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(54) Method for constructing a retaining wall

(57) Method for constructing a retaining wall, wherein a pile-shaped space is bored in each case in the ground and filled with a curing mixture in order to obtain an array of primary piles (1) at a mutual pitch distance, whereafter at least one secondary pile-shaped space is bored in each case in the ground between each pair of adjacent primary piles (1) and filled with a curing mixture in order to obtain an array of secondary piles (3), wherein the pitch distance between the primary piles is sealed by at least one secondary pile (3).

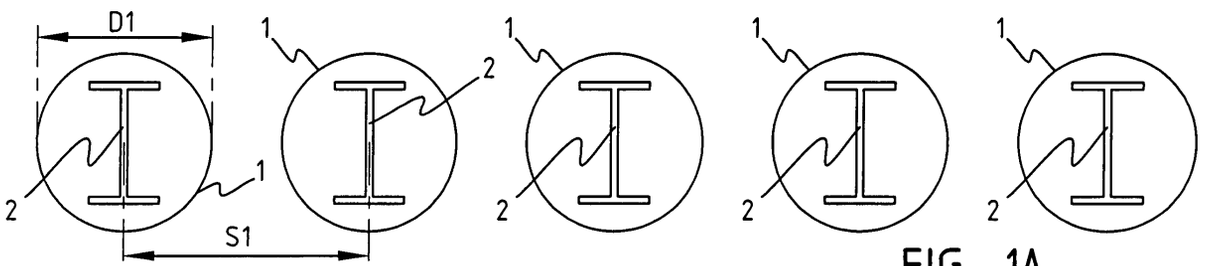

FIG. 1A

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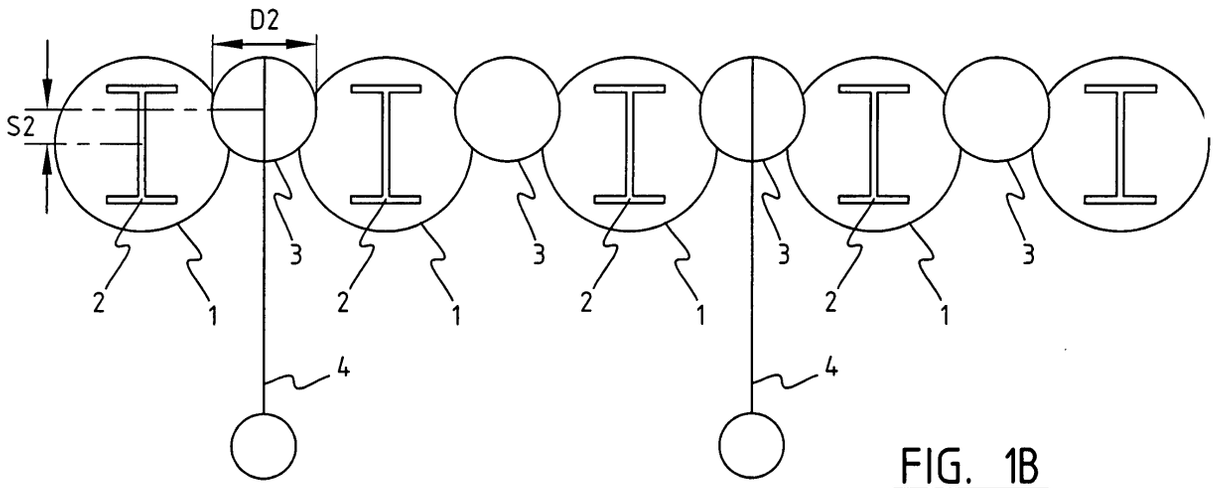


FIG. 1B

Description

[0001] The invention relates to a method for constructing a retaining wall, wherein a pile-shaped space is bored in each case in the ground and filled with a curing mixture in order to obtain an array of primary piles at a mutual pitch distance, whereafter at least one secondary pile-shaped space is bored in each case in the ground between each pair of adjacent primary piles and filled with a curing mixture in order to obtain a secondary array of piles, wherein the pitch distance between the primary piles is sealed by at least one secondary pile.

[0002] Bored piles are often used for the construction of temporary earth-retaining walls, such as a sheet piling for a construction site. Such techniques are well-known. According to a known technique such a construction is built up of a series of primary piles, which are for instance formed by boring a pile-shaped space wherein the soil is replaced by concrete. Between each pair of primary piles is then bored a secondary pile-shaped space, which is filled with concrete and in which a reinforcing profile is generally placed. The distance between the primary piles is smaller than the diameter of the secondary pile, so that a part of the primary piles is removed by the drilling during boring of the secondary pile-shaped spaces. An anchor can subsequently be arranged which runs to the right or left of the reinforcement and therefore not through the middle of the secondary pile.

[0003] Such a technique has the drawback that the asymmetrically arranged anchors do not result in an ideal distribution of the anchor forces. A further drawback of this technique is that the primary piles are embodied in concrete, which involves a great deal of soil removal.

[0004] The invention has for its object a method for constructing a retaining wall with bored piles, wherein the reinforcements and the stabilizing members, such as for instance anchors, can be better arranged.

[0005] The method according to the invention is distinguished for this purpose in that a reinforcing profile is placed in at least a number of the array of primary piles, and that at least a number of the secondary piles is provided with stabilizing members, such as an anchor or a strut, this such that the forces exerted transversely of the secondary piles are transmitted to the reinforcing profiles.

[0006] By arranging the reinforcement in the primary pile and the anchor in the secondary pile, the presence of a reinforcement in the same pile is not a problem and a better distribution of the anchor force is obtained. Since the distance between the centres of two adjacent primary piles is smaller than the diameter of the primary pile plus the diameter of the secondary pile multiplied by the number of secondary piles placed between two adjacent primary piles, the forces exerted on the secondary pile by the anchor can be transmitted to the primary pile, and more particularly to the reinforcement present therein. It will be evident that the dimensions and the strength of the piles, as well as the dimensions and strength of the reinforcement, must be such that these forces are adequately transmitted to the reinforcement.

[0007] The primary and secondary piles can be manufactured as desired by for instance on-site mixing or by removing the soil from the bored pile-shaped spaces and filling these spaces with concrete.

[0008] The invention further has for its object to limit soil removal and the costs associated therewith. According to a variant of the method according to the invention the soil is mixed on-site for this purpose with a binder at the position of the pile-shaped space for the primary pile. This is currently an economically advantageous technique for obtaining the primary piles. The applicability of this technique and the choice of binder depends on, among other factors, the nature of the soil in which the retaining wall must be arranged and on the desired strength of the retaining wall.

[0009] According to a further variant the secondary pile-shaped space is filled with concrete. Concrete provides the necessary strength to the construction and is an advantageous choice for the purpose of arranging the anchors or struts in the secondary piles.

[0010] According to another variant of the method according to the invention, at least one yoke is arranged against the periphery formed by the primary and secondary piles, on which yoke the stabilizing members engage.

[0011] In specific cases it may be advantageous that the array of secondary piles is formed such that the secondary piles contact an outer periphery which substantially coincides with the outside of reinforcing profiles of the primary piles, and that this side of the reinforcing profiles is exposed, whereafter a yoke is placed against this outer periphery formed by the secondary piles and reinforcing profiles. In this manner a good transfer of the forces from the anchor to the reinforcement is obtained.

[0012] The invention also relates to a method for at least partly demolishing a retaining wall manufactured according to one of the above described methods, wherein the reinforcing profiles of the primary piles are recovered.

[0013] Particularly when the reinforcing profiles are arranged in the piles mixed on-site, they can be removed from these piles in simple manner, whereafter they can for instance be re-used in a retaining wall to be constructed at a later stage. The costs of the relatively expensive reinforcements are thus saved, and no unnecessary, recyclable components are left on site.

[0014] The invention also relates to a retaining wall obtained according to any of the above described variants of the method according to the invention.

[0015] According to a preferred embodiment of the present invention, the secondary pile has a diameter which is smaller than or equal to that of the primary pile.

[0016] It is advantageous in many cases for the centre lines of the array of secondary piles to lie in a plane

which is at a distance from the centre lines of the primary piles, this such that the primary and secondary piles adjoin the same outer plane.

[0017] The invention further relates to a boring apparatus for on-site mixing of the soil with a binder for carrying out one of the above described methods, substantially consisting of a drive shaft with cutting and mixing blades placed transversely thereof, on the outer end of which a drilling end is mounted, above which drilling end are arranged spiral-shaped blades provided with injection nozzles for the binder. The boring apparatus according to the invention is distinguished in that recesses are arranged in the spiral-shaped blades. These recesses result in a better mixing of the soil with the binder coming from the injection nozzles.

[0018] According to the preferred embodiment of the boring apparatus according to the invention, the pitch of the spiral-shaped blades is substantially equal to the diameter thereof. Such a pitch-diameter ratio results in a good mixing of the binder and the soil, so that the pile is constructed from a relatively homogeneous material, and important quantities such as the compression strength vary little through the pile.

[0019] The invention will be further elucidated on the basis of the figure description hereinbelow and the annexed drawing, in which:

Figure 1(A) is a schematic cross-section of an array of primary piles of an embodiment of a retaining wall according to the invention;
Figure 1(B) is a schematic cross-section of an embodiment of a retaining wall according to the invention;
Figure 2 is a perspective view of an embodiment of the retaining wall according to the invention;
Figure 3 shows a detail of a front view of an anchor fixed to a secondary pile of an embodiment of the retaining wall according to the invention;
Figure 4 is a cross-section along I-I in Figure 3;
Figure 5 shows a detail of a schematic cross-section of an embodiment of a retaining wall with yoke according to the invention;
Figure 6 is a perspective view of a boring apparatus for on-site mixing with a binder or a curing mixture as according to the prior art;
Figure 7 shows a detail of a front view of an embodiment of the boring apparatus for on-site mixing with a binder or a curing mixture according to the invention;
Figure 8 shows a detail of a side view of an embodiment of the boring apparatus for on-site mixing with a binder or a curing mixture according to the invention.

[0020] The method according to the invention will be explained with reference to figure 1. In step A is shown an array of 4 primary piles 1, which piles 1 are at a mutual pitch distance of S1. These piles 1 are obtained in each case by on-site mixing of a pile-shaped space with a curing mixture, whereafter a reinforcing profile 2 is placed in the array of primary piles 1.

[0021] As shown in figure 1(B), at least one secondary pile-shaped space is then bored in the ground in each case between each pair of adjacent primary piles 1 and filled with concrete in order to obtain an array of secondary piles 3. The pitch distance S1 between primary piles 1 is sealed by a secondary pile 3. Two of the three shown secondary piles 3 are provided with an anchor 4 such that the forces exerted transversely of secondary pile 3 are transmitted to the reinforcing profiles 2.

[0022] The secondary pile preferably has a diameter D2 which is smaller than or equal to that of the primary pile D1, and the centre lines of the array of secondary piles 3 preferably lie in a plane at a distance S2 from the centre lines of the primary piles 1. In this manner the primary piles 1 and the secondary piles 2 adjoin the same outer plane.

[0023] A perspective view of the thus obtained retaining wall is shown in Figure 2.

[0024] Figures 3 and 4 illustrate in detail an anchor mounted on a secondary pile. Anchor 4 protrudes through the secondary pile 3 on which the anchor 4 is mounted by means of a supporting plate 5 and a screw 6. Such a construction guarantees a good transmission to reinforcing profiles 2 of the forces exerted on anchor 4.

[0025] Figure 5 shows a yoke 7 which is arranged against the periphery 8 formed by primary piles 1 and secondary piles 3. On this yoke 7 can engage stabilizing members such as an anchor or strut. The array of secondary piles 3 is formed such that the outer periphery 8 with which the secondary piles 3 make contact substantially coincides with outer side 9 of reinforcing profiles 2. This side 9 of reinforcing profiles 2 is exposed, and in the embodiment of figure 5 the yoke 7 supports directly against these sides 9 of reinforcing profiles 2.

[0026] Figure 6 shows a known device for on-site mixing of a pile-shaped space. During the drilling the shaft 14 of the boring unit is moved downward along shaft 16 and then back up again.

[0027] Figures 7 and 8 show details of the boring apparatus which can for instance be used to obtain the primary piles 1 of the embodiment of figure 1. The boring apparatus must be placed for this purpose at the position of the pile-shaped space for boring, whereupon the boring, in combination with injection of binder, is carried out to the desired depth, which can for instance be 18 metres. The drill is then brought back up while further mixing the soil with the binder.

[0028] The boring apparatus shown in figures 7 and 8 for boring with on-site mixing of the soil with a binder consists substantially of a drive shaft 14 with cutting and mixing blades 15 placed transversely thereof. Mounted on the outer end of shaft 14 is a drilling end 10, above which are arranged spiral-shaped blades 12 provided with injection nozzles 11 for the binder. Recesses 13 are

arranged in spiral-shaped blades 12. These recesses 13 ensure a good mixing of the soil with the binder coming from injection nozzles 11.

[0029] In such a construction the pitch S3 of the spiral-shaped blades 12 is preferably roughly equal to the diameter D3 thereof. Such a ratio of S3/D3 guarantees a good mixing of the binder and the soil, so that the pile is constructed from a relatively homogeneous material.

[0030] The above described embodiments of the invention must be deemed as examples, and the scope of protection of the invention is limited only by the following claims.

Claims

1. Method for constructing a retaining wall, wherein a pile-shaped space is bored in each case in the ground and filled with a curing mixture in order to obtain an array of primary piles at a mutual pitch distance, whereafter at least one secondary pile-shaped space is bored in each case in the ground between each pair of adjacent primary piles and filled with a curing mixture in order to obtain an array of secondary piles, wherein the pitch distance between the primary piles is sealed by at least one secondary pile, **characterized in that** a reinforcing profile is placed in at least a number of the array of primary piles, and that at least a number of the secondary piles is provided with stabilizing members, such as an anchor or a strut, this such that the forces exerted transversely of the secondary pile are transmitted to the reinforcing profiles.

2. Method as claimed in claim 1, **characterized in that** during boring of the pile-shaped space for the primary pile the soil is mixed on-site with a binder.

3. Method as claimed in claims 1-2, **characterized in that** after boring of the pile-shaped space for the secondary pile, this space is filled with concrete.

4. Method as claimed in any of the foregoing claims, **characterized in that** at least one yoke is arranged against the periphery formed by the primary and secondary piles, on which yoke the stabilizing members engage.

5. Method as claimed in claim 4, **characterized in that** the array of secondary piles is formed such that the secondary piles contact an outer periphery which substantially coincides with the outside of reinforcing profiles of the primary piles, and that this side of the reinforcing profiles is exposed, whereafter a yoke is placed against this outer periphery formed by the secondary piles and reinforcing profiles.

6. Method for at least partly demolishing a retaining wall manufactured according to the method as claimed in any of the foregoing claims, **characterized in that** the reinforcing profiles of the primary piles are recovered.

7. Retaining wall obtained according to the method as claimed in any of the foregoing claims.

8. Retaining wall as claimed in claim 7, **characterized in that** the secondary pile has a diameter which is smaller than or equal to that of the primary pile.

9. Retaining wall as claimed in either of the claims 7-8, **characterized in that** the centre lines of the array of secondary piles lies in a plane lying at a distance from the centre lines of the primary piles.

10. Boring apparatus for on-site mixing of the soil with a binder for carrying out the method as claimed in any of the foregoing claims, substantially consisting of a drive shaft with cutting and mixing blades placed substantially transversely thereof, on the outer end of which a drilling end is mounted, above which drilling end are arranged spiral-shaped blades provided with injection nozzles for the binder, **characterized in that** recesses are arranged in the spiral-shaped blades.

11. Boring apparatus as claimed in claim 10, **characterized in that** the pitch of the spiral-shaped blades is substantially equal to the diameter thereof.

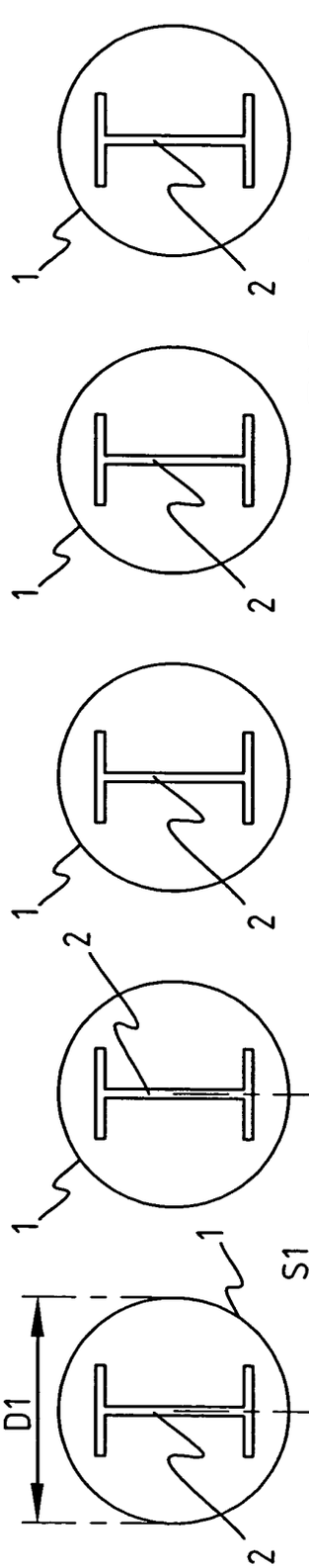


FIG. 1A

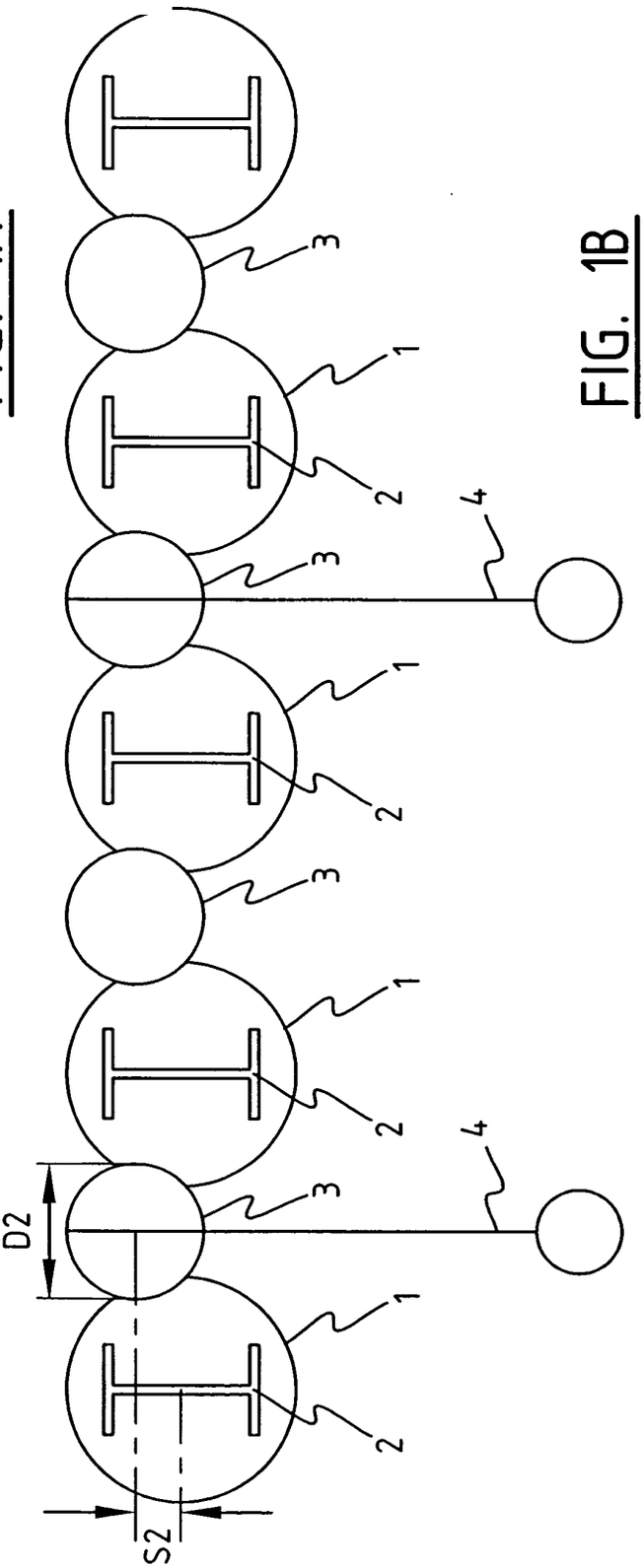
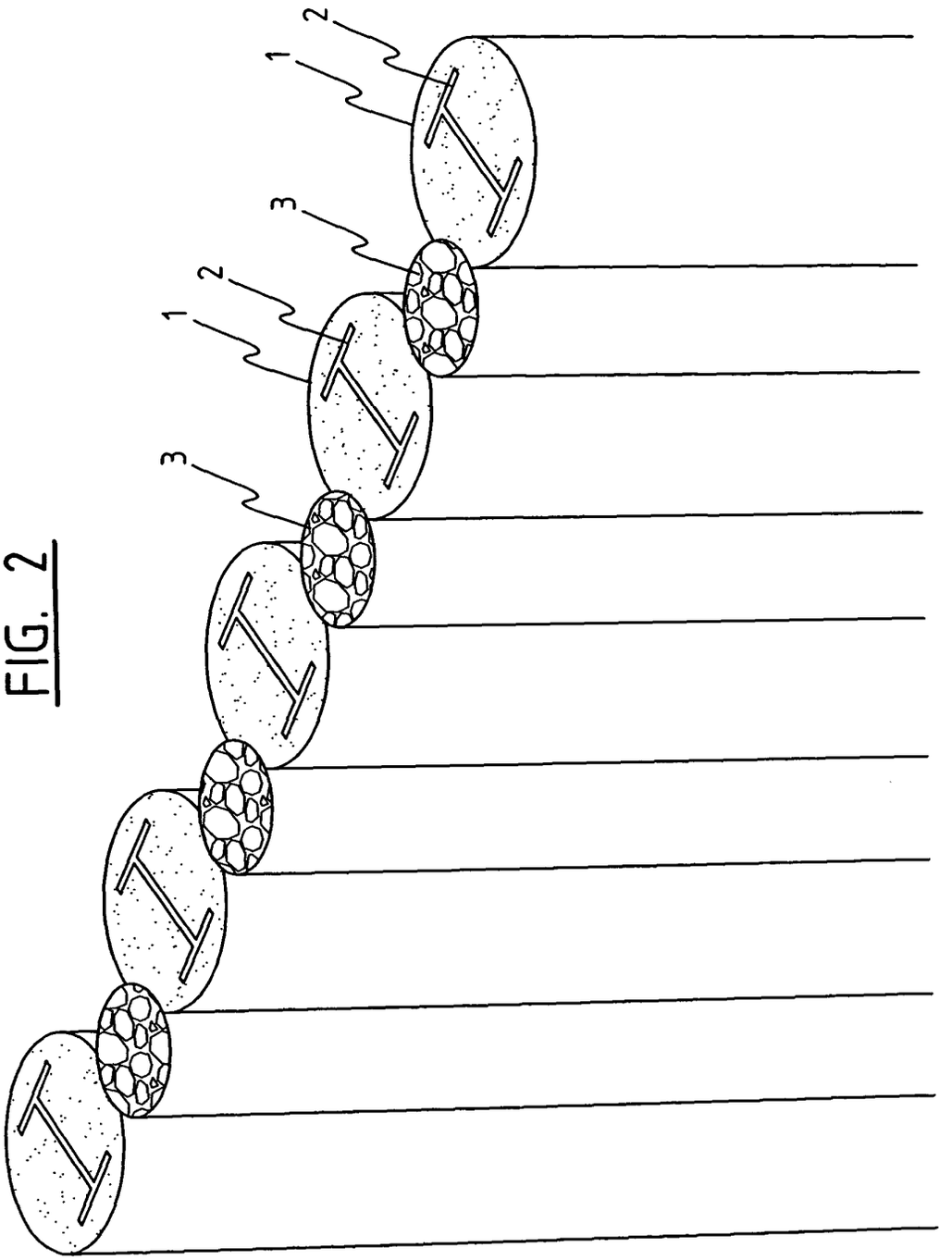


FIG. 1B

FIG. 2



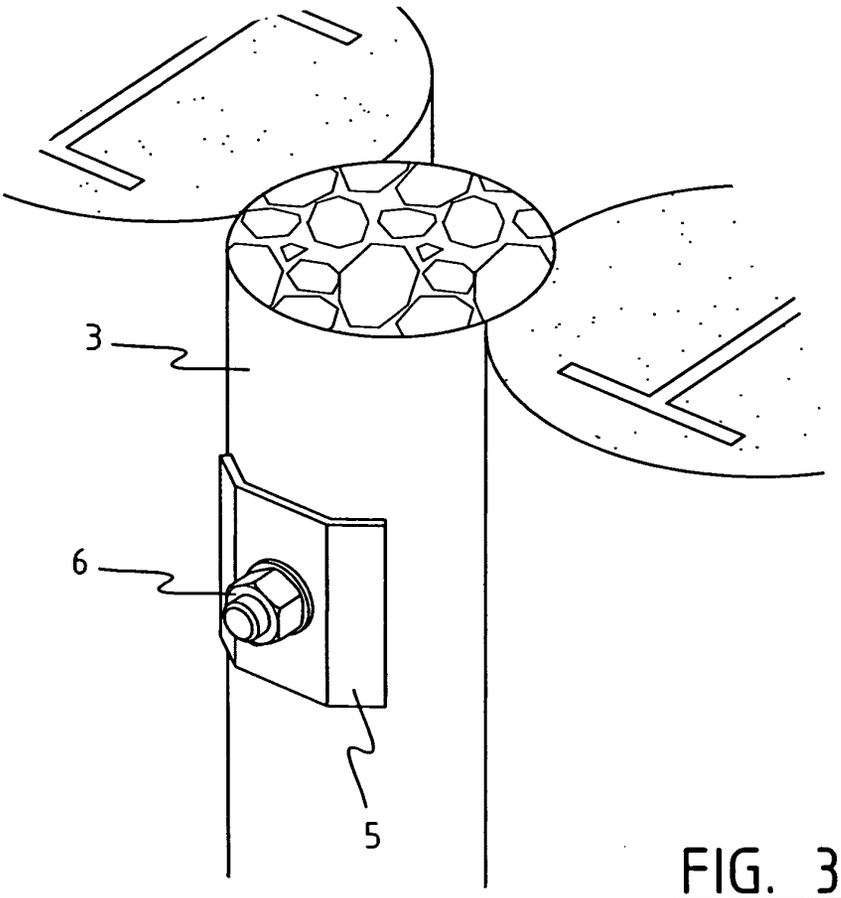


FIG. 3

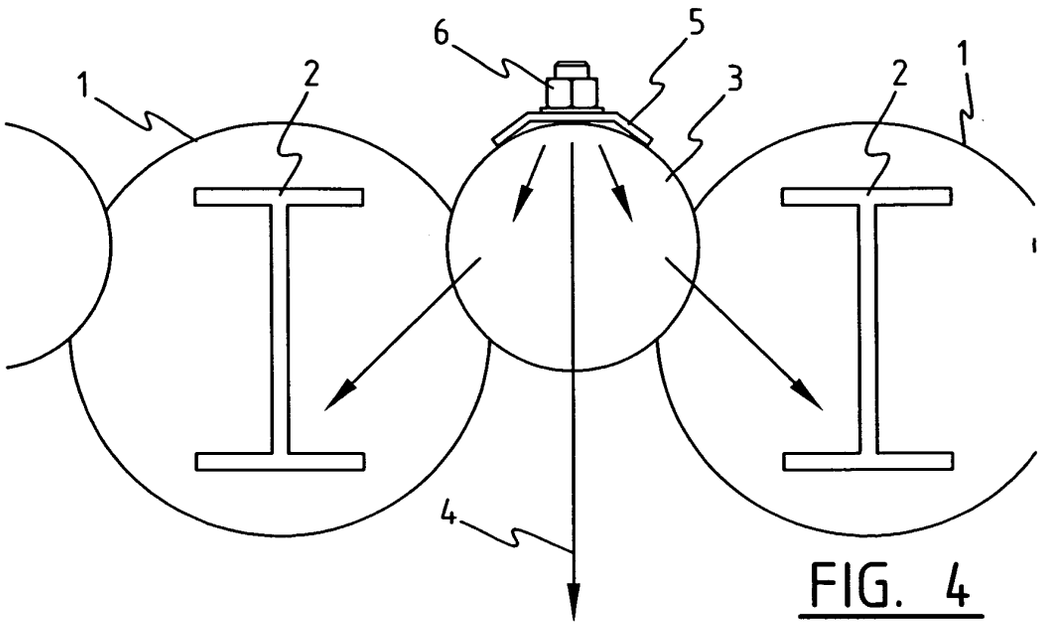


FIG. 4

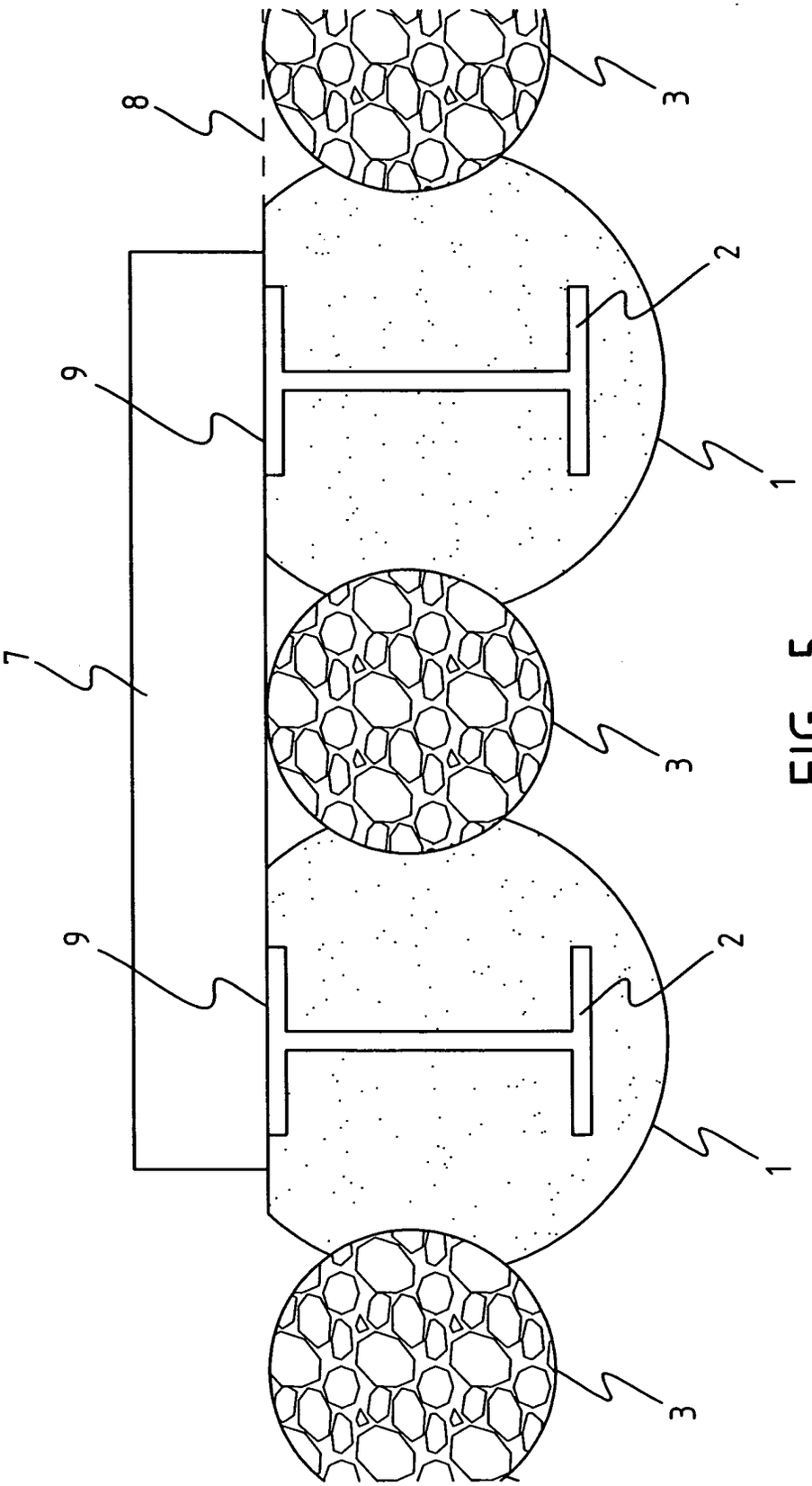


FIG. 5

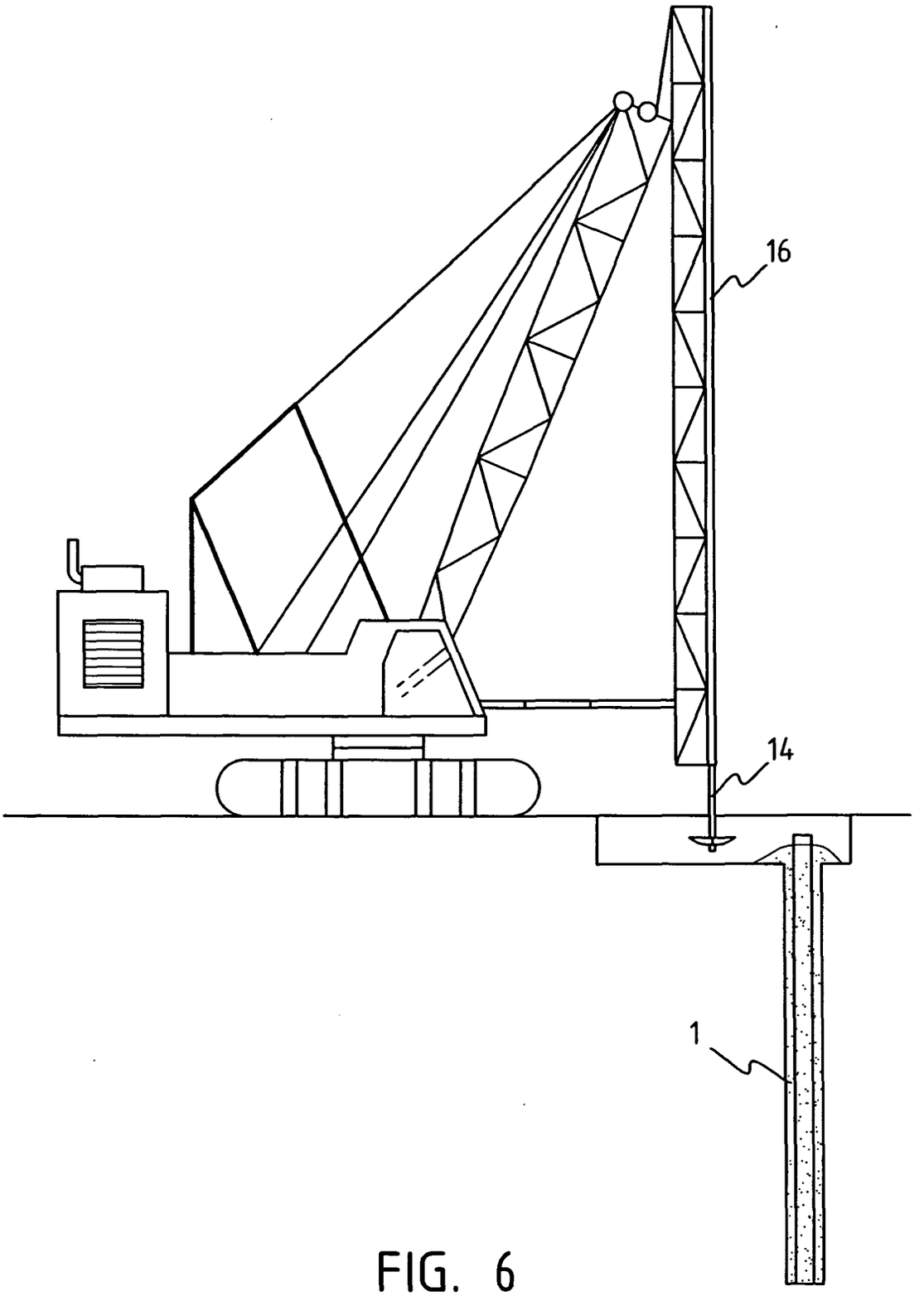


FIG. 6

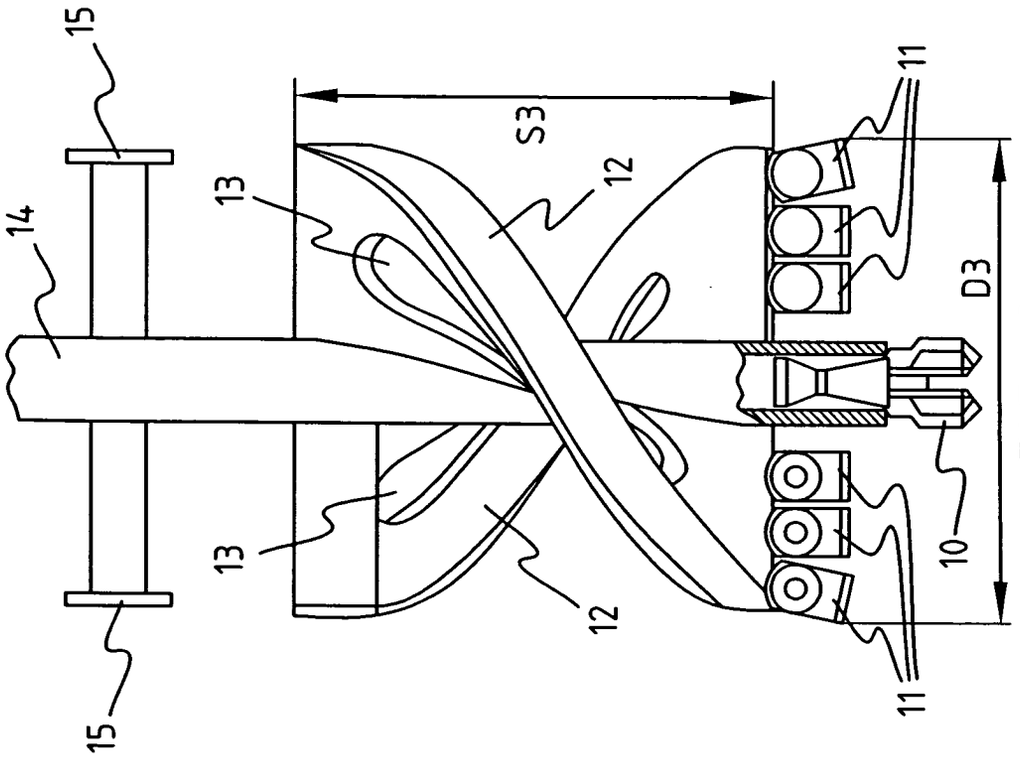


FIG. 8

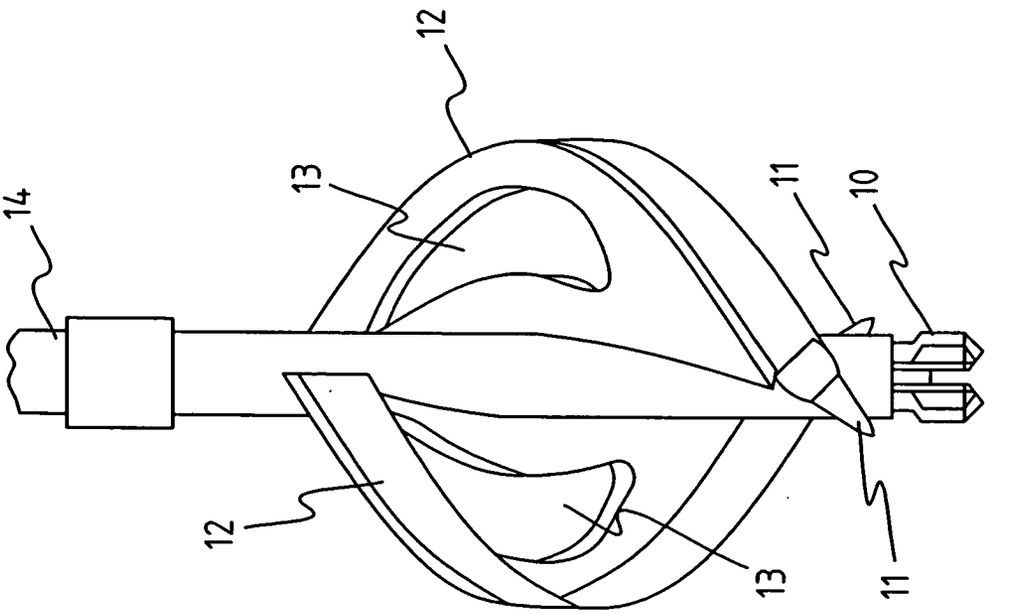


FIG. 7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 07 8471

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Y	* claim 1; figure 5 *	4,5	
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A	* claim 1; figures 3,4 *	11	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	13 February 2004	Hendrickx, X

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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