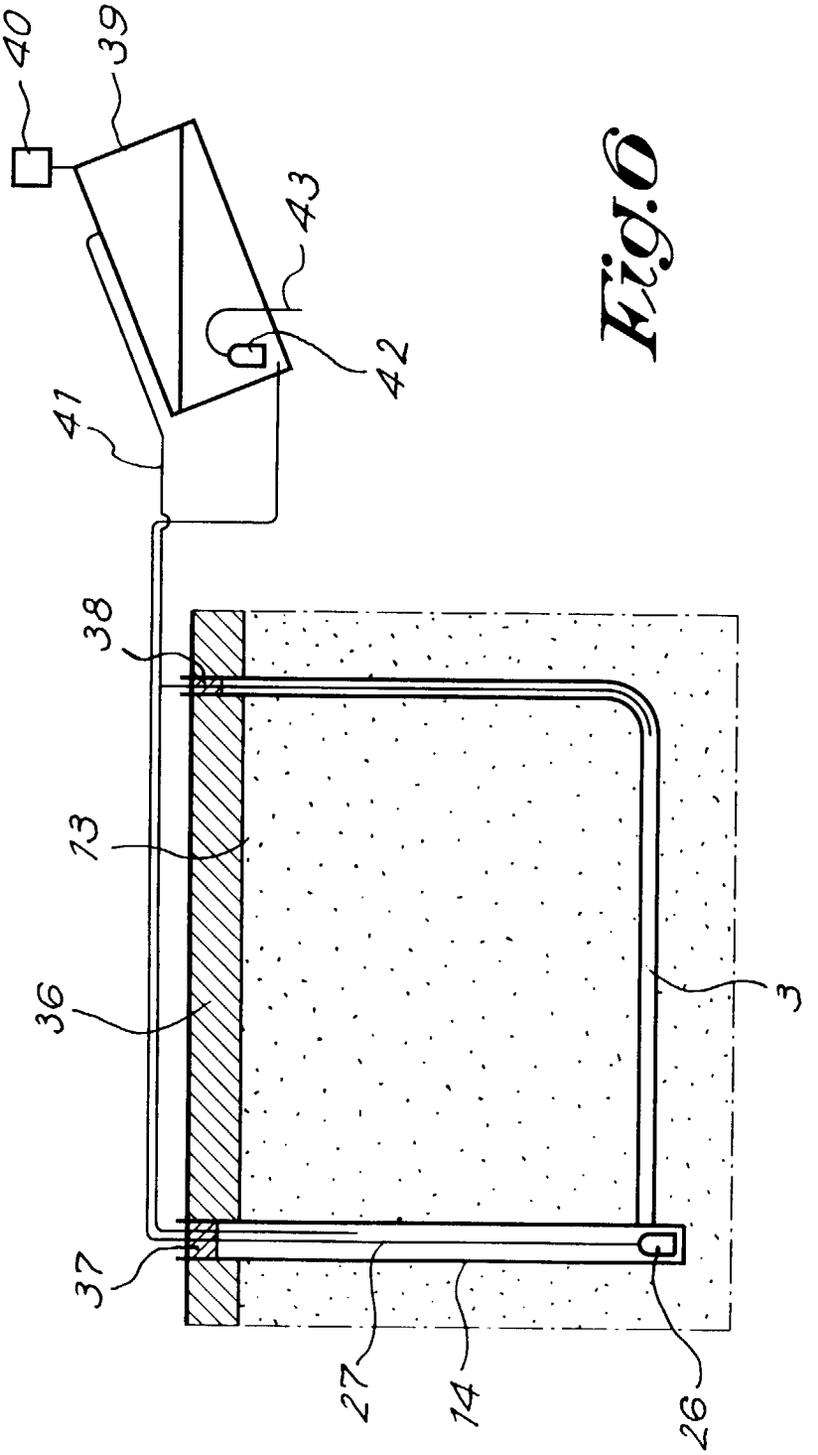



Fig.6

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 98 20 1069

## 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.6) |
|---|---|---|---|
| D,X | CH 486 607 A (OTT) 28 February 1970<br>* column 1, line 32 - column 2, line 35; figures * | 1,3,9,12 | E02B11/02 |
| X | GB 2 268 037 A (LEWIS) 5 January 1994<br>* page 5, line 24 - page 7, line 19; figures * | 1,9 | |
| X | DE 34 31 673 A (CORNELIUS) 13 March 1986<br>* page 11, line 4 - page 14, line 2; figures * | 1,9 | |
| X | DE 18 04 001 A (WERNER CORNELIUS KG TIEF- UND KULTURBAU) 16 June 1971<br>* page 7, line 21 - page 12, line 4; figures * | 1,3,9 | |
| X | GB 2 055 440 A (GILCHRIST) 4 March 1981<br>* page 1, line 65 - page 2, line 31; figures * | 1,9 | |
| A | EP 0 005 982 A (DAVISON) 12 December 1979<br>* abstract; figures * | 1,2,9, 10,13 | TECHNICAL FIELDS SEARCHED (Int.Cl.6)<br>E02B<br>E02F |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 21 July 1998 | De Coene, 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

EPO FORM 1503 03.82 (P04C01)