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(54) **METHOD AND SAW CABLE FOR CONSTRUCTING AN UNDERGROUND BARRIER**

(57) The method for constructing an underground barrier with a cable saw wherein the cable of the cable saw comprises at least one nozzle and the solidifying fluid is ejected via the nozzle during cutting.

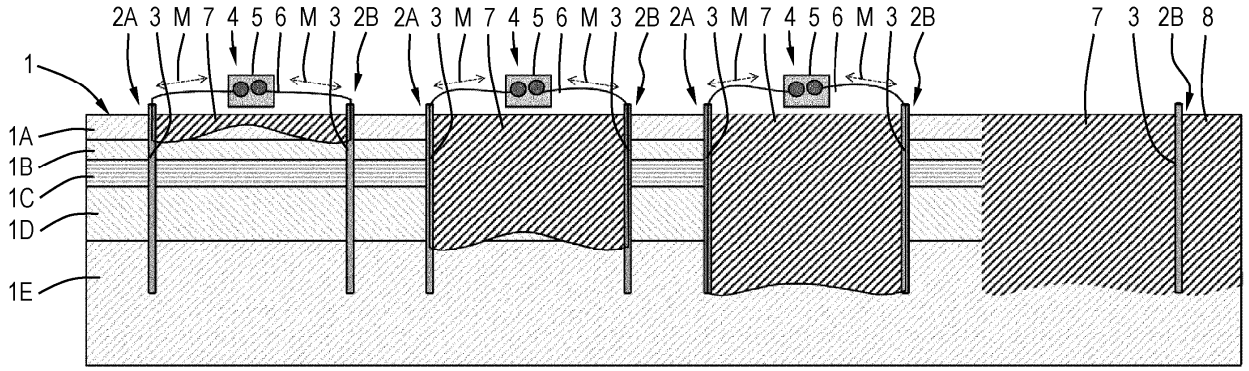


Fig. 1A Fig. 1B Fig. 1C Fig. 1D

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a method for constructing an underground barrier, comprising the steps of providing a cable saw for cutting ground, driving the cable saw such that the ground is cut, and ejecting a solidifying fluid into the cut ground to create the underground barrier. The underground barrier can for example be used to prevent or reduce the passage of water. Such underground barriers can be particularly useful in preventing water from seeping under a water-retaining structure, such as a dam or dike.

BACKGROUND

[0002] EA041277 discloses a method for constructing an underground barrier using a cable saw for creating a gap. In a next step, a hardening fluid is delivered through a flexible pipeline fixed on the back side of the cable of the saw wire of the cable saw. The flexible pipeline is a fragile part that can easily be damaged when pulled through the gap, and can easily detach from the saw wire during cutting.

[0003] The outlets of the flexible pipeline can easily be clogged, resulting in an uneven distribution of the hardening material and consequently in weak spots of the underground barrier.

[0004] It is an object of the invention to provide a more efficient and reliable method for constructing the underground barrier and a more robust configuration of the used cable saw.

SUMMARY

[0005] For these and other purposes, a method is provided comprising the following step: the cable of the cable saw comprises at least one nozzle and the solidifying fluid is ejected via the nozzle or nozzles.

[0006] An advantage of this method is that a simple system can be used for cutting of the ground as well as for injecting the fluid to produce an underground barrier. The cable functions both as a sawing cable as well as supply and injection system for the solidifying fluid. As a result, an underground barrier can be constructed by driving the single cable, wherein a cable needs to pass only once through the ground. This makes the system less susceptible to failure.

[0007] The method may further comprise the steps of:

- providing at least one guiding member, such as a cable guide, and
- guiding the cable during cutting in a direction away from a cable driver of the cable saw.

[0008] The cable saw typically comprises a cable driver for driving the cable for sawing motion. The guiding member can be used to move the cable during cutting downward from a ground surface into the ground. It may further help to construct the underground barrier at an accurately determined position.

[0009] The guiding member may for example be a pulley movable through the respective hole, e.g., along a retaining member within the hole.

[0010] The guiding member may be moved downward during cutting, for example by a pusher, such as a pipe or beam. The pusher may drive the guiding member while the displacement of the guiding member during cutting is accurately controlled.

[0011] The method may further comprise the following steps before cutting:

- making a first hole, such as a borehole, and a second hole, such as a borehole, at a distance from the first hole,
- receiving a first guiding member at least partly in the first hole and receiving a second guiding member at least partly in the second hole.
- guiding the first and second guiding members through the first hole and the second hole, e.g., substantially simultaneously, while guiding the cable from the cable driver to the first guiding member and from the first guiding member to the second guiding member and from the second guiding member back to the cable driver.

[0012] The holes may reach from surface of a ground layer into the ground. The holes are typically elongated boreholes, defining two opposite sides of the underground barrier to be constructed. The holes may have a depth which is at least the depth of the underground barrier that is to be constructed.

[0013] The holes may be stabilized by respective retaining members. Such a retaining member typically is an elongated profile fitting in the respective hole to stabilize and support it. The retaining member may be provided with a recess extending in a longitudinal direction of the retaining member to allow passage of the cable towards the retaining member of the other hole. To this end, the recess of the retaining member in the first hole faces the recess of the retaining member in the second hole. In a particular embodiment, the retaining member can have a C-shaped or H-shaped cross section.

[0014] Alternatively, or additionally, the retaining member may be or comprise a fluid. An example may be a mixture comprising water and bentonite. A hole may be filled with such a mixture to support the wall of the hole.

[0015] The holes provide a passage for the guiding members to move through while the cable cuts the ground. Hence, the guiding members do not have to remove ground.

[0016] Additional guiding member may be provided at an entrance of the holes for guiding the cable into the holes.

[0017] After cutting, at least one end of the cable may

be detached from the cable driver such that the cable has at least one free end. The cable may be removed from the ground by pulling the cable at a distance of the free end such that the free end is pulled downward into one of the holes, pulled along a lower edge of the underground barrier, and upwards through the other one of the holes.

[0018] Optionally, the cable cuts the ground with a reciprocating motion. Cutting the ground with a reciprocating motion allows usage of cable that has a finite length with two end sections rather than a closed loop. With a reciprocating sawing motion, only a section of the cable needs to be used for cutting the ground and for ejecting the solidifying fluid.

[0019] The speed of the motion and/or the force used during the cutting and/or the (downward) speed of advancement of the cable may depend on the type of ground that is cut. Other cutting variables may also influence the speed of cutting. Cutting variables can be programmed depending on measured and/or expected soil types in the various layers of the ground to be cut.

[0020] The solidifying fluid may for example be or comprise a water swellable materials such as a clay, preferably bentonite, and/or a hydraulic or inorganic binder, such as sodium metasilicate, concrete, gypsum and cement, or mixtures thereof.

[0021] The use of such an in-situ injected solidifying fluid to construct an underground barrier is advantageous over conventional sheet metal barriers or prefab sheets of another material and/or type because of one or more of the following reasons: solidifying fluid typically requires relatively little energy to be produced, the solidifying fluid is easier to transport and/or may be transported in a powdered form that is combined with water at a construction site, the solidifying fluid is usually cheaper, the solidifying fluid may be a natural material that has no or little and/or less (negative) influence on the ground and/or nature in (close) proximity to the underground barrier. When the underground barrier is no longer needed, it can be pierced or otherwise rendered unusable, possibly without removing the barrier. Moreover, fluids are typically easier to process than solid prefab barriers, the waterproofness is usually better and the environmental impact is usually lower, in particular if a swelling clay, such as bentonite, is used.

[0022] After solidifying fluid has been ejected into the ground, the underground barrier may be provided with reinforcement. Reinforcement may comprise structural beam(s), a reinforcement mesh, and/or another suitable type of reinforcement. The reinforcement may be pressed, drilled and/or otherwise inserted into the solidifying fluid in the ground.

[0023] The method may further comprise the following steps: constructing a first underground barrier with an aforementioned method and constructing a second underground barrier with an aforementioned method, wherein the first and second underground barrier intersect each other and/or wherein the first and/or second hole of the first underground barrier is used as the first or second hole of the second underground barrier.

[0024] Applying this method for constructing adjacent underground barriers may allow to construct an effective combined underground barrier with larger dimensions than a single underground barrier. This may be beneficial, because the dimensions of a single barrier may be restricted due to machinery and/or other limitations.

[0025] This process can be repeated to achieve a combined underground barrier that comprises more than two underground barriers. The process can be repeated to construct an underground barrier of any desired length.

[0026] In a particular embodiment, the first underground barrier and the second underground barrier may have an angle with respect to each other. This also applies to additional, adjacent underground barriers.

[0027] The aforementioned method for constructing adjacent or intersecting underground barriers may further comprise the following steps:

- making a third hole at a distance from the first and second hole, driving the cable with the cable driver such that at least part of the ground between the first or second hole on the one hand, and the third hole on the other hand is cut by the cable, and
- ejecting the solidifying fluid into the cut ground between the first and third hole and/or between the second and third hole to provide the second, adjacent underground barrier.

[0028] This way, for each additional underground barrier after the first underground barrier, only a single additional hole needs to be provided.

[0029] Here as well, this method can be repeated to achieve more than two adjacent underground barriers.

[0030] The disclosure also pertains to a method for constructing a transverse underground barrier adjacent to a series of at least two earlier constructed underground barriers having a nonzero angle and/or a distance with respect to each other, wherein the transverse underground barrier is substantially transverse, e.g., substantially horizontal to each one of the series of earlier constructed underground barriers. The transverse, e.g., horizontal, underground barrier is constructed by at least the following steps:

- connecting the outer ends of the cables used for constructing the series of earlier constructed underground barriers to provide a joint cable;
- driving the joint cable via a first hole used for constructing a first one of the series of earlier constructed underground barriers, and a second hole used for constructing a last one of the series of earlier constructed underground barriers to pull the joint cable out of the other holes used for constructing the series of earlier constructed underground barriers and to subsequently cut the ground between said other holes and the first and second holes in a

direction substantially transversal to each one of the earlier constructed underground barriers, while ejecting the solidifying fluid from the cable into the cut ground to create the transverse underground barrier.

[0031] This allows to construct an underground barrier that may for example be substantially horizontal. This makes it possible to construct an underground space that is completely surrounded by underground barriers. The underground space may be a body of ground with a substantially triangular or rectangular shape, from a top view, but other shapes, are also conceivable.

[0032] The present disclosure further relates to a cable for cutting the ground. The cable comprises at least one nozzle for ejecting fluid. Thus, the cable can be used for cutting ground as well as ejecting fluid into the ground, possibly at the same time.

[0033] In a particular embodiment, the cable may define an interior fluid supply channel which is in communication with the at least one nozzle.

[0034] In a particular embodiment, at least a part of the cable may have a tubular cross section defining the interior fluid supply channel.

[0035] This way, the fluid can be supplied to the nozzle without requiring a separate supply channel to be in contact with the nozzle directly. A separate supply channel may still be used to supply fluid to the interior supply channel.

[0036] In an embodiment, the cable comprises two or more of fluid supply channels, wherein each one of the fluid supply channels is connected to one of the nozzles. The nozzle may be a single outlet or a cluster of outlets at substantially the same axial position of the cable, e.g., at different radial positions.

[0037] In an embodiment the cable comprises a first cable section, a second cable section and a cutting head, wherein the cutting head is connected to the first cable section at a first side of the cutting head and connected to a second cable section at a second side of the cutting head.

[0038] In an embodiment, the first cable section defines a first fluid channel section, the second cable section defines a second fluid channel section and the cutting head comprises a passage connecting the first fluid channel section and the second fluid channel section, the passage comprising the at least one nozzle.

[0039] In an embodiment, the cutting head comprises at least one cutting element, such as a cutting disc, and preferably two cutting elements, wherein the nozzle is situated adjacent to the cutting element, preferably in between two of the cutting elements. Situating the nozzle adjacent to a cutting element, ensures that the nozzle can eject fluid into ground that has just been cut by the adjacent cutting element. This improves the mixing of the ground and the fluid, resulting in improved quality of the barrier. Situating the nozzle between two cutting elements results in that the nozzle is behind a cutting element in a cutting direction independently of direction of the cable, so in both directions when a cable is moved with a reciprocating motion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040] The above-described aspects will hereafter be more explained with further details and benefits with reference to the drawings showing a number of embodiments by way of example.

Fig. 1A-D show a side cross section of the ground and four phases in the construction of adjacent underground barriers.

Fig. 2A shows an embodiment of a cutting head.

Fig. 2B shows several cross sections from the embodiment of cutting head.

Fig. 3A-3F show several phases in the construction of adjacent underground barriers provided with an underground barrier transversal to the adjacent barriers.

Fig. 4A-4B show an embodiment of a retaining member and a guiding member with a section of a cable.

[0041] Fig. 1 shows a cross section of a ground layer 1. The ground comprises multiple layers 1A - 1E of different material: an upper sand layer 1A, a first clay layer 1B, a peat layer 1C, a second clay layer 1D and a sand bottom layer 1E. With such ground build-ups, some layers may act as aquifers, such as the sand layer 1A for example. It may be desirable to provide water retaining underground barrier to prevent water from passing through the ground. For example, water may pass through an aquifer under a dike from a first side of the dike to a second side of the dike, reducing the effectiveness of the dike in retaining the water on the first side. In such a case, an underground barrier along (a part of) the dike may increase the effectiveness.

[0042] The first shown phase, shown in Fig. 1A, shows two holes 2A, 2B which have been made in the ground layer 1: a first hole 2A and a second hole 2B. The holes have been provided with a retaining member 3 to retain the walls of the holes. In this figure, the retaining members 3 are pipes with a recess (recess not shown) in at least a direction that faces the other hole 2A, 2B. A cable saw 4 has been installed on top of the ground layer 1. The cable saw 4 comprises a saw cable 6 and a cable driver 5 or motor which drives the cable 6 with a reciprocating motion M. The cable is provided with cutting heads and nozzles (both not shown in Fig. 1) and is connected to a source of a solidifying liquid, such as bentonite, as will be later explained in more detail.

[0043] The cable is guided by two guiding members. The guiding members are shown in Figure 4 and are discussed in more detail later on. A first guiding member is provided in the first hole 2A and a second guiding member in the second hole 2B. The cable runs from

the cable driver 5, down the first hole 2A, via the first guiding member, through the ground to the second guiding member, and then back to the cable driver 5. The part of the ground layer 1 above the cable 6, has been cut. The at least one cutting head (not shown) is situated on the cable 6, on a section that remains between the first and second hole 2A, 2B during cutting and ejecting.

[0044] The second shown phase, shown in Figure 1B, shows the cable saw 4 in an advanced position. The ground above the cable 6 has been cut. While cutting, the ground is injected and mixed with a solidifying fluid, such as bentonite.

[0045] In Figure 1C the cable has reached a terminal depth at the level of the lower edge of the underground barrier 7. In the shown embodiment, the end depth coincides with the depth of the first and second hole 2A, 2B, but this end depth may be deeper or less deep than the bottom of the holes. The holes 2A, 2B in the figures are parallel to each other. While this is preferred, holes that are not parallel to each other may also be used for constructing an underground barrier.

[0046] Fig. 1D shows a completed first underground barrier 7 and an adjacent second underground barrier 8. The first hole 2A has been removed, but the first hole 2A may also remain. For the construction of the second, adjacent underground barrier 8, the second hole 2B is used again. As such, the start of a continuous impermeable underground barrier is provided. This process may be repeated as often as desired.

[0047] Fig. 2A shows a side view cross section of a cutting head 10 of the cable 6. The cutting head 10 is provided with a nozzle 16 for ejecting fluid. The cable 10 has a first cable section 61 connected to a first side of the cutting head 101, and a second cable section 62 connected to a second side of the cutting head 102. In this embodiment, the nozzle 16 is a space between the first cable section 61 and the second cable section 62. Between the two cable sections 61, 62, a structural connection, in this exemplary embodiment a wire 21, is provided for transferring (pulling) forces generated by the cable driver between the two cable sections. Via the nozzle 16 the fluid is ejected in all directions, but it is also conceivable that the fluid is only ejected in a certain (angular) range along a longitudinal direction of the cable, e.g. in a range between 90 and 180 degrees, preferably above the cable 6, opposite to the downward cutting direction. On each side of, and adjacent to, the nozzle 16 the cable 6 is provided with a cutting disc 15. The cutting discs 15 have a circular outline that is concentric with the cable 6. The cutting discs 15 have a decreasing radius in the direction of the nozzle 6. The disc 15 are mirrored in a centre plane (not shown) in the middle of the cutting discs 15, perpendicular to the longitudinal direction of the cable 6. The cutting discs 15 are at least partly connected to the cable 6 by means of a structural connection member 14. The cable is reinforced with a structural component. In the exemplary embodiment shown in the drawing the structural component is a structural wire (13), such as a metal wire. Alternatively, other reinforcements may be used, such as a tube, or the cable could have sufficient strength and could be used without additional reinforcement. The cable is tubular and defines an interior fluid supply channel 11. An impermeable cable wall 12 surrounds the interior fluid channel 11. The structural wire 13 reinforces the impermeable cable wall 12. This defines an interior fluid channel 11 for supplying the solidifying fluid (not shown) to eject into the ground. The interior fluid channel 11 is connected to a fluid supply member, such as a pump, for supplying a solidifying fluid to the nozzle 16. The shown cable 6 is tubular on both sides of the cutting head 10, but it may also be tubular on only one side of the cutting head 10.

[0048] Fig. 2B shows the cutting head of Fig. 2A in four radial cross sections along lines A-A to D-D respectively. Cross section A-A shows the cable 6 with the interior fluid supply channel 11. The cable 6 comprises a reinforcement member, in this case a structural wire 13.

[0049] Cross section B-B shows the cable 6 with the interior fluid supply channel 11 and the structural connection member 14.

[0050] Cross section C-C shows the interior fluid supply channel and the cutting disc 15.

[0051] Cross section D-D shows the interior fluid supply, the nozzle, cutting disc 15 and structural wires 21.

[0052] Figs. 3A-3F show progressing phases of a method for constructing an underground space that is completely surrounded by underground barriers and the ground surface.

[0053] Fig. 3A shows a schematic perspective view of a three dimensional section of a ground layer, with three planned vertical cutting surfaces 17, 18, 19 adjoining each other at an angle. For reasons of clarity, the ground between the planned cutting surfaces is not shown.

[0054] A first cutting surface 17 extends between a first and a second hole 2A, 2B. In Figure 3A, a first underground barrier 7 is already constructed at the first cutting surface 17 between the first and second hole 2A, 2B.

[0055] Fig. 3B shows the same section of the ground layer with the first underground barrier 7 being finished.

[0056] Fig. 3C shows the same section of the ground layer wherein a third and a fourth hole 2C, 2D have been provided and a second underground barrier 8 adjacent to the first barrier has been constructed between the second and the third hole 2B, 2C. A third underground barrier 9 has been constructed adjacent to the second underground barrier 8, between the third and the fourth hole 2C, 2D.

[0057] Fig. 3D shows the same section of the ground layer wherein also are shown a first cable 6A, which in this case is used for constructing the first underground barrier 7, a second cable 6B, which in this case is used for constructing the second underground barrier 8 and a third cable 6C, which in this case is used for constructing the third underground barrier 9. An end of the first cable 6A and an end of the second cable 6B that are encircled together with a first dashed circle 20A are to be con-

nected to each other. An end of the second cable 6B and an end of the third cable 6C that are encircled together with a second dashed circle 20B are to be connected to each other. When connected to each other, the first cable 6A, the second cable 6B and the third cable 6C effectively form a single, combined cable. A way of using this combined cable is shown in Figure 3E.

[0058] Fig. 3E shows the side upper view of the three dimensional section of ground. A cable 6, preferably the combined cable as described above, is driven via a hole 2A related to the first underground barrier 7 and a hole 2D related to the third underground barrier 9. These both holes 2A, 2D are provided with a guiding member, which guiding members (not shown in this figure) are situated at the bottom of each hole 2A, 2D. End sections of the cable 6 are pulled upwards through the aforementioned two holes 2A, 2D while the cable 6 is reciprocally driven. Because of the original position of the wire, a middle section of the wire is pulled substantially horizontal through the ground along the lower edges of the first, second and third underground barrier 7, 8, 9 towards the guiding members. The cable cuts the ground adjacent to the first, second and third barrier 7, 8, 9 and ejects a solidifying fluid for constructing a fourth underground barrier 21, which is substantially transversal to the first, second and third underground barrier 7, 8, 9.

[0059] Fig. 3F shows the side upper view of the three dimensional section of ground. A fourth, transverse, e.g. substantially horizontal underground barrier 21 is constructed. A fifth underground barrier (not shown) may can constructed by cutting upwardly between the aforementioned hole 2A related to the first underground barrier 7 and the aforementioned hole 2D related to the third underground barrier 9, thereby achieving an underground space that is completely surrounded by underground barriers and the ground surface.

[0060] Fig. 4A shows an exemplary embodiment of a retaining member 3. The retaining member 3 is pipe with a recess 3A along its longitudinal direction.

[0061] Fig. 4B shows an exemplary embodiment of a guiding member 22. The guiding member 22 comprises a pulley 23 that guides the cable 6 in a vertical direction from the cable saw at the ground surface downwards through a hole in the ground. The cable 6 runs around the pulley 23, through a vertical recess 3A in a retaining member, such as a pipe, that runs along the longitudinal direction of the retaining member 3, so as to form a guiding rail for up and down movement of the pulley and the cable. The recess is situated between (at least part of) the pulley and a respective planned cutting surface.

[0062] The disclosure is not restricted to the above described embodiments which can be varied in a number of ways within the scope of the claims.

[0063] For instance, in a first step the ground may be cut with a first passage of a cable through the ground and subsequently in a second step be injected with a solidifying fluid during a second passage of a cable through the ground. The first step can for example be carried out with a downward movement of the cable, while the second step is carried out when the cable is driven to move back upward. The same tubular cable can be used in both steps, or a solid wire can be used in the first step, while the tubular cable is used only in the second step.

Claims

1. Method of constructing an underground barrier (7, 8, 9), comprising the following steps:

   - providing a cable saw (4) with a cable (6) for cutting ground,
   - driving the cable (6) saw to cut the ground,
   - ejecting a solidifying fluid into the cut ground during or after cutting to create the underground barrier (7, 8, 9),

   characterized in that
   the cable (6) comprises at least one nozzle (16) and the solidifying fluid is ejected via the at least one nozzle (16).

2. Method according claim 1, wherein the cable saw (4) comprises a cable driver (5) for driving the cable (6) and wherein the method further comprises the following steps:

   - providing at least one guiding member (22);
   - during cutting guiding the cable (6) via the at least one guiding member (22) in a direction away from the cable driver.

3. Method according claim 1 or 2, further comprising the following steps:

   - before cutting, making a first hole (2A) in the ground and a second hole (2B) in the ground at a distance from the first hole,
   - receiving a first one of the guiding members (22) at least partly in the first hole (2A) and receiving a second one of the guiding members (22) at least partly in the second hole (2B),
   - during cutting and ejecting, guiding the first and second guiding members (22) through the first hole (2A) and the second hole (2B), while guiding the cable (6) from the cable driver (5) to the first guiding member (22) and from the first guiding member (22) to the second guiding member (22) and from the second guiding member (22) to the cable driver (5).

4. Method according to any of the preceding claims, wherein the cable (6) cuts the ground (1, 1A, 1B, 1C, 1D, 1E) with a reciprocating motion.

5. Method according to any of the preceding claims, wherein the solidifying fluid comprises a water swellable material, such as a clay, preferably bentonite, and/or a hydraulic binder, such as sodium metasilicate, concrete, gypsum or cement, or mixtures thereof.

6. Method for constructing two adjacent underground barriers (7, 8, 9), comprising the following steps:

- constructing a first underground (7, 8, 9) barrier with a method according to any of the preceding claims,
- constructing a second underground (7, 8, 9) barrier with a method according to any of the preceding claims,

wherein the first and second underground barrier (7, 8, 9) intersect each other and/or wherein at least one of the first and second hole (2A, 2B), if provided, related to the first underground barrier (7, 8, 9) is at least one of the first and second hole (2A, 2B) of the second underground barrier (7, 8, 9).

7. Method according to at least claim 3 and 6, comprising the following steps:

- making a third hole (2C) at a distance from the first and second hole (2A, 2B),
- driving the cable (6) with the cable driver (5) such that at least part of the ground between the first or second hole and third hole (2A, 2B, 2C) is cut by the cable,
- ejecting the solidifying fluid into the cut ground between the first and third hole (2A, 2C) and/or between the second and third hole (2B, 2C) to provide the second, adjacent underground barrier (7, 8, 9).

8. Method for constructing a transverse underground barrier (21) adjacent to all underground barriers (7, 8, 9) of a series of at least two earlier constructed underground barriers (7, 8, 9) serially constructed with the method of claim 7 and having a nonzero angle and/or a distance with respect to each other, wherein the transverse underground barrier (21) is substantially transverse to each one of the series of earlier constructed underground barriers (7, 8, 9) and is constructed by at least the following steps:

- connecting the outer ends of the cables (6) used for constructing the series of earlier constructed underground barriers (7, 8, 9) to provide a joint cable;
- driving the joint cable via a first hole (2A, 2B, 2C, 2D) used for constructing a first one of the series of earlier constructed underground barriers (7, 8, 9), and a second hole (2A, 2B, 2C, 2D) used for constructing a last one of the series of earlier constructed underground barriers (7, 8, 9) to pull the joint cable out of the other holes (2A, 2B, 2C, 2D) used for constructing the series of earlier constructed underground barriers (7, 8, 9) and to subsequently cut the ground between said other holes (2A, 2B, 2C, 2D) and the first and second holes (2A, 2B, 2C, 2D) in a direction substantially transversal to each one of the earlier constructed underground barriers, while ejecting the solidifying fluid from the cable (6) into the cut ground to create the transverse underground barrier (21).

9. Cable for a cable saw (4) for cutting ground, **characterized in that** the cable comprises at least one nozzle (16) for ejecting a fluid.

10. Cable according to claim 9, wherein the cable (6) defines an interior fluid supply channel (11) which is in communication with the at least one nozzle (6).

11. Cable according to claim 9 or 10, wherein the cable (6) comprises two or more fluid supply channels (11), wherein each one of the fluid supply channels (11) is connected to a single one of the nozzles (6).

12. Cable according to any of the claims 9-11, comprising a first cable section (61), a second cable section (62) and a cutting head (10), wherein the cutting head (10) is connected to the first cable section (61) at a first side of the cutting head (10) and connected to a second cable section (62) at a second side of the cutting head (10).

13. Cable according to claim 12, wherein the first cable section (61) defines a first fluid channel section and the second cable (62) section defines a second fluid channel section; and
wherein the cutting head comprises a passage connecting the first fluid channel section and the second fluid channel section, the passage comprising the at least one nozzle (6).

14. Cable according to any of the claims 10-13, wherein the cutting head (10) comprises at least one cutting element, such as a cutting disc (15), and preferably two cutting elements, wherein the nozzle (10) is situated adjacent to the cutting element, preferably in between two of the cutting elements.

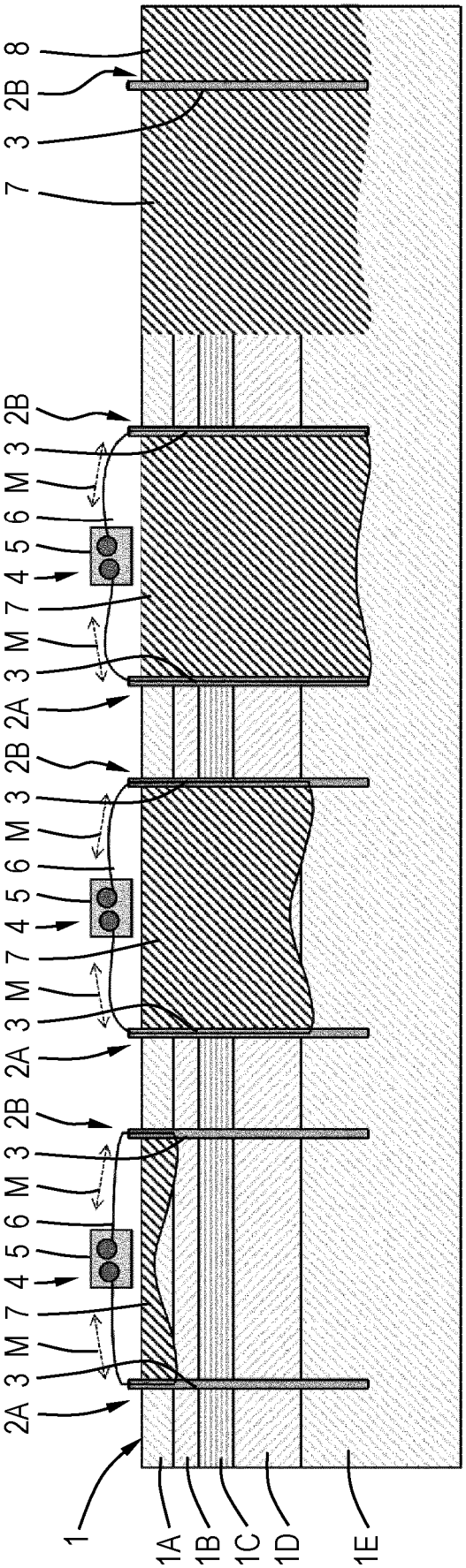


Fig. 1D

Fig. 1C

Fig. 1B

Fig. 1A

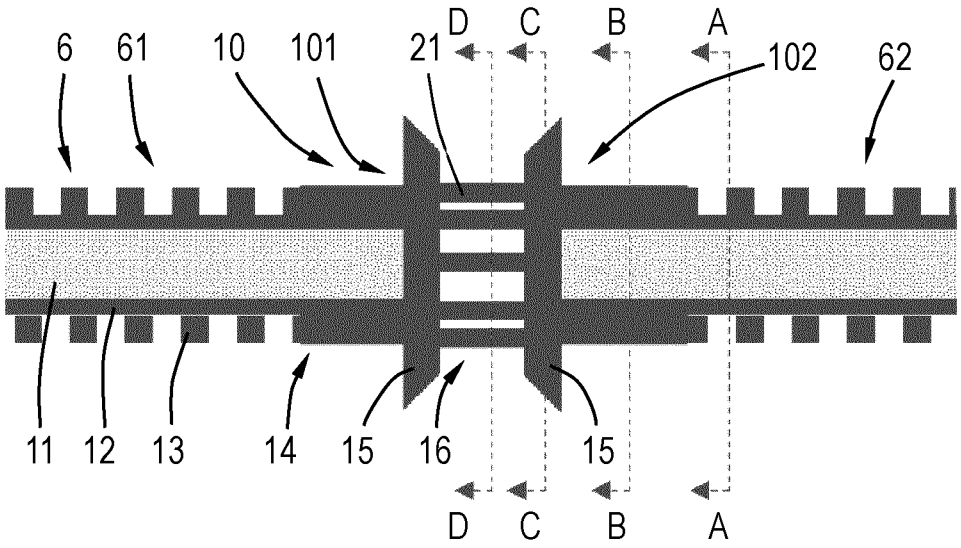

6
61
10
101
21
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C
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A
102
62
11
12
13
14
15
16
15
D
C
B
A

Fig. 2A

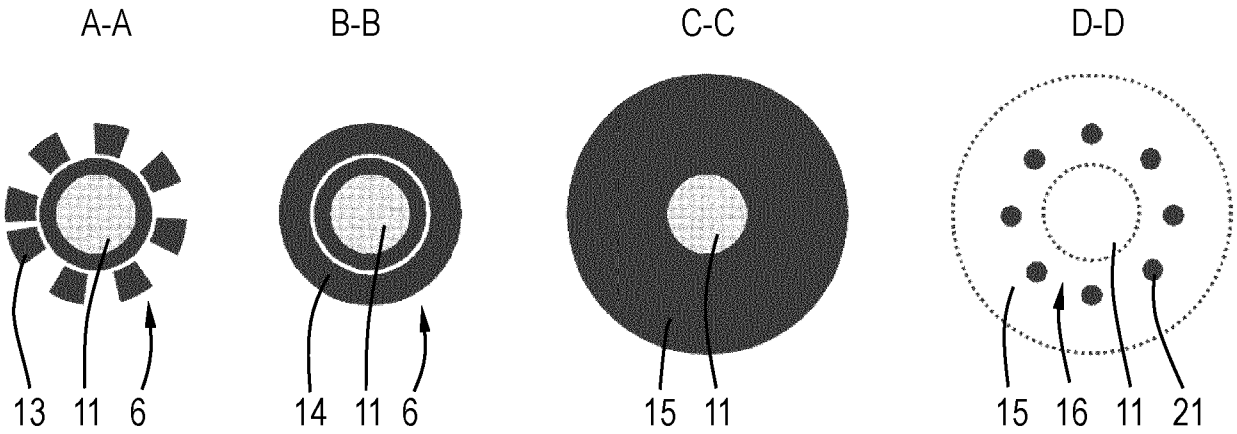

A-A
B-B
C-C
D-D
13
11
6
14
11
6
15
11
15
16
11
21

Fig. 2B

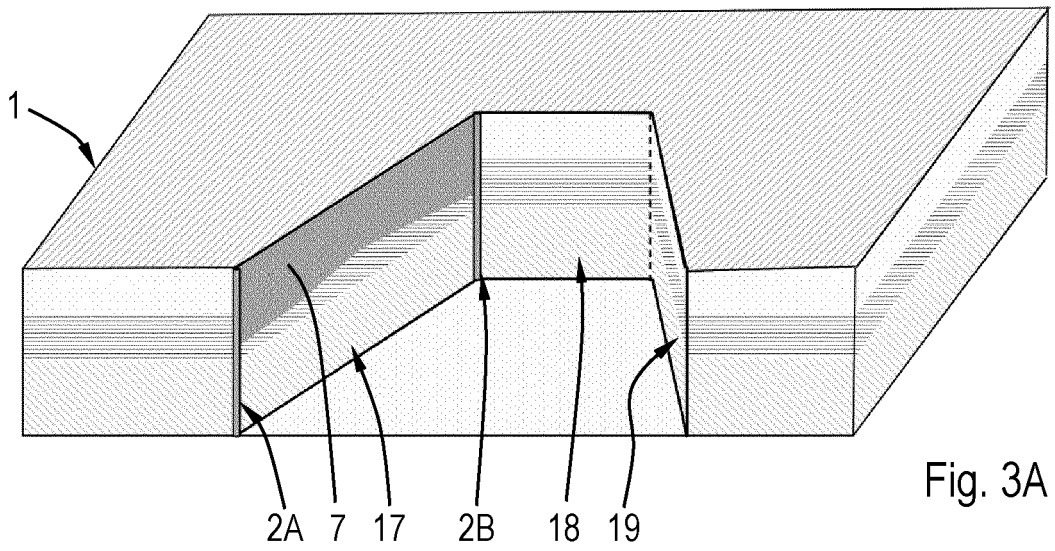


Fig. 3A

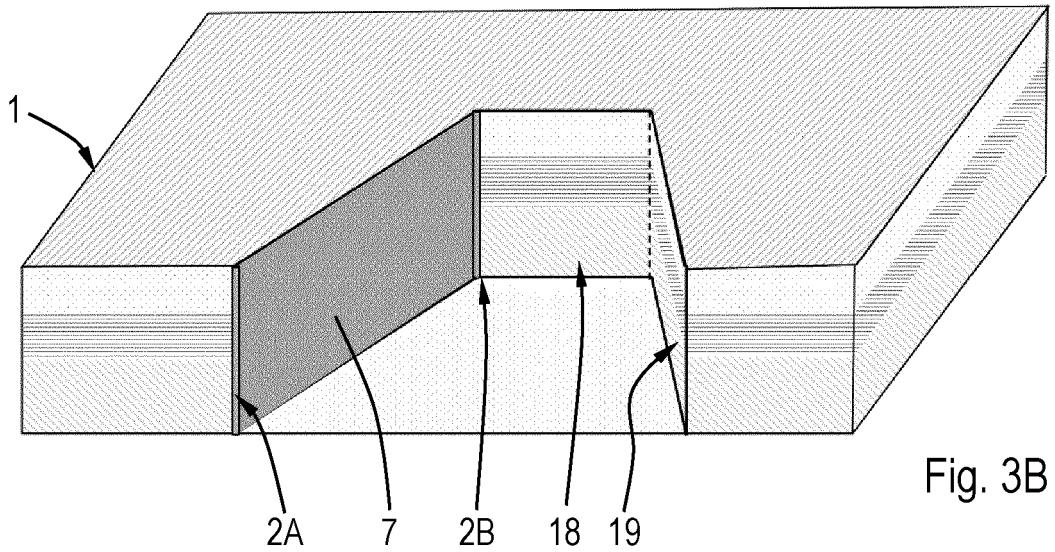


Fig. 3B

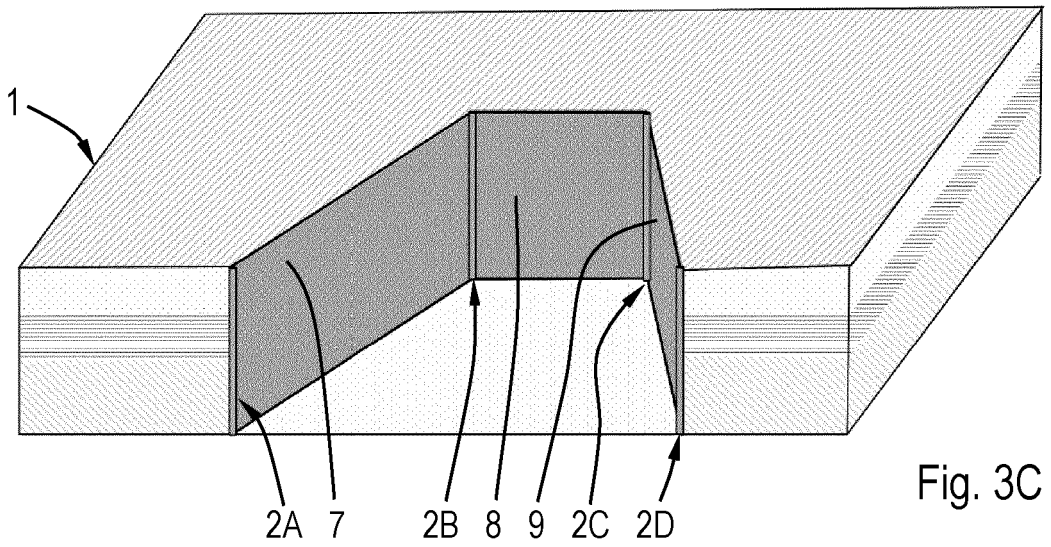


Fig. 3C

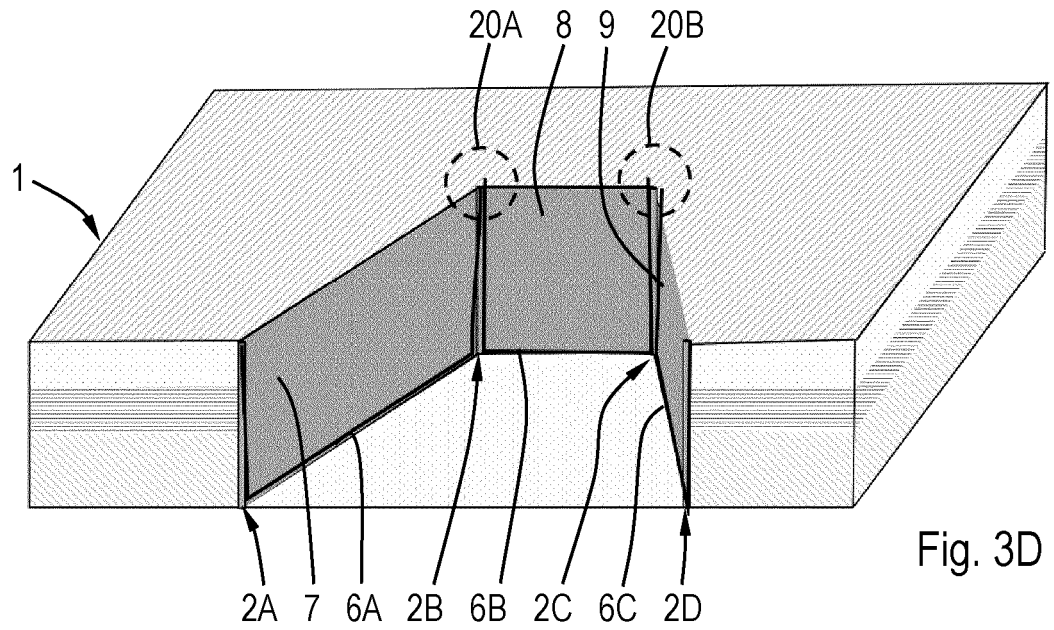


Fig. 3D

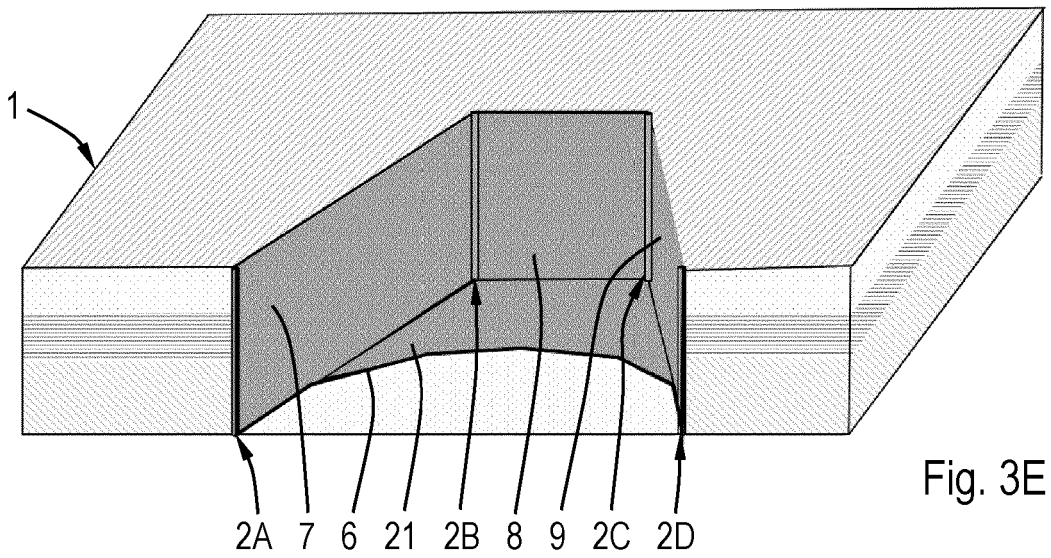


Fig. 3E

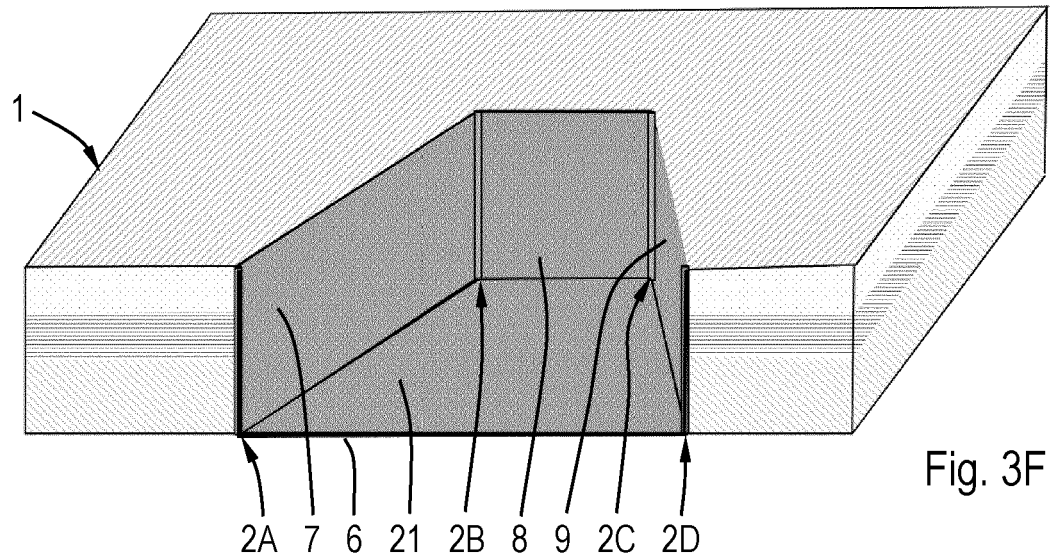


Fig. 3F

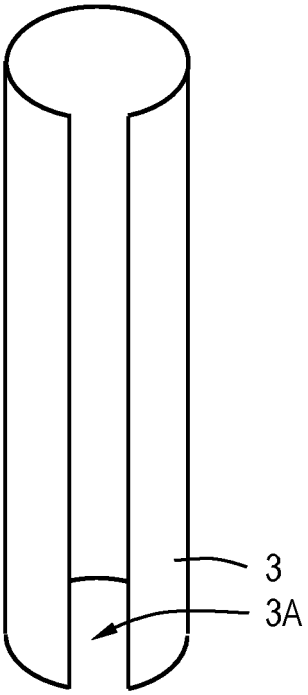


Fig. 4A

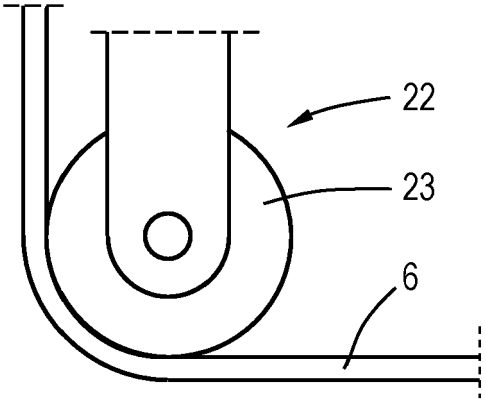


Fig. 4B

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EUROPEAN SEARCH REPORT

Application Number
EP 25 16 7813

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E02D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	16 September 2025	Movadat, Robin

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