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(54) **CONSOLIDATION METHOD FOR SOIL LAYERS WITH LOW PERMEABILITY**

KONSOLIDIERUNGSVERFAHREN FÜR BODENSCHICHT MIT NIEDRIGER DURCHLÄSSIGKEIT

PROCEDE DE CONSOLIDATION DE COUCHES DE TERRAIN A FAIBLE PERMEABILITE

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Description

[0001] The invention relates to for consolidating a water-containing layer of soil with limited liquid permeability, for example a clay- or peat-containing layer, comprising:

- digging at least one trench or hole in the soil,
- bringing a pipe - connected to a filter element - in said trench, said pipe having an impermeable wall,
- filling the trench around said pipe with material having a good water permeability, and raising the ground water which has passed into the pipe via the filter to above ground level by means of a separate riser pipe which riser pipe is situated at least partially in said pipe.

[0002] A method of this nature is known from WO-A-98/02616.

[0003] It is usual to make weak ground consisting of peat or clay ready for building by arranging a layer of sand at ground level, so that the weak ground beneath it is compressed. Unless vertical drainpipes are fitted, this settling process may take a long time. By using drainpipes, the water can quickly be discharged to above ground level. This may require one or more drainpipes per square metre of ground surface. Even then, considerable time is still required to bring about the desired consolidation of the weak soil.

[0004] In the method described in the said WO-A-98/02616, a venturi pump is positioned near the bottom of the trenches. This pump is connected to ground level by means of a liquid feed line and a liquid discharge line. Groundwater and pump water are discharged simultaneously. Although this method works effectively, the costs are relatively high, since process water is required and the venture pump consumes relatively large amounts of power.

[0005] The object of the invention is to avoid these drawbacks, and to provide a method according to the preamble by which the raising of water may take place rapidly, the system also works if the depth of the water level is greater than 6 to 7 meter.

[0006] To this end the method mentioned in the preamble is characterized in that a non-return valve is connected to the filter on the pipe, and in that the said riser line is a suction line which is connected to a suction source positioned above or in the vicinity of ground level, and that the said pipe is placed in communication, via a line and a shut-off valve, with either a suction source or the atmosphere or a pressure source.

[0007] EP-A-329500, figures 4, 5 discloses a method of consolidating a water containing layer of soil with limited liquid permeability. A number of perforated drain pipes, having a diameter of approximately 50 mm, are positioned in the soil. The water discharge plastic pipe (diameter 4-8 mm) is applied inside each drain pipe. All water discharge pipes are connected to a flexible hose

which debouches into a suction source positioned above the ground level. A layer of permeable material (for instance sand) is applied on the soil and an other pipe, in connection with said suction source, debouches into the layer of permeable material. The lower end of the water discharges pipes is connected to a float controlled valve (not a non-return valve); in case of a water level in the water drain pipes above and underneath the float the valve will open and close respectively. By means of two water level detectors the system will work intermittently, that is to say causing underpressure in a top layer (laying on the permeable layer) and bringing water upwards through the water discharge pipe by suction.

[0008] In a particular configuration of the method according to the invention, the space inside the said pipe is divided into two chambers by a diaphragm, the first chamber being in communication, via a line, with means for intermittently placing the said chamber in communication with a suction source, the atmosphere or a pressure source, and the second chamber being connected to the said filter on the underside, via the said non-return valve, and being placed in communication with the suction line on the top side, via a non-return valve. The said diaphragm is preferably in the form of a bag, the interior of which forms the said second chamber.

[0009] In order to provide the possibility of removing or replacing the pipe belonging to the dewatering element without damage and of cleaning or inspecting the filter, it is possible, before the trenches or holes are filled with water-permeable material, for a drainage pipe to be arranged in the said trenches or holes and for the said water-collection pipe to be placed with the water inlet part in the said drainage pipe, in a removable and replaceable manner. The drainage pipe preferably comprises flexible material and has a part which projects approximately as far as or above ground level and a part which extends essentially along the length of the trench in the ground. The drainage pipe will be surrounded by filter material, as is customary.

[0010] It is known to surround an area of land which is to be consolidated with screen which is arranged in the soil and consists of a layer of clay which reaches as far as an impermeable layer of soil. A plastic sheet is usually added to the layer of clay. The advantage of a screen of this nature is that the lowered groundwater table does not extend beyond the limits of the area of land being consolidated, which could cause undesirable subsidence or could affect piled foundations.

[0011] By surrounding the area of land to be consolidated with a trench which is filled with water-permeable material, such as sand, and which is connected to a water source, for example a ditch, it is possible to provide a screen of this nature, which keeps the groundwater table outside the area of land at the same level, at much less expense.

[0012] In order to improve the raising efficiency further, a sheet may be placed over the top surface of the

trench or shaft which is filled with water-permeable material, it being possible to place the bottom surface of the said sheet in communication with a suction source via a line with a valve.

[0013] It should be noted that EP-A-0,608,928 describes a method for consolidating a layer of soil with limited liquid permeability, in which method vertical drainage pipes which are provided with perforations are inserted into the layer of soil with limited permeability, which drainage pipes are surrounded by filter membranes. A riser line, in the form of a suction line which is connected to a suction pump positioned above ground level, is fitted into the said drainage pipes. The bottom of the pipe is closed off by a cover or tight plug and a plug of expanded plastic material is arranged at a short distance from the top of the pipes. In an alternative embodiment, a line for supplying compressed air opens into the drainage pipes. In this known method, there are no trenches filled with sand or similar material dug in the soil. Furthermore, the drainage pipes are provided with perforations over their entire height, so that neither a filter at the bottom of the pipes nor a non-return valve are present. If sand-filled pipes were to be used, the method would not work in combination with the perforations in the pipes. The pressure reduction would then spread across the spaces between the grains of sand and, in the event of compressed air being blown in, this compressed air would disappear into the sand via the perforations. The absence of sand-filled trenches means that the flow of water into the pipes will be slight.

[0014] The invention will now be explained in more detail with reference to the figures which show several exemplary embodiments and in which:

Figure 1 shows a cross section perpendicular to a sand-filled trench which is arranged in the soil and which accommodates dewatering means and also has water-raising features positioned at ground level.

Figure 2 shows a cross section through the trench perpendicular to the cross section of Figure 1.

Figure 3 shows a second embodiment in cross section perpendicular to a sand-filled trench which is dug in the soil and has dewatering means.

Figure 4 shows a cross section in the longitudinal direction of a trench dug in an area of land which is to be consolidated, in a third alternative embodiment.

Figure 5 shows a cross section through the area of land which is to be consolidated, transverse to the trench in the embodiment in accordance with Figure 4.

[0015] In the embodiment in accordance with Figures 1 and 2, parallel trenches 1 are dug in the clay or peat soil at intervals of, for example, 2 to 3 metres. Only one of these trenches 1 is shown. The trenches are filled with sand or another water-permeable material. Also, the top

layer is replaced or covered by a layer of sand 2.

[0016] A pipe 3 is positioned in each trench 1, surrounded by the sand, with a filter 4 attached to its underside. A wall 5 with an opening which can be closed off by a non-return valve 6 is positioned between the filter 4 and the pipe 3. The remaining part of the pipe 3, runs optionally via a horizontal part (as shown in Figure 2), to above ground level and ends at an end piece 7.

[0017] A suction line 8 extends from a point which lies just above the non-return valve 6 to as far as the end piece 7, and from there, via an opening in the end piece 7, to a water collection tank 9.

[0018] A vacuum tank 10, in which the vacuum is automatically maintained within selected limits by a vacuum pump 11, is placed in communication with the suction line 8 via a line 12 with a shut-off/non-return valve 13 and via a line 14 with a drainage pump 15. If drainage pump 15 is not operating, line 14 is closed off.

[0019] The end piece 7 is in communication with the vacuum vessel 10 via line 16 with the shut-off valve 17 and line 18.

[0020] A manifold 19 is fitted in the line 16 below the shut-off valve 17, and a compressed-air line 20 with shut-off valve 21 and a line 22 which opens out into the outside air and has shut-off valve 23 are connected to this manifold 19.

[0021] The line 18 which is connected to the vacuum tank passes through to the bottom surface of a covering sheet 26 which is positioned above the layer of sand arranged on the layer of clay or peat. A shut-off valve 24 is arranged in the line 18. A shut-off valve 25 is positioned in the suction line 8 between the lines 12 and 14.

[0022] The installation operates as follows:

[0023] The normal groundwater level is indicated in Figure 1 by P. The shut-off valve 13 is open and the shut-off valve 17 is closed. The pump 11 generates a vacuum in the vacuum tank 10. The water present in the pipe 3 is sucked up via the suction line 8 and is discharged into the tank 9 via line 12 and the open valve 13, with the valve 25 in the closed position. The water falls to the level Q, the difference in height between the levels P and Q corresponding to the vacuum in the vacuum tank 10. If too much water still remains in the pipe 3, the water level in the pipe 3 can be lowered to the level R by allowing compressed air to flow into the pipe 3 via the open line 20, the shut-off valve 21 and the line 16. The excess pressure which is produced in the pipe 3 closes the non-return valve 6 and the remaining water in the pipe 3 is guided into the vacuum tank 10 via the suction line 8, the line 12 and the open shut-off valve 13. Obviously, the shut-off valve 25 is then closed.

[0024] As soon as the water level R is reached, air will pass through pipe 8 and the shut-off valve 13 is closed. Also, the supply of compressed air is stopped by closing the shut-off valve 21. In order to eliminate the excess pressure, the shut-off valve 23 is opened and then the shut-off valve 23 is closed again and the shut-off valve 17 is opened again, with the result that vacuum is drawn

into the pipe 3. Water which is sucked in via the filter 4 is admitted into the pipe 3 via the automatically opening non-return valve 6. As soon as the water level in the pipe 3 has reached a certain level, the abovementioned cycle is restarted. The water which is passed into the vacuum tank can be guided into the water collection tank 9, by means of the pump 15, via the line 14 and the last part of the suction line 8. Shut-off valve 25 is then closed.

[0025] The installation operates intermittently with a vacuum, at atmospheric pressure or above atmospheric pressure. There is no pump in the pipe 3. By using compressed air, the water depth which can be achieved in the trench 1 is in principle unlimited.

[0026] Figure 2 shows that the pipe 3 has a long horizontal section 3A. The non-return valve 6 is of flap design. This horizontal section forms a buffer.

[0027] By opening the shut-off valve 24, air is sucked out beneath the sheet 26. The result is that the pressure is reduced (for example by 6 metres water column) to as far as the bottom of the trench 1. The load on the subsoil is increased by approximately the same pressure, resulting in accelerated consolidation. The trench 1 will then be filled more quickly with water which is released from clay or peat soil by consolidation. In this process, there is a risk of the water level in the pipe 3 rising to above the level P, since a considerably increased load on the soil is involved. In order to prevent this excessive rise in the water level in the pipe 3, the liquid level in the pipe 3 can be lowered by sucking out water, for which purpose atmospheric air can be admitted into the pipe 3 via the shut-off valve 23 or compressed air can be admitted via the shut-off valve 21. As soon as the water level in the pipe has fallen back to the desired level, the pressure can be reduced by suction.

[0028] The possibility of the features described being used to suck out groundwater continuously instead of intermittently, specifically by reducing the water level in the pipe 3 to as far as the bottom end of the suction line 8, is not ruled out. This can be achieved by means of air leaking continuously via the shut-off valve 23. A mixture of water and air flows into the vacuum tank 10 via the suction line 8. In this case, the suction flow rate is dependent on the difference between the pressure in the trench 1 and the pressure in the vacuum tank 10. If the vacuum in the vacuum tank 10 were to amount to approximately 8 metres water column and the air pressure in the trench 1 were to be approximately 4 metres water column, only 4 metres water column then remains available for forcing the water upwards and overcoming the resistance of the water column. This is therefore likely to be relatively inefficient.

[0029] Moreover, there is a risk of only water being discharged, with the result that the suction process will stop as soon as the water column in the suction line 8 is sufficiently far above the level Q to correspond to the vacuum in the vacuum tank 10. The remedy for this is to briefly introduce compressed air in order to guide the

water column to the vacuum tank 10.

[0030] While groundwater is being sucked out to the vacuum tank 10 via the suction line 8, using atmospheric air flowing in via the valve 23 or compressed air being sucked in via the valve 21, it is necessary to prevent air from flowing into the vacuum tank 10. This is achieved by arranging a check valve 25 in the suction line 8, immediately downstream of line 12, in that part of the line 8 which leads to the tank 9 and makes it possible to discharge water to the tank 9. When the shut-off valve 13 is closed and the compressed air is admitted via the shut-off valve 21, the pipe 3 is emptied by being blown into the tank 9 via the line 8 without air flowing to the vacuum tank 10.

[0031] The system can function unmanned by automatically switching various shut-off valves and flaps within specific time intervals.

[0032] In an alternative embodiment, the pipe 3 together with the suction line 8 is installed in a plastic drain which is known per se and functions as a filter 4. An advantage of this embodiment is that components of the system according to the invention which lie in the soil can be retrieved and reused.

[0033] The embodiment in accordance with Figure 3 differs from the embodiment in accordance with Figures 1 and 2 in that that part of the suction line 8 which is situated in the pipe is replaced by an elongate diaphragm 30, which is connected to the filter 4 by means of non-return valve 6 and is connected to the suction line 8 via the non-return valve 31. It will be clear that by admitting compressed air into the pipe 3 the bag 30 is compressed, in order to force the water in the said bag upwards, while if a vacuum is generated in the pipe 3 the diaphragm bag walls will bulge outwards, thus generating a vacuum in the bag and allowing groundwater to flow into the bag 30 via filter 4.

[0034] As an alternative to a diaphragm bag, it is possible to make use of a diaphragm wall which is arranged in the pipe 3 and divides the chamber inside the pipe into two sub-chambers, one sub-chamber being in communication with the filter via the non-return valve 6 and a vacuum, atmospheric pressure or superatmospheric pressure being generated in the other sub-chamber.

[0035] As an alternative to sand-filled trenches 1 which are arranged next to and at a distance from one another, it is also possible to use sand-filled holes which are located at a distance from one another.

[0036] Figures 4 and 5 show in a more or less diagrammatic manner that a number of drainage trenches 1 have been dug, at intervals of, for example, 2 to 3 m, in an area of land which comprises a layer of soil with limited water permeability, such as peat or clay, and which is to be consolidated by settling, in which drainage trenches a water-collection hose 3 is placed, with a non-return valve 6 at its bottom end, followed by a filter which can filter water flowing in. As in the preceding embodiments, the other end 7 of the water collection hose 3 extends to above ground level, and in the manner de-

scribed above a line 16 is connected to the end 7, which line may be connected, via shut-off valves, to a suction line, a compressed-air line or a line which opens out to the atmosphere.

[0037] A water suction hose 8, which is connected in the manner described above to a vacuum tank (not shown) and which opens out above a water collection tank (not shown), is situated in the water collection hose 3.

[0038] The water collection hose 3 is arranged in a flexible drainage pipe 32 which is positioned in the trench 1 before this trench is filled with sand or another water-permeable material. The drainage pipe 32 will have a filter material, such as coir or a nonwoven, wound around it.

[0039] Usually, the flexible drainage pipes 32 will extend over substantially the entire length of the trenches. A sheet 26 may be laid over the surface of the soil to be consolidated.

[0040] From the sand fill, water flows into the trenches 1 via the filter material around the flexible drainage pipe and small holes formed in the wall of the drainage pipe, and then, from this drainage pipe, through the filter 4 and the non-return valve 6, into the water collection hose 3.

[0041] The suction hose 8 which is connected to a vacuum source is used to suck the water out of the hose 3 and guide it into a tank. The water level in the water collection hose 3 falls to a level which corresponds to the vacuum generated by the suction source.

[0042] The water level in the water collection pipe 3 can be lowered further by connecting the line 16 to a compressed-air source, with the valve 6 closed and the remaining water being discharged via the hose 8 by means of the excess pressure. As soon as the lowest water level has been reached (just below the bottom limit of the horizontal section of the water collection hose 3), the supply of compressed air is stopped and the hose 8 is again connected to the vacuum source. Water can be admitted back into the water collection hose 3 via the non-return valve 6. As soon as the water level in the hose has reached a certain level, the cycle is started again. Thus vacuum and compressed air are used intermittently. The possibility of using atmospheric pressure instead of compressed air is not ruled out.

[0043] The most important advantage of the system according to Figures 4 and 5 is that the water collection hose 3 with non-return valve 6 and any filter can easily be removed for inspection or cleaning or repair and, if necessary, can be replaced. Furthermore, the drainage capacity of the system with a continuous flexible drainage pipe over the length of the draining body of sand is many times greater than with the system according to Figures 1 to 3 inclusive.

[0044] In order to ensure that the lowered groundwater level is limited to the area to be consolidated, the said area is surrounded by a water-replacing wall 33, comprising a trench which is filled with sand or another

water-permeable material and is fed with water, for example by means of a make-up ditch 34. The groundwater level is indicated by dashed lines in Figure 2 and in the vicinity of the wall 33 rises steeply up to the water level in the ditch 34. There is no reduction in the groundwater level outside the area which is to be consolidated. There is no risk of subsidence or damage to piled foundations in the immediate vicinity of that area.

[0045] The advantage of the system described is that a low power consumption can be assumed and that no process water is required. Groundwater can be raised from depths in excess of approx. 8 m water column. Reaching the lowest water level in pipe 3 can be monitored by measuring the water discharged into the tank 9. Compressed-air facilities are inexpensive and the system can be fitted in plastic drains, resulting in a reduction in price.

Claims

1. Method for consolidating a water-containing layer of soil with limited liquid permeability, for example a clay- or peat-containing layer, comprising:

- digging at least one trench or hole in the soil,
- bringing a pipe (3) - connected to a filter element (4) - in said trench, said pipe having an impermeable wall,
- filling the trench around said pipe (3) with material having a good water permeability, and raising the ground water which has passed into the pipe (3) via the filter (4) to above ground level by means of a separate riser pipe (8; 8, 30) which riser pipe (8; 8, 30) is situated at least partially in said pipe (3),

characterized in

that a non-return valve (6) is connected to the filter (4) on the pipe (3),

that said riser pipe (8; 8, 30) is a suction pipe which is connected to a suction source (10, 11) positioned above or in the vicinity of ground level, and

that the said pipe (3) is placed in communication, via a line (16, 18, 22, 20) and a shut off valve (17, 23, 21) with either a suction source or the atmosphere or a pressure source.

2. Method according to Claim 1, **characterized in that** the said suction line has a connection (12), which can be shut off by a shut-off valve (13), to a suction source which is designed as a vacuum tank (10) connected to a vacuum pump (1), which vacuum tank is connected, via a line (14) with pump (15), to a line which opens out in or above a water collection tank (9).

3. Method according to Claim 1 or 2, **characterized**

in that the space inside the said pipe (3) is divided into two chambers by a diaphragm (30), the first chamber being in communication, via a line (16), with means for intermittently placing the said chamber in communication with a suction source (10), the atmosphere or a pressure source, and the second chamber being connected to the said filter (4) on the underside, via the said non-return valve (6), and being placed in communication with the suction line (8) on the top side, via a non-return valve (31).

4. Method according to Claim 3, **characterized in that** the said diaphragm (30) is in the form of a bag, the interior of which forms the said second chamber.

5. Method according to one of the preceding claims, **characterized in that**, before the trenches or holes (1) are filled with water-permeable material, a drainage pipe (32) is arranged in the said trenches or holes and the said water-collection pipe (3) is placed with the water inlet in the said drainage pipe (32), in a removable and replaceable manner.

6. Method according to Claim 5, **characterized in that** the drainage pipe (32) comprises flexible material.

7. Method according to Claim 5 or 6, **characterized in that** the drainage pipe (32) has a part which projects approximately as far as or above ground level and a part which extends essentially along the length of the trench in the ground.

8. Method according to one of Claims 5 to 7, **characterized in that** the drainage pipe (32) is surrounded with filter material.

9. Method according to one of the preceding claims, **characterized in that** the layer to be consolidated is surrounded by a trench (33) which is filled with water-permeable material and is connected to a water source, such as a ditch (34).

10. Method according to one of the preceding claims, **characterized in that** a sheet (26) is placed over the top surface of the trench or hole (1) which is filled with water-permeable material, it being possible to place the bottom surface of the said sheet in communication with a suction source (10) via a line (18) with valve (24).

Patentansprüche

1. Verfahren zum Konsolidieren einer wasserhaltigen Erdschicht mit begrenzter Flüssigkeitspermeabilität, beispielsweise einer lehm- oder torfhaltigen Schicht, umfassend:

- Graben mindestens eines Grabens oder eines Loches in die Erde,
- Einbringen eines an ein Filterelement (4) angeschlossenen Rohrs (3) in den Graben, wobei das Rohr eine undurchlässige Wand aufweist,
- Füllen des Grabens um das Rohr (3) herum mit einem Material mit einer guten Wasserpermeabilität und Anheben des in das Rohr (3) über den Filter (4) eingedrungenen Grundwassers mit Hilfe eines separaten Steigrohrs (8; 8, 30) über Bodenhöhe, wobei das Steigrohr (8; 8, 30) mindestens teilweise in dem Rohr (3) angeordnet ist,

dadurch gekennzeichnet,

daß mit dem Filter (4) an dem Rohr (3) ein Rückschlagventil (6) verbunden ist,

daß das Steigrohr (8; 8, 30) ein Saugrohr ist, das mit einer über Bodenhöhe oder in ihrer Nähe positionierten Saugquelle (10, 11) verbunden ist, und **daß** das Rohr (3) über eine Leitung (16, 18, 22, 20) und ein Absperrventil (17, 23, 21) in Verbindung mit entweder einer Saugquelle oder der Atmosphäre oder einer Druckquelle angeordnet ist.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, daß** die Saugleitung eine von einem Absperrventil (13) absperrbare Verbindung (12) mit einer Saugquelle aufweist, die als ein an eine Vakuumpumpe (1) angeschlossener Vakuumtank (10) ausgelegt ist, wobei der Vakuumtank über eine Leitung (14) mit der Pumpe (15) mit einer Leitung verbunden ist, die in oder über einem Wassersammeltank (9) mündet.

3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, daß** der Raum in dem Rohr (3) durch eine Membran (30) in zwei Kammern unterteilt wird, wobei die erste Kammer über eine Leitung (16) mit Mitteln in Verbindung steht, die die Kammer mit Unterbrechungen mit einer Saugquelle (10), der Atmosphäre oder einer Druckquelle in Verbindung bringen und die zweite Kammer über das Rückschlagventil (6) mit dem Filter (4) auf der Unterseite verbunden und über ein Rückschlagventil (31) in Verbindung mit der Saugleitung (8) auf der Oberseite gebracht ist.

4. Verfahren nach Anspruch 3, **dadurch gekennzeichnet, daß** die Membran (30) in Form eines Beutels vorliegt, dessen Inneres die zweite Kammer bildet.

5. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** vor dem Füllen der Gräben oder Löcher (1) mit wasserdurchlässigem Material in den Gräben oder Löchern ein Drainagerohr (32) angeordnet wird und das Wass-

ersammelrohr (3) auf entfernbare und ersetzbare Weise mit dem Wassereinlaß in dem Drainagerohr (32) angeordnet wird.

6. Verfahren nach Anspruch 5, **dadurch gekennzeichnet, daß** das Drainagerohr (32) aus flexiblem Material besteht. 5
7. Verfahren nach Anspruch 5 oder 6, **dadurch gekennzeichnet, daß** das Drainagerohr (32) einen Teil, der ungefähr bis oder über Bodenhöhe vorsteht, und einen Teil, der sich im wesentlichen entlang der Länge des Grabens in dem Boden erstreckt, aufweist. 10
8. Verfahren nach Anspruch 5 bis 7, **dadurch gekennzeichnet, daß** das Drainagerohr (32) von Filtermaterial umgeben ist. 15
9. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** die zu konsolidierende Schicht von einem Graben (33) umgeben ist, der mit wasserdurchlässigem Material gefüllt und mit einer Wasserquelle, wie etwa einem Entwässerungsgraben (34), verbunden ist. 20 25
10. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** über die Oberfläche des mit wasserdurchlässigem Material gefüllten Grabens oder Lochs (1) eine Folie (26) gelegt wird, wobei es möglich ist, die Unterseite der Folie über eine Leitung (18) mit einem Ventil (24) in Verbindung mit einer Saugquelle (10) zu bringen. 30

Revendications

1. Procédé de consolidation d'une couche de sol contenant de l'eau, possédant une perméabilité limitée aux liquides, par exemple une couche contenant de l'argile ou de la tourbe, comprenant le fait de : 40
 - creuser au moins une tranchée ou un trou dans le sol,
 - amener un tuyau (3) - relié à un élément de filtration (4) - dans ladite tranchée, ledit tuyau possédant une paroi imperméable,
 - remplir la tranchée autour dudit tuyau (3) avec une matière possédant une bonne perméabilité à l'eau, et faire monter l'eau souterraine qui est passée dans le tuyau (3) via le filtre (4) jusqu'au-dessus du niveau du sol à l'aide d'un tuyau montant séparé (8 ; 8, 30), ledit tuyau montant (8 ; 8, 30) étant situé au moins en partie dans ledit tuyau (3), 50

caractérisé

en ce qu'une soupape de non-retour (6) est reliée

au filtre (4) sur le tuyau (3),

en ce que ledit tuyau montant (8 ; 8, 30) est un tuyau d'aspiration qui est relié à une source d'aspiration (10, 11) positionnée au-dessus ou à proximité du niveau du sol, et

en ce que ledit tuyau (3) est mis en communication, via un conduit (16, 18, 22, 21) et via une soupape d'arrêt (17, 23, 21), soit avec une source d'aspiration, soit avec l'atmosphère ou avec une source de pression.

2. Procédé selon la revendication 1, **caractérisé en ce que** ledit conduit d'aspiration possède un raccord (12), qui peut être obturé par une soupape d'arrêt (13), à une source d'aspiration qui est conçue sous la forme d'une cuve à vide (10) reliée à une pompe à vide (1), ladite cuve à vide étant reliée, via un conduit (14) comprenant une pompe (15), à un conduit qui s'ouvre dans ou au-dessus d'un réservoir de récolte d'eau (9). 15
3. Procédé selon la revendication 1 ou 2, **caractérisé en ce que** l'espace à l'intérieur dudit tuyau (3) est subdivisé en deux chambres par un diaphragme (30), la première chambre étant mise en communication, via un conduit (16), avec un moyen pour placer par intermittence ladite chambre en communication avec une source d'aspiration (10), avec l'atmosphère ou avec une source de pression, et la deuxième chambre étant reliée audit filtre (4) dans sa partie inférieure, via ladite soupape de non-retour (6), et étant mise en communication avec le conduit d'aspiration (8) dans sa partie supérieure, via une soupape de non-retour (31). 25 30
4. Procédé selon la revendication 3, **caractérisé en ce que** ledit diaphragme (30) se présente sous la forme d'un sac dont l'intérieur forme ladite deuxième chambre. 35
5. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que**, avant de remplir les tranchées ou les trous (1) avec une matière perméable à l'eau, on arrange un tuyau de drainage (32) dans lesdites tranchées ou dans lesdits trous et on place ledit tuyau de récolte d'eau (3) avec l'entrée d'eau dans ledit tuyau de drainage (32), d'une manière amovible et remplaçable.
6. Procédé selon la revendication 5, **caractérisé en ce que** le tuyau de drainage (32) comprend une matière flexible.
7. Procédé selon la revendication 5 ou 6, **caractérisé en ce que** le tuyau de drainage (32) possède une partie qui fait saillie approximativement jusqu'au niveau du sol ou au-dessus de ce dernier et une partie qui s'étend essentiellement sur toute la longueur de

la tranchée dans le sol.

8. Procédé selon l'une quelconque des revendications 5 à 7, **caractérisé en ce que** le tuyau de drainage (32) est entouré d'une matière filtrante. 5
9. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la couche qui doit être consolidée est entourée par une tranchée (33) qui est remplie avec une matière perméable à l'eau et est reliée à une source d'eau telle qu'une rigole (34). 10
10. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'on** place une feuille (26) par-dessus la surface supérieure de la tranchée ou du trou (1) qui est rempli avec une matière perméable à l'eau, en permettant de mettre la surface inférieure de ladite feuille en communication avec une source d'aspiration (10) via un conduit (18) comprenant une soupape (24). 15 20

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fig-1

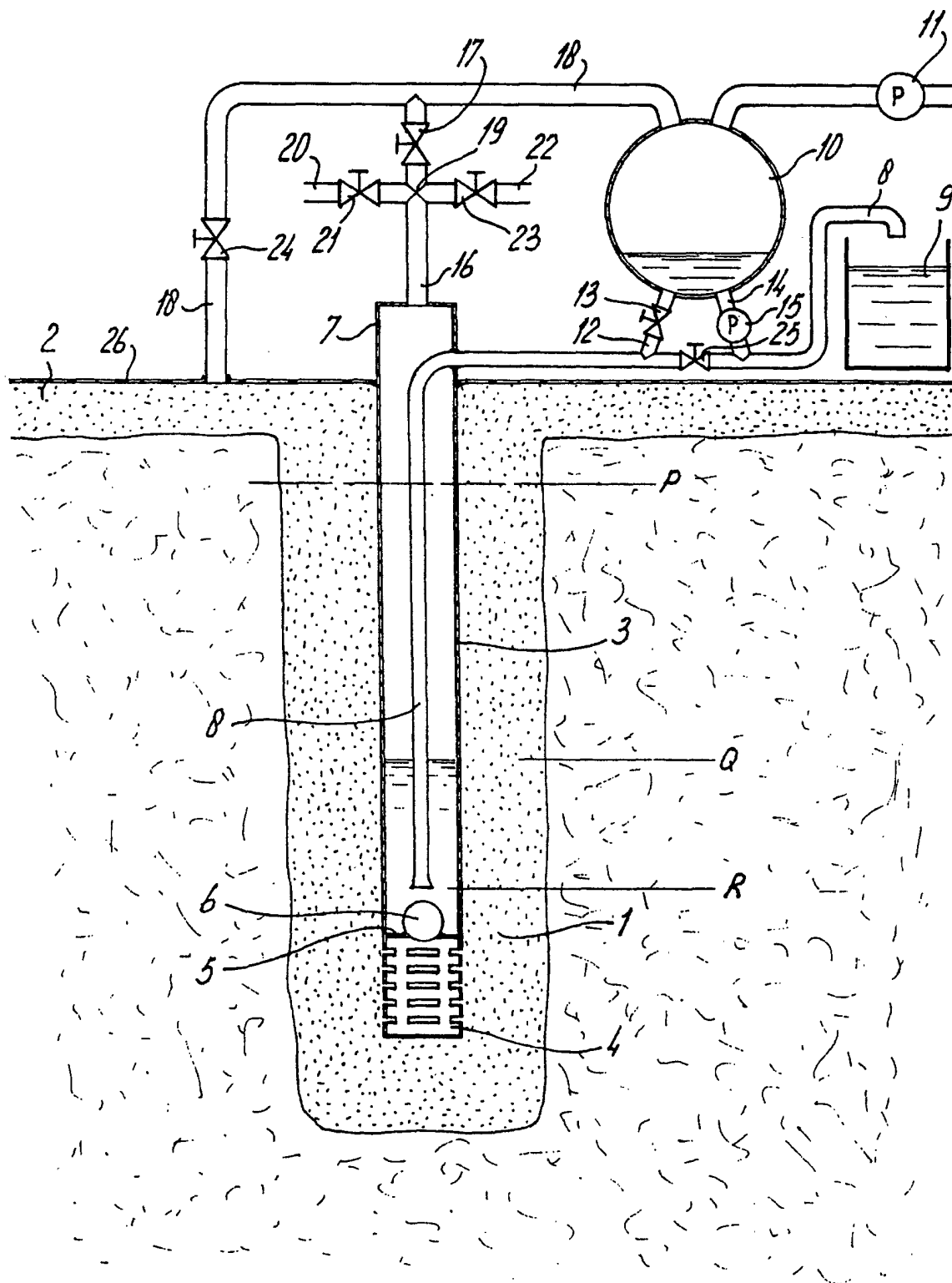


fig-2

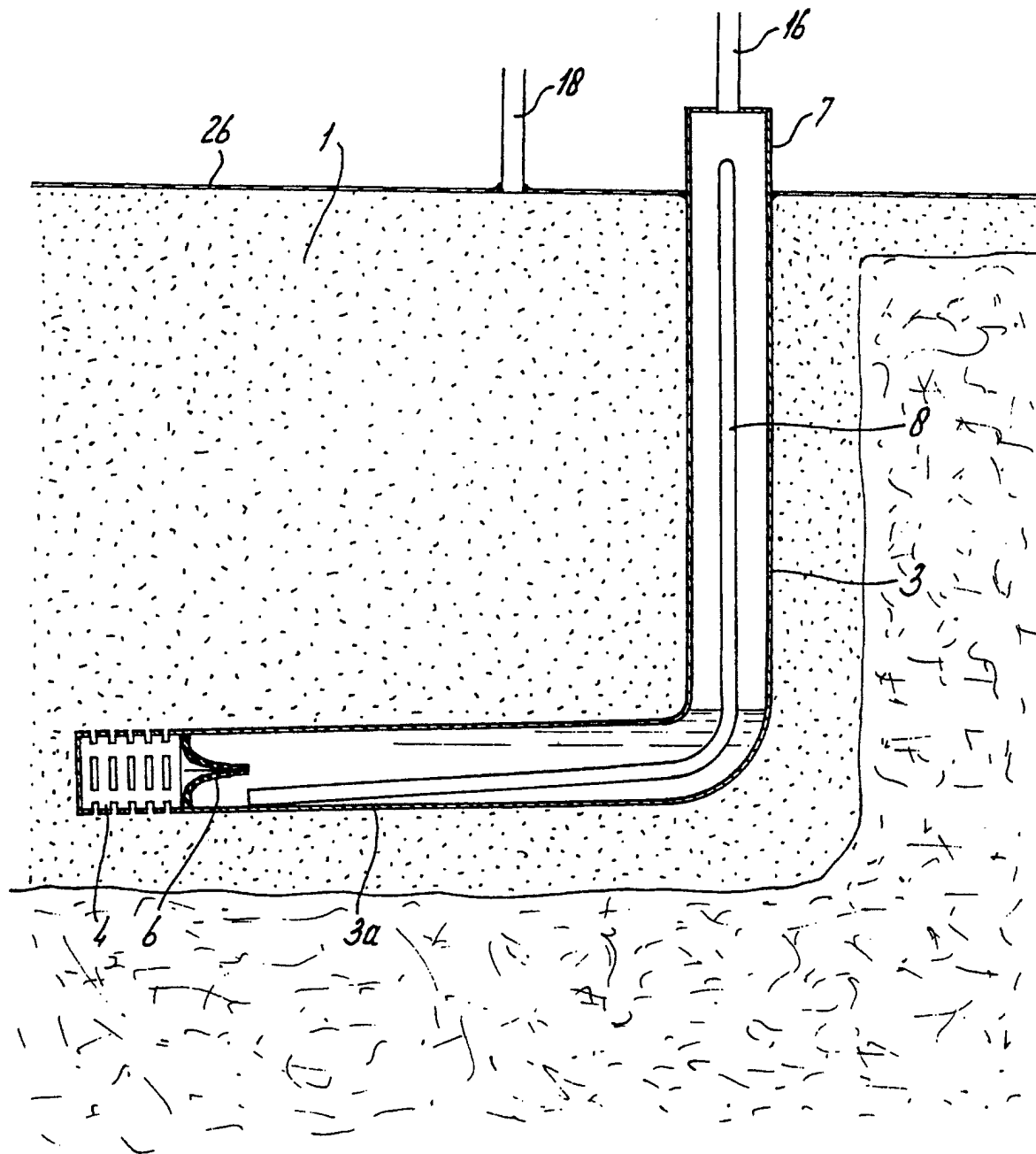


fig-3

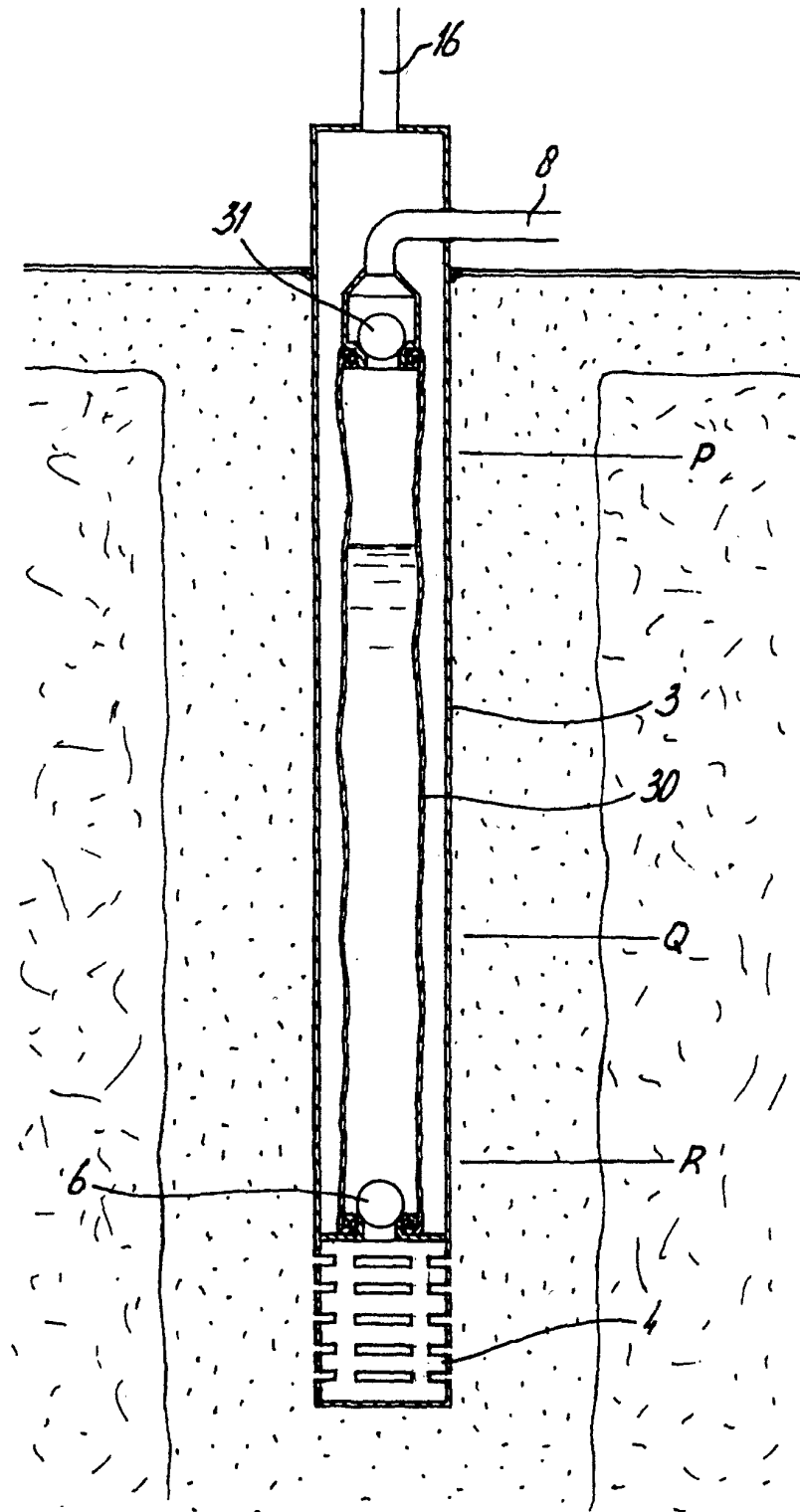


fig-4

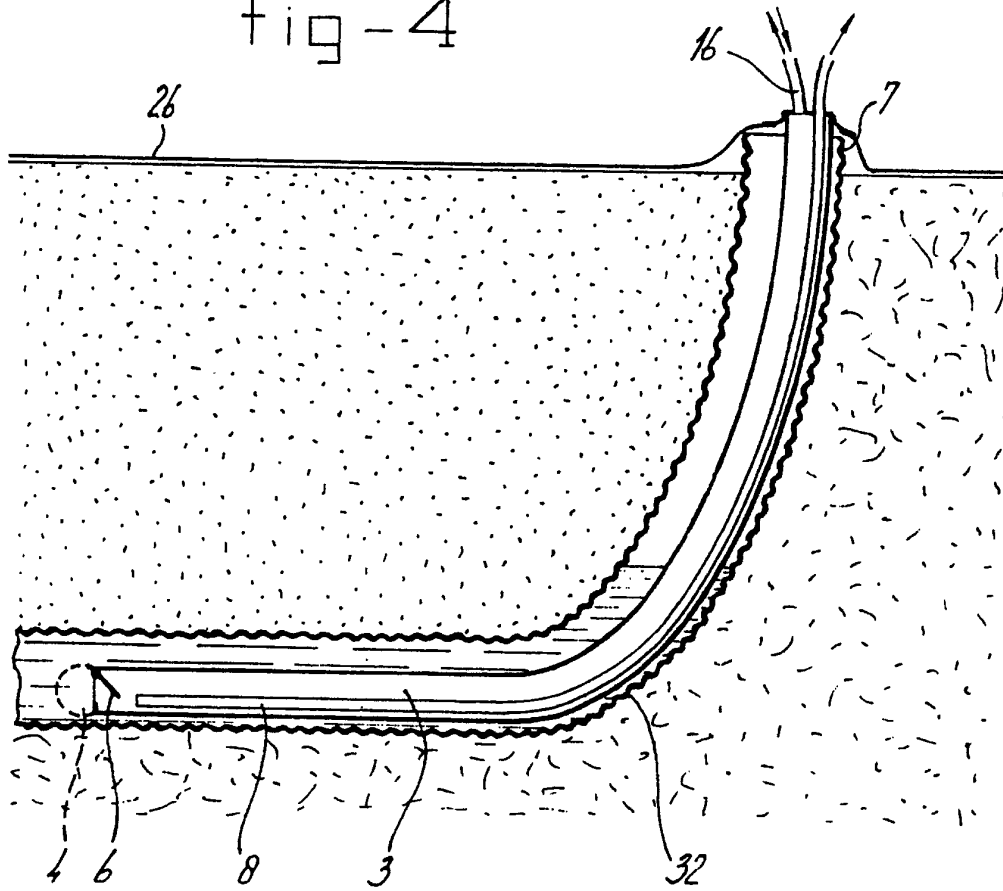


fig-5

