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(54) STOP-END PIPE FOR THE CONSTRUCTION OF CONCRETE DIAPHRAGM WALLS

(57) A stop-end pipe (1) for the construction of concrete diaphragm walls, which comprises a longitudinally extended structure (3) which has at least one first face (5) configured to face the concrete (7) intended to fill an excavation (9) for the provision of a diaphragm wall, at least one tubular chamber (11) being associated with the first face (5) and having a longitudinal axis which is substantially parallel to the axis of longitudinal extension of

the structure (3), where the tubular chamber (11) is expandable hydraulically in a direction that is transverse to its axis, so that the expansion of such tubular chamber (11) is adapted to impart a translation of the stop-end pipe (1) with respect to the concrete (7), such translation being intended to detach it from the concrete that is present in the excavation (9).

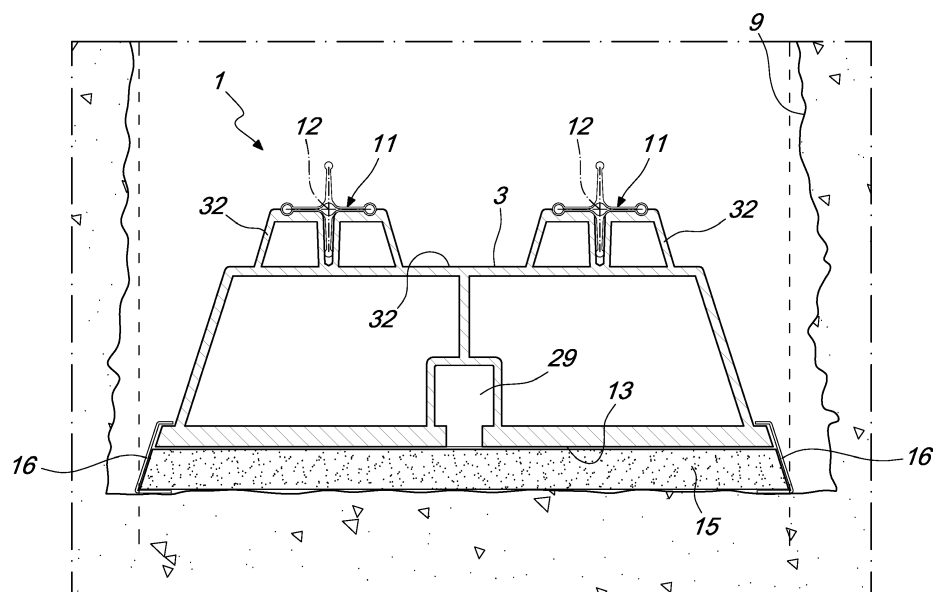


Fig. 1

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Description

[0001] The present invention relates to a stop-end pipe for the construction of concrete diaphragm walls.

[0002] The construction of continuous diaphragm walls of reinforced concrete occurs by providing, in succession, a series of panels which are contiguous with each other and comprise interlocking joints of various forms, for example semicircular or trapezoidal or dovetail-shaped, which provide the static cooperation between contiguous panels.

[0003] Often, in particular in the presence of aquifers, such joints are made so as to be sealed against liquids as well, i.e. so as to keep out water that could filter through the joint interface between one panel and the next. Such liquid seal is usually ensured by the presence of profiles in rubber (PVC or neoprene) called "waterstops".

[0004] Providing the panels that make up a diaphragm wall usually involves the use of "stop-end pipes", i.e. longitudinally extended tubular structures that make it possible in particular to provide the joint portion between two contiguous panels.

[0005] The method for providing a diaphragm wall usually comprises the steps of:

- carrying out an excavation, or perforation, with a substantially rectangular cross-section, for example with a clamshell bucket;
- arranging vertically, at a short side of the excavation, a stop-end pipe, checking that it is correctly vertical;
- arranging the reinforcement cages in the excavation and pouring the concrete;
- after the casting has set, removing and recovering the stop-end pipe.

[0006] The step of removing the stop-end pipe is one of the most delicate steps of the entire method for providing a concrete diaphragm wall. In particular, to date, a method has not yet been devised for correctly and safely removing the stop-end pipe, i.e. a removal that does not entail damaging the stop-end pipe proper, or the reinforced concrete that has just been obtained.

[0007] In fact, one of the biggest difficulties in recovering the stop-end pipe derives from the fact that the liquid concrete poured into the excavation tends to "envelop" the stop-end pipe, in that it tends to fill the pockets created in the excavation trench wall around the stop-end pipe proper, for example owing to the presence of layers or portions of soil which are not capable of supporting their own weight. This happens in particular in non-homogeneous ground, where coherent layers with usually fine and medium granulometry alternate with incoherent layers with coarse granulometry, which tend to be penetrated and filled by the liquid concrete.

[0008] Currently, stop-end pipes are removed by "pulling them away", by way of a crane or a vertical extractor, possibly after an attempt has been made to remove, where possible, by way of scrapers or chisels, the spills

of concrete that envelop the stop-end pipe.

[0009] However, the difficulty to remove the stop-end pipes can, sometimes, actually result in leaving part or all of the stop-end pipe in the excavation trench.

[0010] At present, stop-end pipes also exist inside which there are horizontal hydraulic cylinders which, once actuated, protrude from the face of the stop-end pipe which faces toward the concrete that has just been formed and which exert a push that tends to distance the stop-end pipe from the concrete, so as to facilitate, in theory, its subsequent removal.

[0011] However, the removal of stop-end pipes by way of the above mentioned methods very often entails damaging the stop-end pipe by bending, which then creates further difficulties, not least in the excavation for subsequent panels.

[0012] Such damage to the stop-end pipe is practically guaranteed to happen when, between two portions in which the stop-end pipe is in direct contact with the soil, there is an empty pocket in the excavation trench wall, created by the excavation and/or owing to a spontaneous collapse, which was then filled with concrete during the casting of the panel.

[0013] With regard to stop-end pipes provided with hydraulic cylinders, it has further been found that often the action of such cylinders is insufficient to cause a shift of the soil behind the stop-end pipe, in order to create the empty space between the casting and the stop-end pipe which is required in order to be able to extract and recover the stop-end pipe.

[0014] In particular, since for reasons linked to the rate of production of the panels, the stop-end pipe is removed when the concrete has only partially cured, and since the thrust surface of the hydraulic cylinders is very modest with respect to the extent of the contact surface between the concrete and the stop-end pipe, activation of the hydraulic cylinders often does not result in the retraction of the stop-end pipe with respect to the concrete, but instead results in the penetration of the hydraulic cylinders into the concrete, thus damaging the panel locally in the region of the joint.

[0015] The aim of the present invention consists in providing a stop-end pipe that solves the above mentioned technical problems and overcomes the limitations of the known art.

[0016] Within this aim, an object of the present invention is to provide a stop-end pipe that can be removed and recovered without being damaged and without damaging the panels of concrete.

[0017] Another object of the invention consists in providing a stop-end pipe that can be easily removed and recovered even in the presence of castings of concrete that partially envelop it.

[0018] Another object of the invention consists in providing a stop-end pipe that makes it possible to accelerate the method for providing diaphragm walls in concrete.

[0019] Another object of the invention consists in providing a stop-end pipe that is capable of offering the wid-

est guarantees of reliability and safety in use.

[0020] Another object of the invention consists in providing a stop-end pipe that is easy to implement and economically competitive when compared to the known art.

[0021] This aim and these and other objects which will become better apparent hereinafter are achieved by a stop-end pipe for the construction of concrete diaphragm walls, according to claim 1.

[0022] Further characteristics and advantages of the invention will become better apparent from the detailed description of a preferred, but not exclusive, embodiment of a stop-end pipe, which is illustrated by way of non-limiting example in the accompanying drawings wherein:

Figure 1 is a cross-sectional view of a stop-end pipe, according to the invention;

Figure 2 is an enlarged portion of the stop-end pipe in Figure 1, according to the invention, which illustrates a hydraulically expandable element of the stop-end pipe;

Figures 3 and 4 are views of two successive steps of the method of recovering the stop-end pipe in Figure 1, according to the invention.

[0023] With reference to the figures, the stop-end pipe for the construction of concrete diaphragm walls, generally designated by the reference numeral 1, comprises a longitudinally extended structure 3 which has at least one first face 5 configured to face the concrete 7 intended to fill an excavation 9 for the provision of a diaphragm wall.

[0024] The first face 5 has, conveniently along the entire height of the stop-end pipe 1, a male contour, so as to define, in the concrete panel 7, a corresponding female contour, conveniently along the entire height of the concrete panel that is to be formed.

[0025] According to the invention, the first face 5 is associated with at least one tubular chamber 11 which has a longitudinal axis 12 substantially parallel to the axis of longitudinal extension of the structure 3. The tubular chamber 11 is hydraulically expandable in a direction that is transverse to its axis 12, more preferably in a direction that is substantially perpendicular to the axis 12, so that the expansion of the tubular chamber 11 is adapted to impart a translation of the stop-end pipe 1 with respect to the concrete 7 which is intended to detach it from the concrete present in the excavation 9.

[0026] Advantageously the structure 3 has a second face 13 which lies opposite to the first face 5, which is associated with a compressible element 15 which is adapted to be compressed in order to absorb the above mentioned translation of the stop-end pipe 1 with respect to the concrete 7.

[0027] Advantageously the tubular chamber 11 extends substantially along the entire length of the structure 3.

[0028] Advantageously, the compressible element 15 also extends in length substantially along the entire length of the structure 3.

[0029] The structure 3 can be composed of a plurality of longitudinally extended sections, connected to each other by way of adapted fixing means, which comprise, for example, plug couplings locked by way of through pins.

[0030] The tubular chamber 11 can have a cross-section of any shape. Preferably, however, it has a cross-section which is narrower in a direction transverse to the longitudinal axis. In this manner the surface of the face of the tubular chamber 11 which faces toward the structure 3 is advantageously increased.

[0031] The stop-end pipe 1 can comprise a pair of tubular chambers 11 which are associated with the first face 5.

[0032] Advantageously, the stop-end pipe 1 can have a substantially trapezoidal transverse cross-section, with the smaller side and the inclined sides made of sheet steel of medium thickness (indicatively comprised between 10 and 20 millimeters), and the larger side also made of sheet steel but thicker (indicatively comprised between 25 and 40 millimeters). Advantageously, furthermore, the tubular chambers 11 can be associated with portions 32 with a cross-section trapezoidal which protrude from the first face 5 of the stop-end pipe 1. The portions 32 with cross-section trapezoidal can comprise two metallic profiles of thickness less than the thickness of the plates that define the walls of the structure 3.

[0033] The tubular chamber 11 advantageously comprises a duct 17 for injecting a fluid that is adapted to be pressurized, and at least one lateral sac 19, 21 which is connected to the injection duct 17. Advantageously there are two lateral sacs 19 and 21, at the sides of the injection duct 17.

[0034] The ends of the lateral sacs 19 and 21 can comprise two expansion bulbs 20 and 22, which are also connected to the injection duct 17.

[0035] Advantageously, the tubular chamber 11 comprises walls which are made of an elastically deformable material. Such material can be of the type of rubber or neoprene. Such material can also be a thermoplastic polymer.

[0036] The tubular chamber 11 advantageously comprises at least one waterstop flap 23, 26. Preferably, the tubular chamber 11 comprises a pair of waterstop flaps 23 and 26. Advantageously, at least one of the waterstop flaps 23 and 26 is adapted to be partially embedded in the concrete 7, so as to be able to prevent, or at least slow down, the passage of water or other liquids at the interface between two contiguous panels of a diaphragm wall.

[0037] Advantageously the structure 3 comprises, at the face 5, a seat 27 which is configured to accommodate detachably at least one waterstop flap 23, 26. The seat 27 is conveniently defined at the protruding portion 32.

[0038] In substance, as illustrated in Figure 2, a first waterstop flap 26 is adapted to be partially embedded in the concrete 7, while a second waterstop flap 23 is adapted to be accommodated in the seat 27 of the structure

3. Thanks to the presence of the above mentioned waterstop flaps 23 and 26, once the concrete 7 has been poured into the excavation 9, when the stop-end pipe 1 is extracted, the tubular chamber 11 is intended to be detached from the stop-end pipe 1 and remain in its seat at the interface between two contiguous panels. In this manner it can be ensured that the continuous diaphragm wall that is being built is sealed against water, in particular even at the joints between the various panels.

[0039] Advantageously the compressible element 15 is extended along the entire second face 13 of the structure 3, and also beyond the lateral edges of the structure 3. In this manner the compressible element 15 can fill any empty pocket that forms in the excavation trench wall around the stop-end pipe 1.

[0040] Advantageously, the compressible element 15 is made of a material of the type of expanded polystyrene or polyurethane or polystyrene.

[0041] The compressible element 15 can be provided in the form of a panel, or mat, with a thickness comprised between 40 and 80 millimeters. In any case, the thickness, the density and therefore the resistance of the compressible element 15 can be selected as a function of the expected thrust factors based on the depth of the excavation trench and on the nature of the soil.

[0042] The compressible element 15 can be fixed to the second face 13 of the structure 3 by adhesive bonding, and/or by way of the use of clips 16.

[0043] The structure 3 advantageously comprises, at the second face 13, a longitudinal compartment 29 which is adapted to engage excavation means in order to provide an adjacent excavation. In particular, the longitudinal compartment 29 is defined in the side of the stop-end pipe 1 which is against the soil, and can allow the sliding of the grab-guide fairlead, in order to ensure the alignment between the excavation just carried out and the excavation to be carried out.

[0044] Advantageously, the tubular chamber 11 can be injected with cement mixtures, after the concrete has cured, to further ensure the impermeability of the joint between the panels.

[0045] The present invention also relates to a hydraulically expandable element for stop-end pipes 1, which comprises a tubular chamber 11 as described above, i.e. a hydraulic chamber 11 which is hydraulically expandable in a direction that is transverse to its longitudinal axis.

[0046] Such hydraulically expandable element has walls which are made of an elastically deformable material and comprises at least one waterstop flap 23, 26 as described above.

[0047] The present invention also relates to a method of recovering a stop-end pipe 1, which comprises the steps of:

- expanding at least one tubular chamber 11 which is associated with the stop-end pipe 1 and has a longitudinal axis that is substantially parallel to the axis of longitudinal extension of the stop-end pipe 1, so

that the stop-end type 1 detaches from the concrete 7 which is present in the excavation 9 for providing a diaphragm wall;

- extracting the stop-end pipe 1 once it has detached from the concrete 7.

[0048] Operation of the stop-end pipe for providing diaphragm walls in concrete is described hereinafter.

[0049] First of all the tubular chamber 11 is inserted, by way of one of the waterstop flaps 23, 26, into the seat 27 of the structure 3 of the stop-end pipe 1, and then the compressible mat 15 is fixed by adhesive bonding and/or by way of clips 16.

[0050] Subsequently, the stop-end pipe 1 is lowered, vertically, into a space made in the ground, i.e. inside the excavation 9 where the concrete 7 will be poured in order to provide a panel of the diaphragm wall. If the stop-end pipe 1 is made up of several vertical sections, it can be provided by lowering one section at a time into the space, and conveniently fixing the various sections together.

[0051] Usually a surface device is provided which, by way of guiding walls, facilitates the insertion of the stop-end pipe 1 into the space.

[0052] Once the stop-end pipe 1 is lowered, the reinforcement cages are inserted into the excavation 9 and the concrete 7 is poured.

[0053] Optionally, before casting the concrete 7, a test can be carried out of the injection plant used to pressurize the liquid present in the tubular chamber 11 in order to expand it.

[0054] The liquid concrete, once poured, fills the excavation 9, and also any empty excavation pockets that may be present about the stop-end pipe 1. The liquid concrete tends therefore to envelop, in a substantially unpredictable manner, the stop-end pipe 1, including the face thereof against the soil, i.e. at the second face 13 of the structure 3, where the compressible element 15 is present.

[0055] After the required curing of the concrete 7, sufficient pressure is applied in the tubular chamber 11, by way of introduction of water, air or oil, to expand the tubular chamber 11, as illustrated in Figure 4. The expansion of the tubular chamber 11, in a direction transverse to the extension of the stop-end pipe 1, causes a horizontal translation of the stop-end pipe 1 with respect to the concrete 7. In particular the expansion affects the principal duct 17, and the lateral sacs 19 and 21, and also the expansion bulbs 20 and 22.

[0056] Irrespective of the consistency of the wall of soil that faces the stop-end pipe 1, and irrespective of the shape structure of any tentacles of concrete that envelop the stop-end pipe 1, the translation of the stop-end pipe 1 is advantaged by the presence of the compressible element 15, which is capable of being compressed in order to absorb the shifting of the stop-end pipe 1, and thus ensure the separation thereof from the wall of concrete 7 that has just been formed. The translation of the stop-end pipe 1 can be in the order of 10-15 millimeters.

[0057] After the separation of the stop-end pipe 1 from the concrete 7, and the release of the pressure present in the tubular chamber 11, it is possible to recover, easily, by way of vertical extraction, the stop-end pipe 1, thus preventing damage both to the stop-end pipe and to the concrete that has just been poured. The stop-end pipe 1 can be optionally divided into sections, during recovery, and subsequently reassembled.

[0058] The fact that the tubular chamber 11 exerts a thrust pressure on an interface between the concrete 7 and the stop-end pipe 1 which is spread out ensures the correct distribution of the forces both on the concrete 7 and on the structure 3 of the stop-end pipe 1, with the result that neither the concrete 7 nor the stop-end pipe 1 undergo localized mechanical stresses that would damage and/or deform them.

[0059] The compressible mat 15, in addition to facilitating the movement of the stop-end pipe 1, also prevents direct contact between the stop-end pipe 1 and the concrete 7 that has spilled out from the excavation 9. In this manner the compressible mat 15 remains isolated and can easily be removed during the excavation of the adjacent panel.

[0060] In practice it has been found that the stop-end pipe, according to the present invention, achieves the intended aim and objects in that it can be easily removed and recovered for a subsequent use.

[0061] Another advantage of the stop-end pipe, according to the invention, consists in that its removal does not entail damaging the stop-end pipe and the concrete that has just been formed.

[0062] Another advantage of the stop-end pipe, according to the invention, consists in that its easy removal makes it possible to drastically reduce the time for the construction of a diaphragm wall in concrete.

[0063] Another advantage of the stop-end pipe, according to the invention, consists in that it can be easily removed, irrespective of the precision with which the excavation for the formation of the panels of concrete has been carried out.

[0064] Another advantage of the stop-end pipe, according to the invention, consists in that the tubular chamber, the function of which is to facilitate the removal and recovery of the stop-end pipe, also performs the function of waterstop.

[0065] Another advantage relates to the fact that the stop-end pipe, once recovered, requires minimal cleaning operations from the residual concrete that has adhered to its walls, thanks in part to the presence of the compressible mat.

[0066] Another advantage relates to the fact that considerable depths can be reached, since the traction of separation between concrete, stop-end pipe and soil are drastically reduced.

[0067] All these advantages make it possible, definitively, to schedule work with certainty, thus reducing the times and costs of situations of dealing with unforeseeable problems.

[0068] The stop-end pipe, thus conceived, is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

[0069] Moreover, all the details may be substituted by other, technically equivalent elements.

[0070] In practice the materials employed, provided they are compatible with the specific use, and the contingent dimensions and shapes, may be any according to requirements.

[0071] The disclosures in Italian Patent Application No. MI2014A001758 (102014902299211) from which this application claims priority are incorporated herein by reference.

[0072] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A stop-end pipe (1) for the construction of concrete diaphragm walls, which comprises a longitudinally extended structure (3) which has at least one first face (5) configured to face the concrete (7) intended to fill an excavation (9) for the provision of a diaphragm wall, **characterized in that** at least one tubular chamber (11) is associated with said first face (5) and has a longitudinal axis (12) which is substantially parallel to the axis of longitudinal extension of said structure (3), said tubular chamber (11) being expandable hydraulically in a direction that is transverse to its axis (12), so that the expansion of said tubular chamber (11) is adapted to impart a translation of said stop-end pipe (1) with respect to said concrete (7), said translation being intended to detach it from the concrete that is present in said excavation (9).
2. The stop-end pipe (1) according to claim 1, **characterized in that** said structure (3) has a second face (13) which lies opposite said first face (5), a compressible element (15) being associated with said second face (13) and being adapted to be compressed in order to absorb said translation of said stop-end pipe (1) with respect to said concrete (7), said translation being intended to detach it from the concrete that is present in said excavation (9).
3. The stop-end pipe (1) according to claim 1 or 2, **characterized in that** said at least one tubular chamber (11) is extended substantially along the entire length of said structure (3).
4. The stop-end pipe (1) according to one or more of

the preceding claims, **characterized in that** the length of said at least one compressible element (15) is extended substantially along the entire length of said structure (3).

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5. The stop-end pipe (1) according to one or more of the preceding claims, **characterized in that** said tubular chamber (11) has a cross-section which is narrower in a direction transverse to said longitudinal axis. 10
6. The stop-end pipe (1) according to one or more of the preceding claims, **characterized in that** said tubular chamber (11) comprises a duct (17) for injecting a fluid that is adapted to be pressurized, and at least one lateral sac (19, 21) which is connected to said injection duct (17). 15
7. The stop-end pipe (1) according to one or more of the preceding claims, **characterized in that** said at least one tubular chamber (11) comprises walls made of an elastically deformable material. 20
8. The stop-end pipe (1) according to one or more of the preceding claims, **characterized in that** said tubular chamber (11) comprises at least one waterstop flap (23, 26). 25
9. The stop-end pipe (1) according to one or more of the preceding claims, **characterized in that** said structure (3) comprises, at said first face (5), a seat (27) which is configured to accommodate detachably said at least one waterstop flap (23, 26). 30
10. The stop-end pipe (1) according to one or more of the preceding claims, **characterized in that** said compressible element (15) is extended at said second face (13) of said structure (3) and beyond the lateral edges of said structure (3). 35
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11. The stop-end pipe (1) according to one or more of the preceding claims, **characterized in that** said structure (3) comprises, at said second face (13), a longitudinal compartment (29) which is adapted to engage excavation means in order to provide an adjacent excavation. 45
12. A hydraulically expandable element for stop-end pipes (1), **characterized in that** it comprises a tubular chamber (11) which is hydraulically expandable in a direction that is transverse to its longitudinal axis. 50
13. The hydraulically expandable element for stop-end pipes (1) according to claim 12, **characterized in that** it comprises at least one waterstop flap (23, 26). 55
14. A method for recovering a stop-end pipe (1), **char-**

acterized in that it comprises the steps of:

- expanding at least one tubular chamber (11) which is associated with said stop-end pipe (1) and has a longitudinal axis that is substantially parallel to the axis of longitudinal extension of said stop-end pipe (1), so that said stop-end type (1) detaches from the concrete (7) which is present in an excavation (9) for providing a diaphragm wall;
- extracting said stop-end pipe (1) once it has detached from said concrete (7).

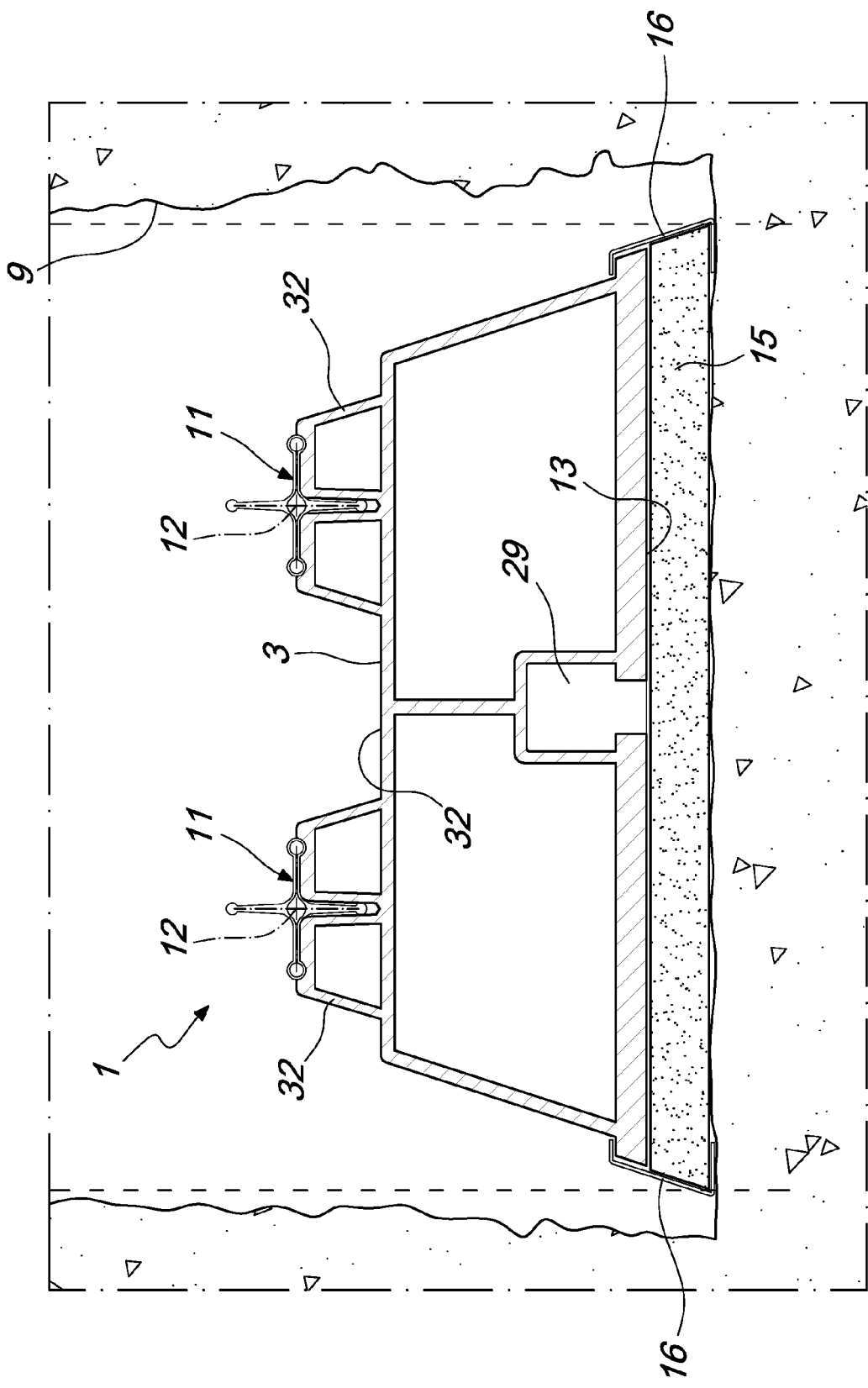


Fig. 1

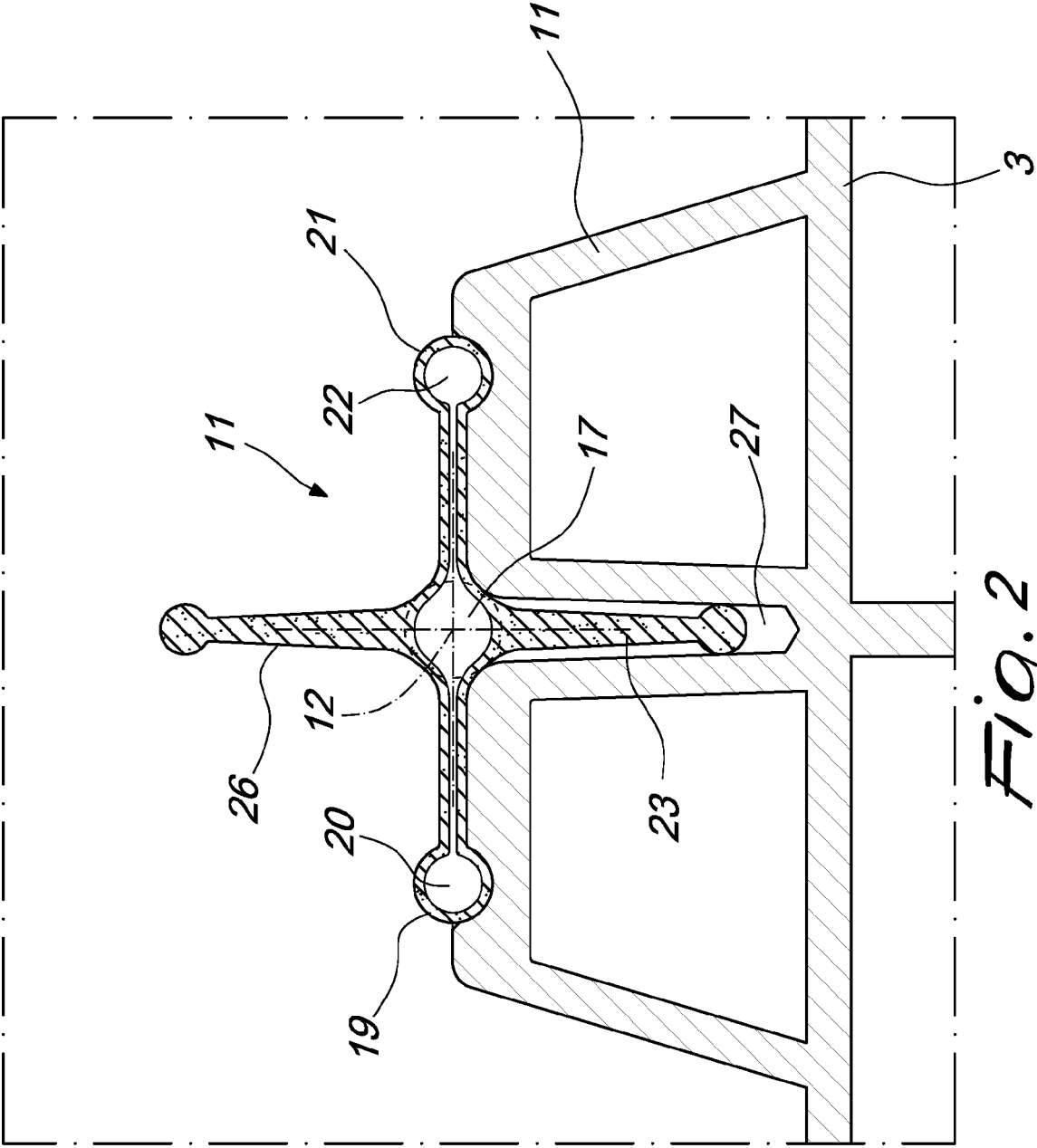


Fig. 2

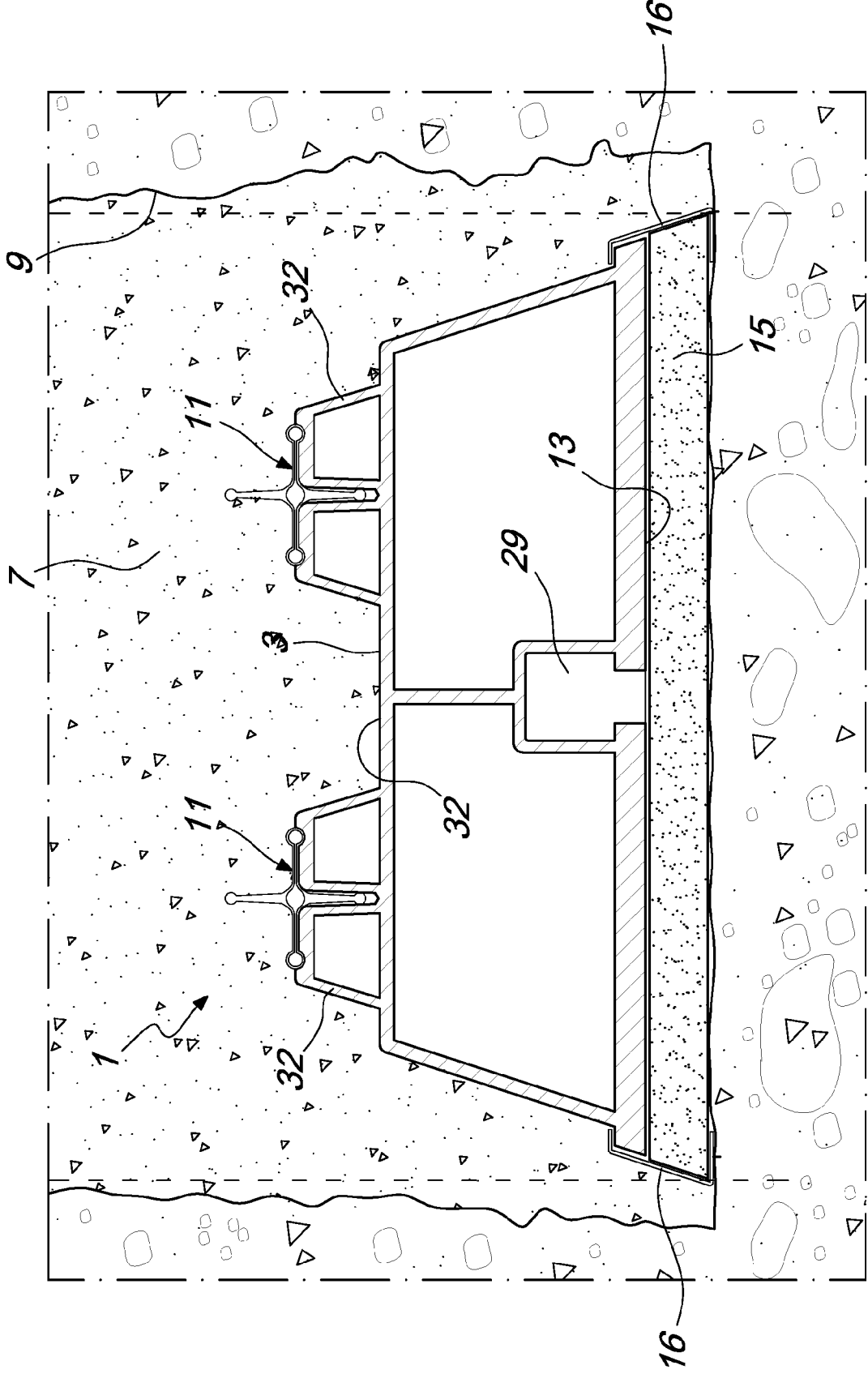


Fig. 3

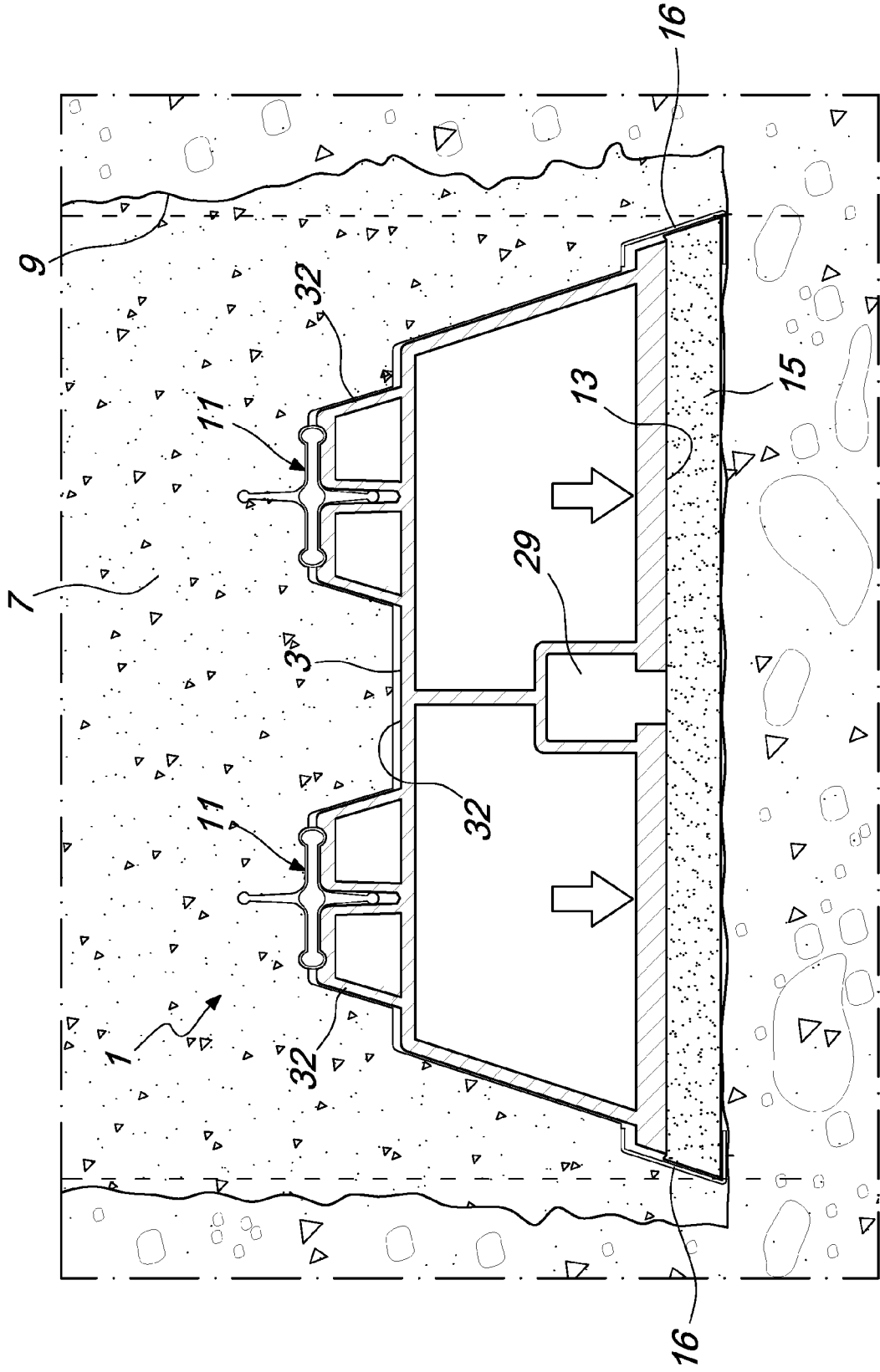


Fig. 4



EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 580 926 A1 (RODIO & C CONST G [IT]) 2 February 1994 (1994-02-02) * the whole document *	1-14	INV. E02D5/18
A	FR 2 617 881 A1 (SPIE BATIGNOLLES [FR]) 13 January 1989 (1989-01-13) * the whole document *	1,12,14	
			TECHNICAL FIELDS SEARCHED (IPC)
			E02D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 28 January 2016	Examiner Friedrich, Albert
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 15 18 8509

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The members are as contained in the European Patent Office EDP file on
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28-01-2016

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0580926	A1	02-02-1994	NONE

FR 2617881	A1	13-01-1989	NONE

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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