

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
15 January 2009 (15.01.2009)

PCT

(10) International Publication Number
WO 2009/007760 A1

(51) International Patent Classification:

B09C 1/06 (2006.01) **E03B 3/11** (2006.01)
E02D 7/02 (2006.01) **F16L 1/028** (2006.01)

(21) International Application Number:

PCT/HU2008/000079

(22) International Filing Date: 4 July 2008 (04.07.2008)

(25) Filing Language: Hungarian

(26) Publication Language: English

(30) Priority Data:

P0700466 6 July 2007 (06.07.2007) HU

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(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(54) Title: METHOD FOR INCREASING THE EFFECTIVENESS OF WELLS, AND PRIMARILY OF EQUIPMENT FOR SOIL AND GROUNDWATER TREATMENT

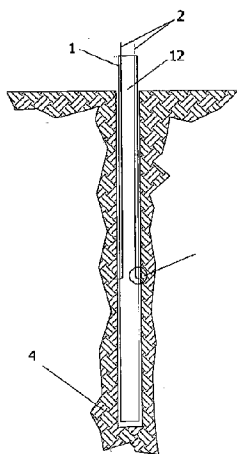


Fig 1

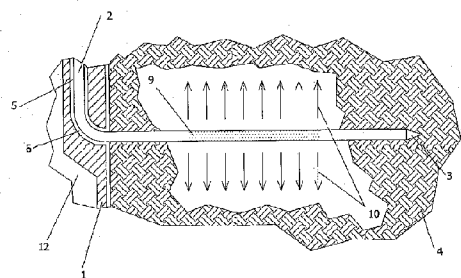


Fig 4

(57) Abstract: The object of the invention is a group of methods for introducing small-diameter drainage pipes (2) into the ground in a given depth in radial directions starting from vertically arranged engineering structures (wells, soil penetrating lances, etc.) applied for soil and groundwater treatment, or for groundwater extraction or injection, said engineering structures being utilised as supporting structural elements (1). The methods are essentially characterised by that each drainage pipe (2) has a head portion (3) adapted for facilitating the insertion of the drainage pipe (2) into the targeted ground region (4), and by that the supporting structural element (1) comprises guide ducts (5) for guiding the drainage pipes (2), each duct having an arced section (6) guiding the drainage pipes (2) towards the ground. A given portion of the drainage pipes (2) thus introduced into the ground region (4) has perforations (9) or is otherwise made permeable, permitting that liquids or gases fed into the drainage pipes (2) may enter into (10) the soil of the ground region (4) through the permeable section. In case the drainage pipes are put under vacuum, liquids or gases may be extracted from the ground region (4) through the permeable section.

**Method for increasing the effectiveness of wells, and primarily of
equipments for soil and groundwater treatment**

The object of the invention is a group of methods, structures, and engineering solutions, that make improvements on existing point-type, usually vertically arranged engineering structures, applied for soil and groundwater treatment, or for groundwater extraction or injection (wells, soil penetrating lances, etc.) in the field of soil and groundwater treatment. With the application of the methods small-diameter drainage pipes may be set into the ground in a given depth, in radial directions, thus the affected zone of the original solution could be enlarged, and/or the applicability of the original solution could be increased, and/or the original solution may be able to combine with other applications.

There are many in-situ technologies known nowadays for remedy soil and groundwater contamination. Most of these conventionally applied solutions aim cost-effective soil and groundwater treating by minimizing the mass movement. For the sake of cost reduction, minimizing the amount of moved soil is a priority. Therefore, we usually aim at solving the problem deep down in the ground, directly in the given depth, where the contamination is located. Existing physical, chemical, or biological methods, and methods produced by the combination of these, are mainly based on line-type and surface-type (trench drains, drain pipes, surface drains, etc.) or point-type (wells, lances, etc.) structural elements. The core of the drain-based techniques is that a trench is formed in the ground region to be treated, wherein a permeabilized (usually perforated) pipe (drainage-tube, ground-pipe) is laid in a porous bed (mostly sand-, sandy gravel, or gravel bed). In that way this combination would become applicable for collecting the groundwater, swallow down the technically manipulated water, aerating the soil mass, or injecting bacterium cultures, nutritify and aerating them. Such a solution is described in patent application P9200430 (publication number: 64438). There are also types of excavations, that doesn't contain drain-tubes, or drain-pipes, only a highly porous trench, which is providing the necessary drainage function. The main advantage of these solutions is their large affected zone, which results a quick and effective operation. A major disadvantage is, however, that these solutions require moving large amounts of soil, and also require intermediates

(e.g. gravel) in great quantities. So therefore they are expensive technologies, and also they are often not suitable for application in built-up areas. Point-type solutions are based on a tubular device (casing pipe of a drilled well, or soil penetrating lance, etc.), what is made permeable (usually by slotting), and is inserted into the ground (by drilling, forcing down, etc.). These devices are also suitable for collecting groundwater, for swallowing the handled water (reinjection), aerating the soil mass, or injecting bacterium cultures, nutritify and aerating them. Because they involve moving significantly smaller amounts of soil, point-type systems are much cheaper, then their line- or surface-type counterparts. Due to their point-type nature, they may be successfully applied in densely built-up areas. However, they also have disadvantages. As they affected zone is highly depend of the characteristics of the aimed soil mass, so they often have to be installed with a relatively high density, which reduces the cost-efficiency. The application of the point-type devices is further limited, in the case of soil- and groundwater treatment techniques demanding aeration, by the so-called "cone effect", which causes the fall of the aeration's affected zone.

Another problem is the treatment of regions located under larger buildings. Often those situations are not treatable with any of the existing technologies. Although there exist a subtype of the lance-based methods, where lances are inserted with angle instead of vertically, but it requires pits, or a large trench, and special equipment, which makes the method also expensive.

Utilizing the present invention, the aims of raising the efficiency of the point-type technologies, like the characteristic of the line-typed method's affected zone may be realized. With the application of specific implementations of the invention, multiple phases of operation could be applied for groundwater utilizing the same engineer structure. For instance, the same engineering structure may be applied for groundwater extraction, and the desiccation of the treaded water.

Details of the invention will now be explained referring by the attached schematic drawings, where

Fig. 1 is the schematic view of the system installed in the ground, before inserting a drainage pipes into the target zone.

Fig. 2 shows in greater detail the region around the exit point of the drainage pipe shown in fig. 1.

Fig. 3 shows the advance of the drainage pipe in the ground.

Fig. 4 illustrates how the positioned drainage pipe is used for injecting substances into the ground.

Fig. 5 illustrates how the positioned drainage pipe is used with vacuum.

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The invention is based on improving the existing, basically used casing pipes, soil penetrating lances, and other fixed-structure vertical elements utilised as supporting structural elements 1 in such a manner that they include longitudinal ducts 5 that are adapted for guiding small-diameter drainage pipes 2. The ducts are arranged such, that at a predetermined point of the supporting structural element 1 that corresponds to the depth of the region to be treated, an arced section 6 curving towards the outer surface of the supporting structure element 1 is disposed to prevent a curve break. The small-diameter drainage pipes 2 move forward in a vertical direction in the ducts 5 under a force applied on the surface. When they reach the arced sections 6 they change direction without breaking and continue moving in a horizontal direction 8 parallel with the radius of the supporting structural element 1. As the drainage pipes 2 are moved further forward they move away from the supporting structural element 1 and enter the surrounding region 4 (soil).

Penetrating into the surrounding region 4 (soil) is subserved primarily by the configuration of the head portion 3 of the drainage pipes 2 chosen with respect to the applied pipe insertion technology (pipe jacking, drilling, pipe jacking with flushing, etc.) A given section of the wall of the properly positioned drainage pipes comprises perforations 9 or is otherwise made permeable, providing that the liquid or gas fed under pressure into the drainage pipe 2 may be introduced into the surrounding region 4, or liquid or gas may be extracted 11 from the surrounding region 4 through the drainage pipes 2 with the application of vacuum.

In case it is permitted by the configuration of the supporting structural element 1, the inner space 12 thereof may be utilised for installing instruments for measure, for water extraction, or for other processes.

The second way of implementing the invention can be the so called "drilled microdrain" according to Claim 3. According to this implementation the entire surface of the small-diameter drainage pipe and/or a portion or portions thereof

comprise a spirally arranged blade. In this case the drainage pipe is urged forward by the spiral blade as the pipe is rotated in a given direction in the ground.

Utilising this way of implementing the method smaller inhomogeneities of the soil (pebbles, clay lumps) present in the ground region may be bypassed.

5 The third way of implementing the inventive method can be the so-called "drilled, jacked microdrain" according to Claim 6 (this is essentially the combination of the two previous methods). The head portion of the drainage pipe has a conical configuration to reduce head point resistance. The surface of the drainage pipe comprises a high-pitch spiral blade, so the application of a pressuring force on the
10 pipe will result in a slight rotating movement in the ground, which under certain circumstances provides easier penetration in the ground.

The fourth possible way of implementing the invention is the so-called "jacked microdrain with water flushed drill bit" according to Claims 4, 5. In accordance with Claim 4 the head portion of the drainage pipe comprises bores
15 directed forward and in other necessary directions, through this bores high-pressure water may be introduced into the surrounding soil region. The flushing water washes out, dislodges or slurries the soil in front of the drainage pipe, and the drainage pipe may easily be inserted into the dislodged soil zone thus produced. By applying continuous water flushing, the drainage pipe can be
20 positioned in the desired region. After the pipe has been positioned as desired, the valve unit should be activated according to Claim 5, for instance by closing the flush bores at the head portion of the drainage pipe, with a ball introduced therein and producing a check valve in the noise-pipe. As a result, flushing water fed to the drainage pipe will enter the targeted region primarily not through the head
25 portion but through the perforations in the wall of the drainage pipe.

Of course, in addition to the exemplary implementations described here a number of other applications are possible. Serial production of parts required for the different realizations of the invention can be achieved utilising known materials. Dimensioning/sizing rules for the different types may be determined
30 experimentally, and design reference brochures for implementing the invention may also be easily produced. The on-site application of different implementations of the invention is based on existing technology that may be improved and complemented to better suit the application of the invention. Industrial applicability

of the invention does not pose any specific problems.

As regards the advantages of introducing the inventive method to market it should be pointed out that the invention may bring about changes mainly in the field of environmental technology, but at present it is difficult to esteem its direct and indirect effects. However, some changes can be foreseen to greater or lesser extent.

Recirculation groundwater remediation techniques may benefit from the addition of a relatively simple cleaned water recirculation system that helps mitigate the adverse effects of water extraction and may even replace conventional desiccation methods. An equally important consideration could be that with the application of the invention cleaned groundwater can be reinjected in the immediate vicinity of the target remediation zone.

A new method may thus be added to the group of soil leaching and soil aeration techniques utilised for in situ soil remediation methods. In certain cases, trench type drains (that require a huge amount of construction work) may become unnecessary and methods involving surface spraying techniques may also find a new alternative. Cleaning fluids and remediated groundwater utilised for leaching may also be injected directly into the treated zone, which increases the efficacy of soil remediation and potentially reduces the amount of chemicals used.

With the application of the inventive method, the breeding stock of bacteria applied for the bioremediation of soil and groundwater may be introduced more effectively into to the region to be treated. Nutrient feeding and aeration can also become more efficient. To some extent the cone effect that occurs related to the aeration of wells and lances may be mitigated.

Contaminated regions located under buildings, pavements, and other engineering structures in built-up areas may become accessible to a certain extent, shortening remediation time or making remediation possible on sites hitherto inaccessible. The invention may become a significant alternative solution in densely built areas, as it is expected to be feasible to apply the inventive method in constricted regions.

In sum, the inventive method will likely become an alternative of currently applied solutions, and in many cases it will replace more costly and/or less effective methods.

Claims

1. Method based on drainage pipe technology combined with well casing pipes, soil penetrating lances and other fixed-structure ground and groundwater treatment devices, and possibly groundwater extraction devices utilised as supporting structural elements, characterised by that small-diameter, flexible drainage pipes (2) can be introduced, under a force applied on the surface, into a ground region (4) located further away from a supporting structural element (1) with the help of said supporting element (1) that has guide ducts (5) comprising an arced section (5), where said drainage pipes (2) are guided from vertical-direction movement to a horizontal-direction movement as they are being introduced into said ground region (4), and where said drainage pipes (2) have mechanical characteristics corresponding to soil conditions, with the drainage pipes (2) having a point or other head portion (3) adapted for penetrating soil and also have perforations (9) or are otherwise made permeable; and by that the two- or three-phase zone (soil, groundwater, soil air) located in the vicinity of the drainage pipes can be treated through the drainage pipes and gas (gas mixture, vapour) or liquid (solution, mixture, suspension, etc.) can be introduced (10) to or extracted (11) from said region.

2. The method according to Claim 1, characterised by that the drainage pipes are introduced into the ground through the supporting structural element by mechanical, pneumatic, or other pipe jacking.

3. The method according to Claim 1, characterised by that the drainage pipes are introduced into the ground through the supporting structural element by providing a special configuration to the head portion or the entire outer surface of the drainage pipes and by means of rotating movement.

4. The method according to Claim 1, characterised by that the drainage pipes are introduced into the ground through the supporting structural element with the help of liquid flushing and/or gas flushing.

5. The method according to Claim 4, characterised by that a valve portion is disposed in the flushing head adapted for helping the advance of the drainage pipe (2) in the ground or in other elements of the flushing method, where the valve portion may be closed after the drainage pipe has been positioned as desired, such that the perforated section of the drainage pipe can be better utilised.

6. The method according to Claim 1, characterised by that the drainage pipes are introduced into the ground through the supporting structural element by combining the methods of Claim 2 and/or Claim 3 and/or Claim 4 and/or Claim 5.

7. The method according to Claim 1, characterised by that the drainage pipes are introduced into the ground through the supporting structural element by other means.

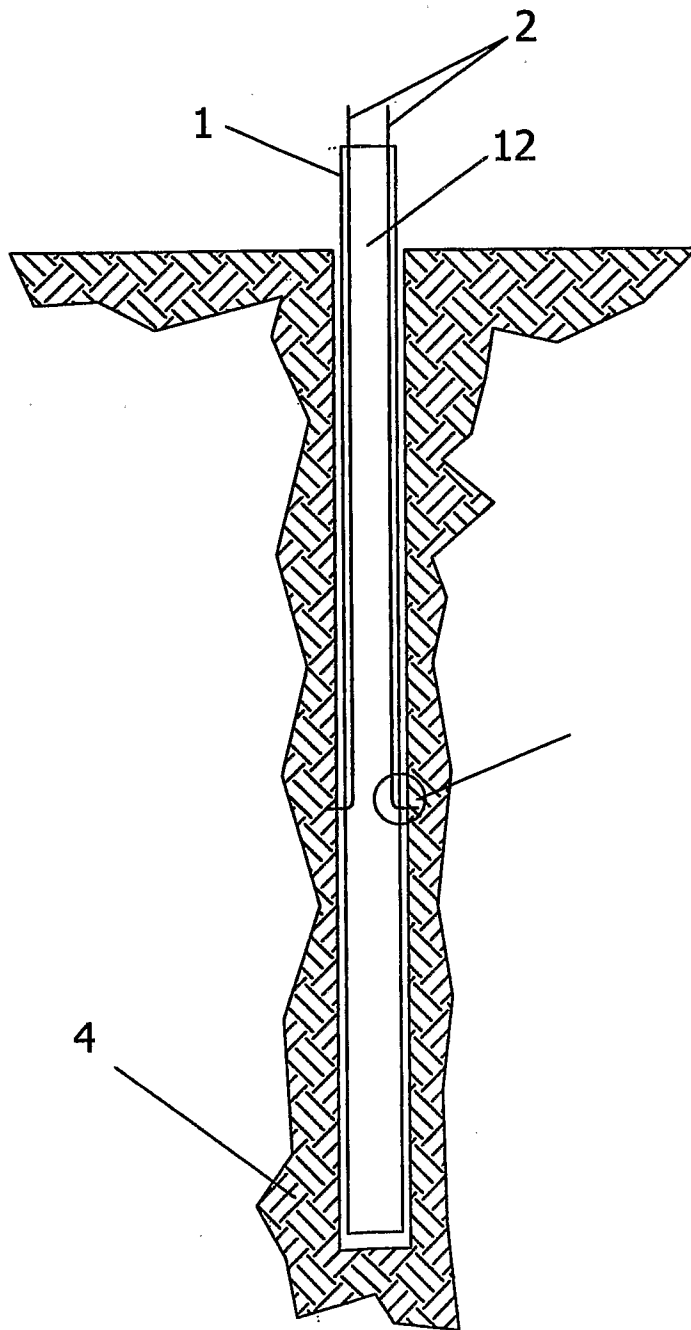


Fig 1

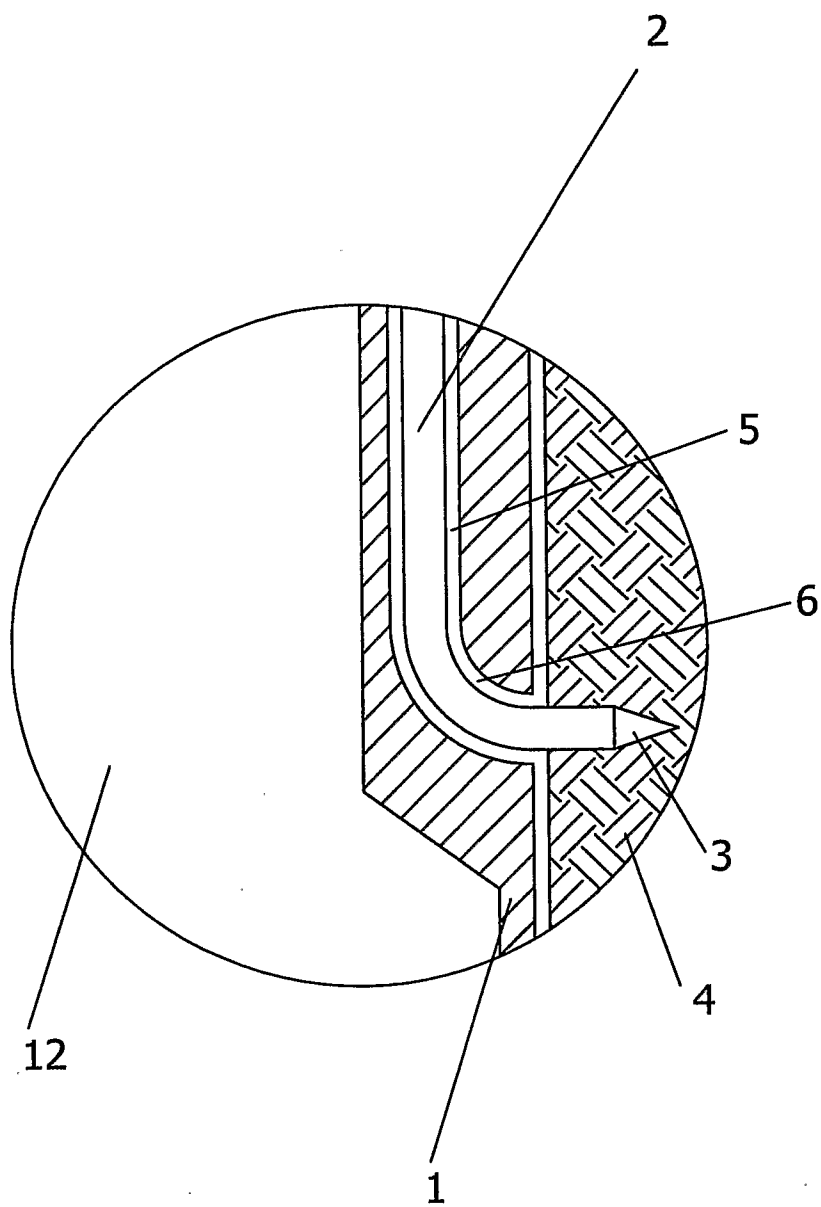


Fig 2

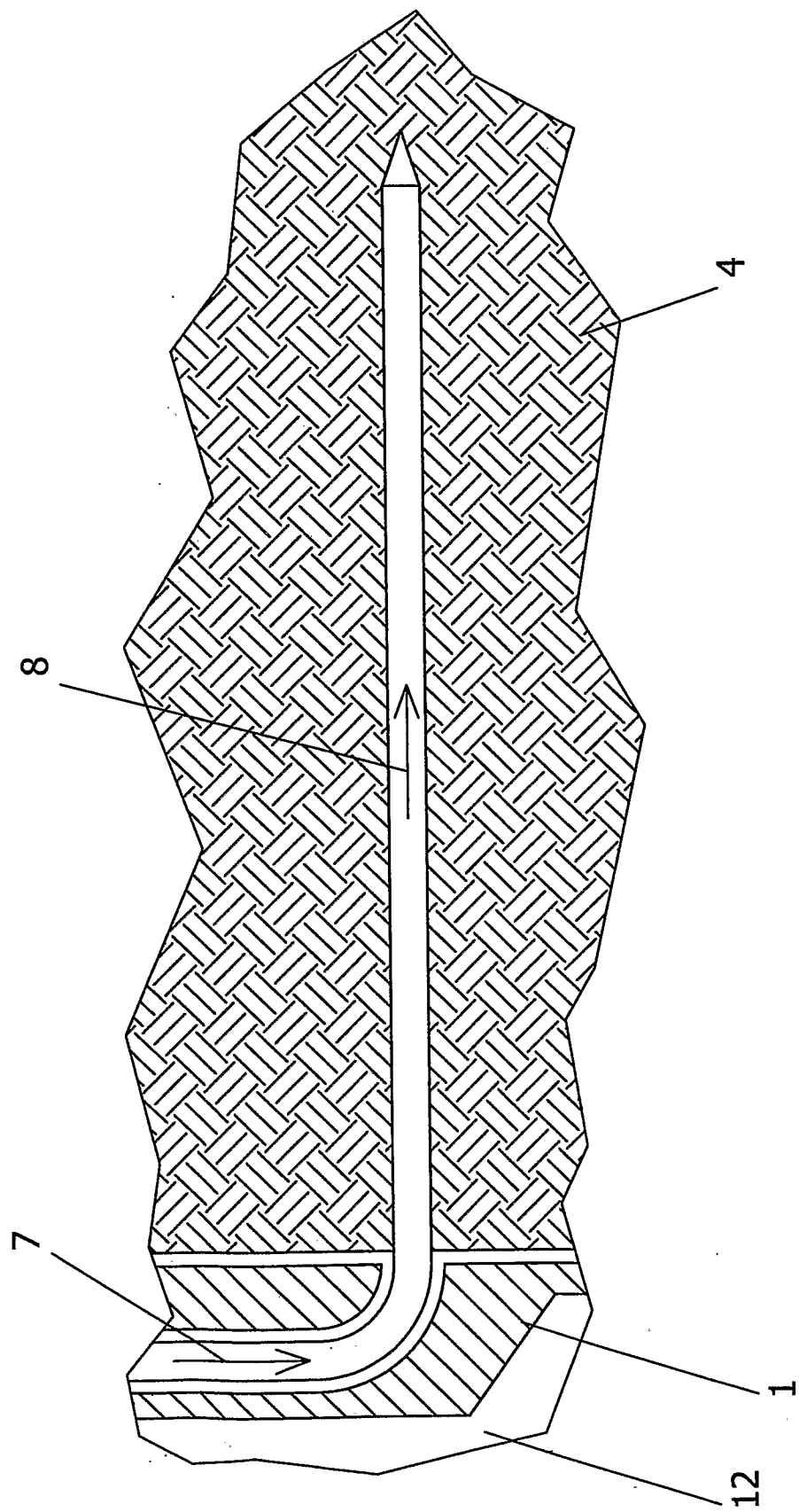


Fig 3

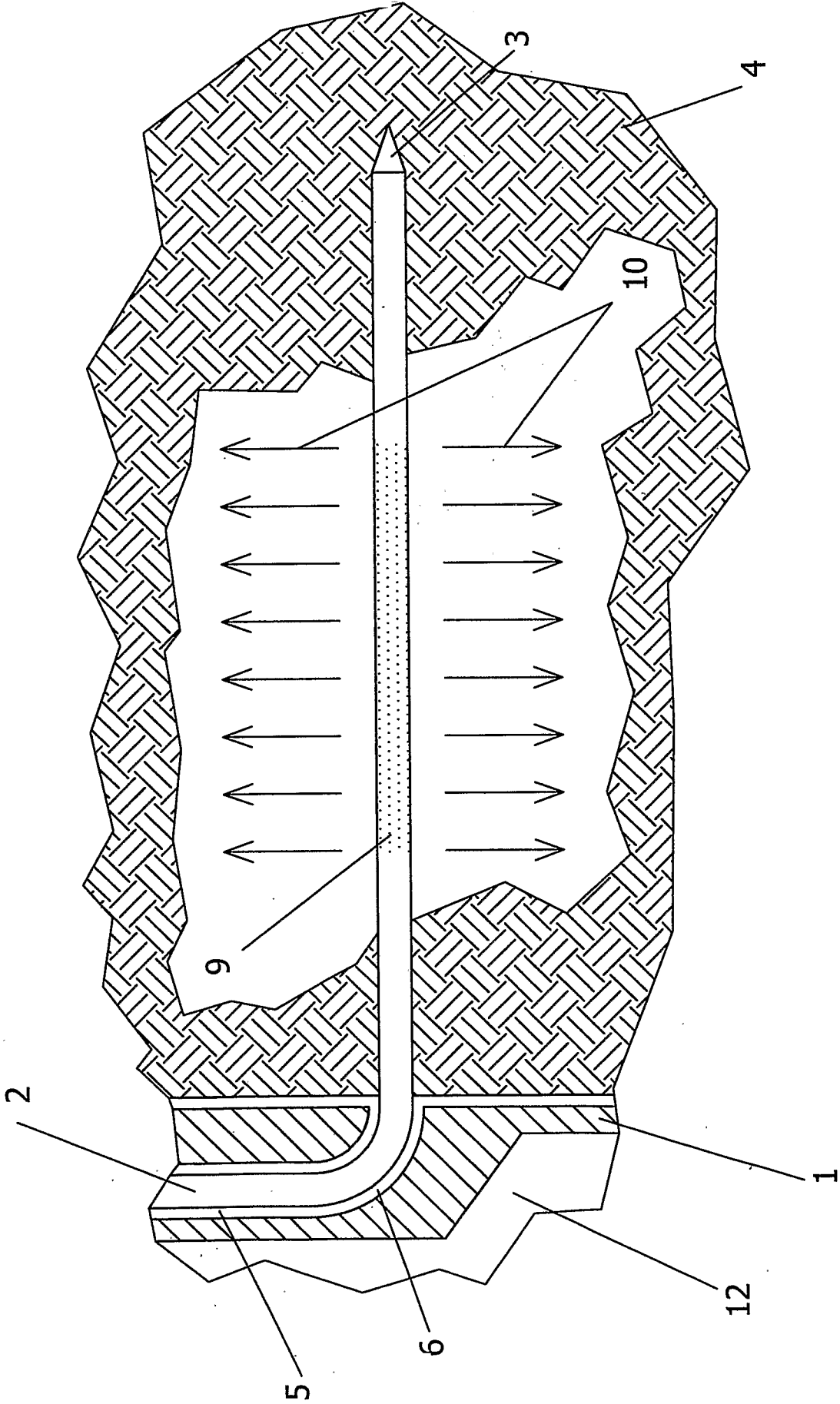


Fig 4

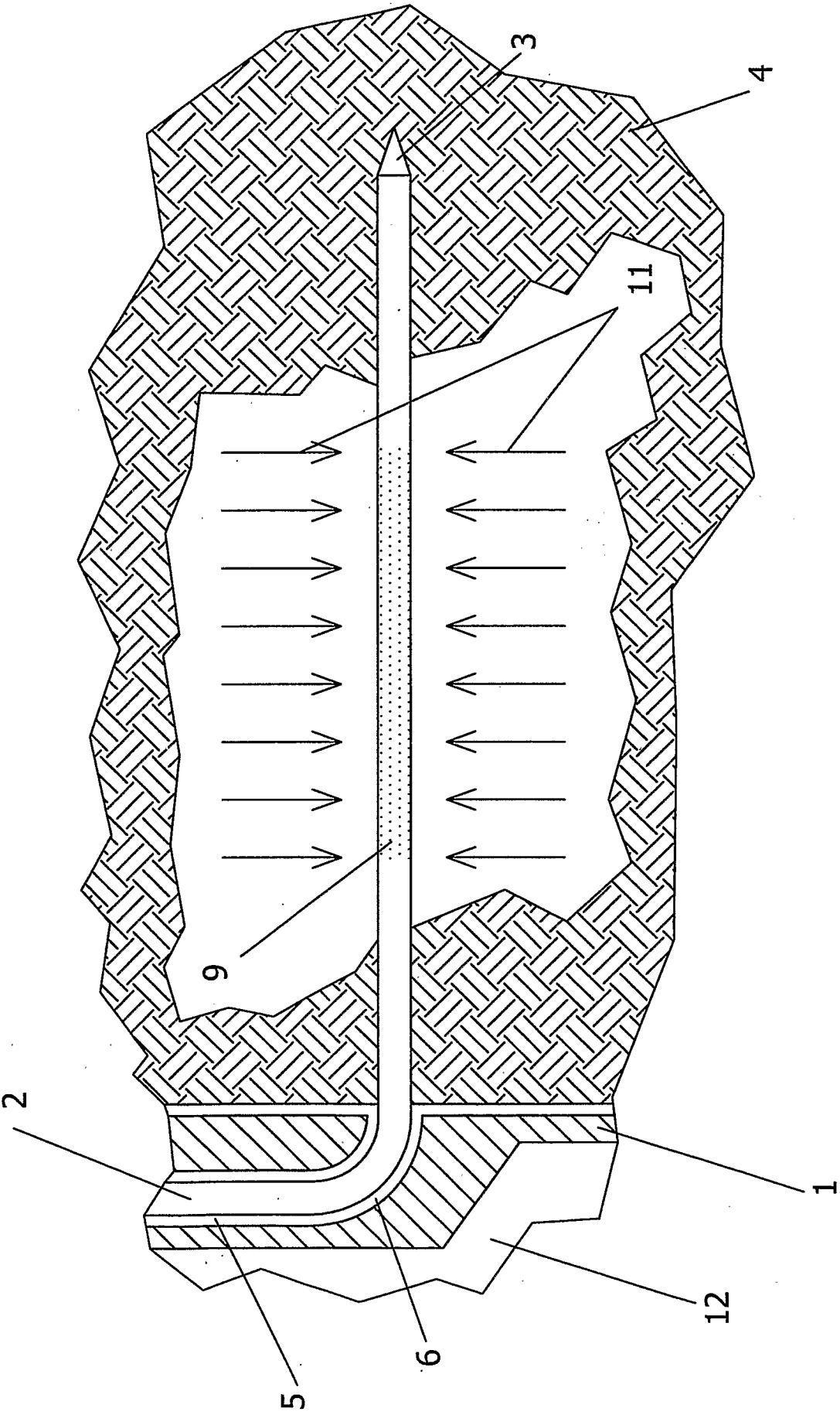


Fig 5

INTERNATIONAL SEARCH REPORT

International application No

PCT/HU2008/000079

A. CLASSIFICATION OF SUBJECT MATTER

INV. B09C1/06 E02D7/02 E03B3/11 F16L1/028

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B09C E02D E03B F16L E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	JP 01 260194 A (NIPPON KOKAN KK; JAPAN STEEL & TUBE CONSTR) 17 October 1989 (1989-10-17) abstract; figure 1 ----- -/--	1,2



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

2 December 2008

Date of mailing of the international search report

09/12/2008

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INTERNATIONAL SEARCH REPORT

International application No

PCT/HU2008/000079

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

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