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(54) **SELF-LAUNCHING FORMWORK SYSTEM AND METHOD FOR LINING A TUNNEL**

(57) The invention refers to a formwork system (1) for lining a tunnel, comprising: a reconfigurable formwork structure (3) and a guiding structure (10) configured to be attached and detached from a fixed part of the tunnel. The formwork system (3) is configured such that: the guiding structure (10) is slidable in the longitudinal direction of the tunnel, supported by the formwork structure (3) in its deployed configuration and when the guiding structure is released, and the formwork structure (3) is slidable in the longitudinal direction of the tunnel supported by the guiding structure (10) when the formwork structure (3) is in its folded configuration and the guiding structure is fixed. The invention also refers to a method for lining a tunnel, using the formwork system previously described. The invention reduces execution time, reduces construction cost and improve safety.

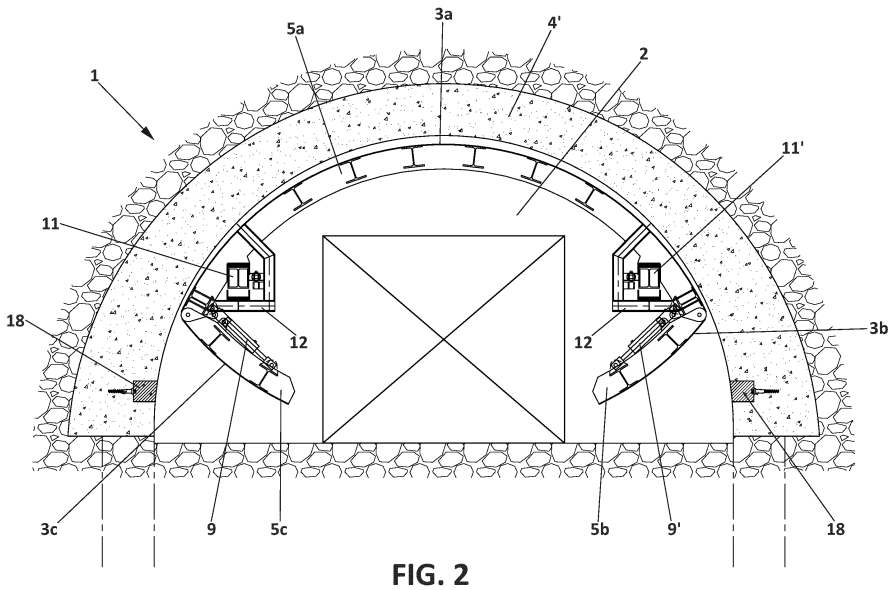

FIG. 2

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Description

TECHNICAL FIELD

[0001] The present invention refers in general to formwork machinery and methods for lining mine tunnels.

[0002] An object of the invention is the provision of a formwork system and a method for lining a tunnel, that: reduce execution time, reduce construction cost and improve safety.

[0003] The use of the invention is especially advantageous for the construction of tunnels in soft soils,
for example, in cases when the so-called Belgian method of tunneling is recommended.

STATE OF THE ART

[0004] Formwork machinery for internally lining the interior of a tunnel by concrete casting, are made up of a series of panels that form a ring defining the vault and the sides of the tunnel. The formwork assembly is normally mounted on a trolley that moves longitudinally along the tunnel, from one section to the next, supported on pre-laid railway rails or on the tunnel's floor. The formwork panels are fitted with hinged joints that allow the side panels to be folded inwards, so that the formwork can be folded and moved to be positioned for the next batch and then concreted in the next pour.

[0005] In the particular case of the so-called Belgian method or traditional method of Madrid for excavating and lining a tunnel, the execution method is carried out in two main stages: advance excavation and down excavation.

[0006] The sequence of operational phases of this construction method are as follows:

- excavation and shoring of a small advance gallery at the vault level,
- lateral widening and shoring of the advance gallery,
- formwork installation and concrete casting of the vault,
- down excavation and concreting of the gables,
- execution of the counter-vault.

[0007] Therefore, in this method the vault excavation is gradually shored and widened to form the complete vault, but with a longitudinal offset for each widening stage, so that the excavation face is small in order to assure stability of the excavation.

[0008] The Belgian method is generally used for the execution of short tunnels excavated in soils consisting of compact clays or clays with a certain percentage of sands, and it provides the advantage of reducing the risk of instabilities of the excavation because a small vault excavation is first performed.

[0009] However, this method is slow and expensive because the tunnel has to be excavated manually by skilled workers, and lined in short sections or batches, so that a large number of assembly and disassembly operations of the formwork are required.

[0010] Therefore, it would be desirable to have formwork system capable of executing the above-described tunneling method in a more automated manner, in order to reduce execution time and cost.

DESCRIPTION OF THE INVENTION

[0011] The invention is defined in the attached independent claims, and satisfactorily solves the above-described drawbacks of the prior art, by the provision of a formwork system and a tunnel lining method as described in the attached independent claims.

[0012] Therefore, an aspect of the invention refers to a formwork system for lining a tunnel or a part of the same, especially for lining the vault of a tunnel, wherein the formwork system comprises a reconfigurable formwork structure that can be configured in a deployed or shuttering position for lining a part of a tunnel by concrete casting, and in a folded position for demolding and transporting the formwork structure.

[0013] Conventionally, the formwork structure in turn comprises a vault section and two side sections articulately coupled respectively to the two lateral ends of the vault section, and first hydraulic means coupled with the formwork structure for deploying and folding the formwork structure as described above.

[0014] The formwork system further comprises a guiding structure configured to be attached and detached from a fixed part of the tunnel, preferably to the concrete of a previously lined section of the tunnel.

[0015] Preferably, the guiding structure comprises a pair of rails parallel to each other and placed in a longitudinally direction of the tunnel (that is, in the normal direction of moving forward inside a tunnel) when the formwork structure is operatively installed for lining a tunnel.

[0016] The rails are placed internally or at least in part, within the space defined internally by the formwork structure. For example, the rails can be placed at the same height within the space defined internally by the formwork structure.

[0017] The formwork system is configured such that the guiding structure can move forward in the longitudinal direction of the tunnel (when the formwork structure is operatively installed for lining a tunnel), supported by the formwork structure when the formwork structure is in its deployed configuration and when the guiding structure is released.

[0018] Additionally, the formwork structure is movable in the longitudinal direction of the tunnel (when the formwork structure is operatively installed for lining a tunnel), supported and guided by the guiding structure when the formwork structure is in its folded configuration, and the guiding structure is fixed to a part of the tunnel, such as to the concrete of a previously lined section.

[0019] In a preferred implementation of the invention,

the displacement of the guiding structure in the longitudinal direction of the tunnel, is carried out by second hydraulic means, such as hydraulic cylinders or jacks, and the displacement of the formwork structure in the longitudinal direction of the tunnel, is carried out by third hydraulic means, such as hydraulic cylinders or jacks. Alternatively to the use of hydraulic cylinders, other conventional means suitable for the displacement of the guiding structure and the formwork structure, for example a mechanism comprising gears and racks, could be used.

[0020] With the above-described configuration, the formwork system is self-launchable into the tunnel, because the formwork structure is launched forward into the tunnel supported and guided by the guiding structure, and in turn the guiding structure is launched forward into the tunnel supported by the formwork structure. In this way, the time and complexity of the process required for the assembly, disassembly and positioning of the formwork structure to perform as many batches as required for the complete lining of a tunnel of a part thereof such as the vault, is significantly reduced.

[0021] In a preferred embodiment of the invention, the guiding structure and the formwork structure are movable in relation to each other by means of the vault section of the formwork structure.

[0022] For attaching the guiding structure to a fixed part of the tunnel, such as a previously lined section of the tunnel, the system comprises a supporting frame configured to be anchored to the concrete of a previously lined section of the tunnel, and for attaching and detaching the guiding structure.

[0023] To allow the formwork structure to easily move on the guiding structure and vice versa, the system is fitted with first displacement means arranged such that the formwork structure can move supported on the guiding structure, and second displacement means for the guiding structure to move supported on the formwork structure. Preferably, first and second displacement means comprises a plurality of rollers, which can be mounted with the formwork structure or with the guiding structure.

[0024] The formwork structure comprises at least one frame member. In a preferred embodiment, the formwork structure comprises at least two frame members, and more preferably four frame members coaxially arranged with respect to each other and along the axis of the tunnel when they are in the tunnel. Each frame member has a vault section and two side sections articulately coupled with the vault section, and each vault section of each frame member has a left pair of rollers and a right pair of rollers, so that a left rail is placed inside the left pairs of rollers of the vault sections, and a right rail is placed inside the right pairs of rollers of the vault sections. In each pair of rollers, one roller is placed above the other.

[0025] There are lower contact points between the formwork structure and the guiding structure when the guiding structure is moving on the formwork structure, and similarly, there are upper contact points, above the previously mentioned contact points, between the formwork structure and the guiding structure when the formwork structure is moving on the guiding structure in a steady manner. Preferably, there are at least two lower and two upper contacts points, and more preferably there are four lower and four upper contact points.

[0026] Another aspect of the invention refers to a method for lining a tunnel especially the vault thereof, wherein the method preferably uses the formwork system previously described.

[0027] The method comprises the steps of:

- deploying a formwork structure for lining a curved section of a tunnel, and pouring concrete for lining that section of the tunnel,
- moving a guiding structure forward into the tunnel supported by the formwork structure in its deployed configuration, and fixing the guiding structure to a previously casted section of the lining,
- folding the formwork structure inwards such that it rests on the guiding structure, and moving the formwork structure forward in its folded configuration into the tunnel supported and guided by the guiding structure, and
- deploying again the formwork structure for lining a subsequent curved section of the tunnel.

[0028] Due to the guiding structure, the formwork structure can be moved towards the new badge to be executed without the need to dismantle and assemble the formwork structure at each badge, and because it is anchored to the concrete of the previous badge previously executed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] To complete the description and in order to provide a better understanding of the invention, a set of drawings is provided. These drawings form an integral part of the description and illustrate embodiments of the invention, which should not be interpreted as restricting the scope of the invention, but just as examples of how the invention can be carried out. The drawings comprise the following figures:

Figure 1.- shows a front elevational view of a formwork system of the invention in its deployed position for internally lining the vault of a tunnel.

Figure 2.- shows a similar representation than Figure 1 but with the formwork structure in its folded position for demolding an already concrete casted section and for transporting the same.

Figure 3.- shows a schematic representation in perspective view of the resistive members of the formwork structure according to the invention.

Figure 4.- shows a longitudinal cross-sectional view of the formwork system of the previous figures, in its deployed position for casting a section of a tunnel.

Figure 5.- shows in a similar representation than the previous figure, the next stage of the process wherein the rails are being launched forward into the tunnel (movement indicated by arrows), once a section of a tunnel has been casted.

Figure 6.- shows in a similar representation than the previous figure, the next stage of the process wherein the formwork structure is folded and lowered to be supported on the rails (movement indicated by arrows).

Figure 7.- shows in a similar representation than the previous figure, the next stage of the process wherein the formwork structure is being launched forward into the tunnel supported and guided by the guiding structure (movement indicated by arrows).

Figure 8.- shows in a similar representation than the previous figure, the next stage of the process wherein the formwork structure is being deployed again for casting the next section of a tunnel (movement indicated by arrows).

Figure 9.- shows in a similar representation than the previous figure, the next stage of the process wherein the supporting frame is moved forward on the rails to the next attaching position.

DESCRIPTION OF WAYS OF CARRYING OUT THE INVENTION

[0030] **Figures 1** and **2** show a formwork system (1) for constructing a concrete lining (4,4',4") for the vault (2) of a tunnel, wherein the system (1) comprises a reconfigurable formwork structure (3) formed by a vault surface (3a) and two side surfaces (3b,3c) articulately coupled respectively to two lateral ends of the vault surface (3a).

[0031] As represented in **Figures 5** to **9,** the formwork structure (3) comprises frame members (5,6,7,8) coaxially arranged, each frame member (5,6,7,8) having vault segment (5a,6a,7a,8a) to support the vault surface (3a), and two side segments (5b,5c,6b,6c,7b,7c,8b,8c) to support the side surfaces (3b,3c), and articulately coupled to the lateral ends of the respective vault segment (5a,6a,7a,8a) by means of pivot joints, and operated respectively by hydraulic cylinders (9,9') in a known manner, so as to configure repeatedly the formwork structure (3) in the deployed configuration shown in **Figure 1** for concrete casting, or in the folded configuration shown in **Figure 2** for demolding and transporting the formwork structure (3).

[0032] In this exemplary implementation there are four frame members (5,6,7,8), but other implementations of the invention may have more or less than four frame members.

[0033] The formwork system (1) additionally comprises a guiding structure (10) for supporting and guiding the displacement of the formwork structure (3). The guiding structure (10) comprises a pair of rails (11,11') implemented for example as straight beams, placed at least in part within the space defined inside the formwork structure (3). The rails (11,11') extend longitudinally in the direction of the tunnel when the formwork system (1) is operatively installed for lining a tunnel as shown in the figures. As shown especially in **Figures 1** and **2,** the rails (11,11') are parallel to each other and are placed preferably at the same height within the vault (2) being lined. As it can be appreciated in **Figures 1** and **2,** the provision of the rails (11,11') at the lateral sides of the formwork structure (3), allow a large clearance for the passage and movement of vehicles and machinery required for the excavation work.

[0034] The formwork system (1) additionally includes a supporting frame (12) that can be attached to an already constructed section of a tunnel as represented in **Figures 4** to **8,** and detached from it as shown in **Figure 9.** The rails (11,11') can be attached to the supporting frame (12) by any type of fastening means, for example screws and nuts, and released from the supporting frame (12).

[0035] The supporting frame (12) has a pair of left guides (13) for the left rail (11), and a right pair of guides (13') for the right rail (11'). The guides (13,13') in each pair are aligned so as to maintain and guide the movement of the respective rail (11,11') longitudinally (in the direction of the tunnel), for example as represented in **Figure 5.** For that purpose, each guide (13,13') is fitted with rollers above and below the respective rail (11,11').

[0036] Furthermore, the vault segment (5a,6a,7a,8a) of each frame member (5,6,7,8) has a left pair of rollers (not shown) and a right pair of rollers (14,15,16,17), such that the left rail (11) is received inside the left pair of rollers, and the right rail (11') is received inside the right pair of rollers (14,15,16,17). In each pair of rollers, one roller is placed above the other, and the separation distance between rollers of the same pair, is longer than the height of the respective rail, as it can be noted for example in **Figure 1.** The axis of the rollers are transversally arranged in relation to the longitudinal axis of the rails (11,11').

[0037] In this manner, the guiding structure (10) and the formwork structure (3) can move in relation to each other by means of the vault segments (5a,6a,7a,8a).

[0038] With the above described configuration of the formwork system (1) and as represented in **Figure 5,** the guiding structure (10) formed by the rails (11,11') is movable in the longitudinal direction of the tunnel supported by the formwork structure (3) and by the support-

ing frame (12) (rolling on the lower rollers of the frames), when the formwork structure (3) is in its deployed configuration and when the rails (11,11') are released from the supporting frame (12).

[0039] Moreover, and as represented in **Figures 6** and **7,** when the formwork structure (3) is folded inwards for demolding a concrete section of the lining once forged, the formwork structure (3) is lowered until it rests on the rails (11,11'). In this position, the formwork structure (3) is moved forward (rolling on the upper rollers) into the tunnel supported and guided by the rails (11,11') which have been fixed again to the supporting frame (12).

[0040] As it can be noted in the figures, when the formwork structure (3) moves on the guiding structure (10), there are eight contact points between the two structures, four contact points for the left rail (11), and four for the right rail (11') all contact points within the same a first plane. Similarly, when the guiding structure (10) move on the formwork structure (3), there are eight contact points between the two structures, four contact points for the left rail (11), and four for the right rail (11') all contact points within another plane, parallel and below the second plane.

[0041] As represented in **Figure 8,** when the formwork structure (3) is positioned correctly for the next batch, then it is deployed again until it reaches the correct heigh for concrete casting the next section (4‴) of the vault (2).

[0042] The displacement of the guiding structure (10), and the displacement of the formwork structure (3) in the longitudinal direction, may be realized for example by means of respective hydraulic cylinders in a conventional manner.

[0043] At this stage, as represented in **Figure 9** the supporting frame (12) is released from its attachment to an already casted section of the tunnel, and moved forward moving on the rails (11,11'), and when supporting frame (12) reaches a position close to the formwork structure (3), then it is fixed again to a casted section of the tunnel.

[0044] The method for lining a tunnel using the previously described formwork system (1), comprises the following steps (not necessarily in the sequence described below):

In its deployed position, the formwork structure (3) is positioned for casting a section (4") of the vault (2) of a tunnel **(Figure 4).** At this stage, first and second frame members (5,6) are anchored to the concrete of a previously lined section (4') of the tunnel by means of brackets (18) so that third and fourth frame members (7,8) are overhanging supported by first and second frame members (5,6), as schematically represented in **Figure 3.** Then, concrete is poured for casting the section (4").

[0045] In the deployed position of the formwork structure (3), for example once the concrete in section (4") has forged, the rails (11,11') are detached from the supporting frame (12) and they are moved forward by means of hydraulic cylinders rolling on the lower rollers of the frame members (5,6,7,8) and guided by the supporting frame (12) **(Figure 5).** At this stage, an end segment of the rails (11,11') is cantilevered in a length similar to the length of the next section (4‴) of the tunnel to be lined.

[0046] In the next step, once the concrete in section (4") has forged, the rails (11,11') are attached again to the supporting frame (12), first and second frame members (5,6) are released from the brackets (18), and section (4") is demolded by folding the formwork structure (3) inwards **(Figure 6),** until the formwork structure (3) rest on the rails (11,11') through the upper rollers.

[0047] In its folded configuration, the formwork structure (3) is launched forward by means of hydraulic cylinders, supported and guided by the rails (11,11') to the correct position for the next batch **(Figure 7),** for casting the next section (4‴) and then the formwork structure (3) is deployed again and positioned correctly.

[0048] Finally, the supporting frame (12) is released from the concrete and from the rails (11,11') and it is moved forward by hydraulic cylinders guided by the rails (11,11'), until it reaches the first frame member (5) **(Figure 9),** and then it is fixed again to the concrete of a casted section of the vault of the tunnel and to the rails (11,11'), and first and second frame members (5,6) are anchored again to the previously lined section (4").

[0049] The above-described process is repeated as many times as necessary to complete the lining of the tunnel.

[0050] The invention is obviously not limited to the specific embodiment(s) described herein, but also encompasses any variations that may be considered by any person skilled in the art (for example, as regards the choice of materials, dimensions, components, configuration, etc.), within the general scope of the invention as defined in the claims.

Claims

1. Formwork system (1) for lining a tunnel, comprising:

a reconfigurable formwork structure (3) that can be configured in a deployed position for lining a tunnel by concrete casting, and in a folded position for its transportation,

a guiding structure (10) configured to be attached and detached from a fixed part of the tunnel,

and wherein the formwork system (3) is configured such that:

the guiding structure (10) is movable in the longitudinal direction of the tunnel, when the formwork structure (3) is operatively installed for lining a tunnel, supported by the formwork structure (3) when the formwork structure (3) is in its deployed configuration and when the guiding structure (10) is released, and

wherein the formwork structure (3) is movable in the longitudinal direction of the tunnel,
when the formwork structure (3) is operatively installed for lining a tunnel, supported by the guiding structure (10) when the formwork structure (3) is in its folded configuration and the guiding structure (10) is fixed.

2. Formwork system according to claim 1, further comprising a supporting frame (12) configured for attaching and detaching the guiding structure (10) to a fixed part of the tunnel.

3. Formwork system according to claim 1 or 2, wherein the guiding structure (10) comprises a pair of rails (11,11') placed internally in relation to the formwork structure (3), and wherein the rails (11,11') are parallel to each other and extent longitudinally in the direction of the tunnel when the formwork structure is operatively installed for lining a tunnel.

4. Formwork system according to any of the preceding claims, wherein the formwork structure (3) comprises first displacement means arranged such that guiding structure (10) can move supported by the formwork structure (3), and second displacement means arranged such that the formwork structure (3) can move supported on the guiding structure (10).

5. Formwork system according to claim 4, wherein the first and second displacement means comprises a plurality of rollers (13,13') mounted with the formwork structure (3) or with the guiding structure (10).

6. Formwork system according to any of the preceding claims, wherein the formwork structure (3) comprises a vault section (3a) and two side sections (3b,3c) articulately coupled respectively to two lateral ends of the vault section (3a), and wherein the guiding means (10) and the formwork structure (3) are movable in relation to each other by means of the vault section (3a).

7. Formwork system according to any of the preceding claims, configured such that there are at least two lower contact points between the formwork structure (3) and the guiding structure (10) when the guiding structure (10) is moving on the formwork structure (3), and there are at least two upper contact points between the formwork structure (3) and the guiding structure (10) when the formwork structure (3) is moving on the guiding structure (10).

8. Formwork system according to any of the preceding claims, further comprising:

first hydraulic means coupled with the formwork structure (3) and adapted for deploying and folding the formwork structure,
second hydraulic means for displacing the guiding structure in the longitudinal direction of the tunnel, and
third hydraulic means for displacing the formwork structure (3) in the longitudinal direction of the tunnel.

9. Formwork system according to any of the preceding claims, wherein the formwork structure (3) comprises frame members (5,6,7,8) coaxially arranged, and each frame member having a vault segment (5a,6a,7a,8a) and two side segments (5b,5c,6b,6c,7b,7c,8b,8c) articulately coupled with the respective vault segment (5a,6a,7a,8a), and wherein the vault segment (5a,6a,7a,8a) of each frame member (5,6,7,8) has a left pair of rollers (13) and a right pair of rollers (13').

10. Formwork system according to claim 9, wherein the formwork structure (3) comprises two or more frame members and preferably four frame members (5,6,7,8).

11. Formwork system according to claim 3, 9 and 10, wherein a left rail (11) is placed inside the left pairs of rollers (13) of the vault segments (5a,6a,7a,8a), and a right rail (11') is placed inside the right pairs of rollers (13') of the vault sections (5a,6a,7a,8a), and wherein in each pair of rollers one roller is placed above the other.

12. Formwork system according to any of the claims 2 to 10, configured such that when the guiding structure (10) is released from the supporting frame (12), the guiding structure (10) is displaceable guided by the supporting frame (12), and wherein the supporting frame (12) is also displaceable guided by the guiding structure (10).

13. Method for lining a tunnel, using the formwork system (1) of any of the preceding claims, the method comprising the steps of:

deploying a formwork structure (3) for lining an curved section of a tunnel, and pouring concrete for lining that section of the tunnel,
moving a guiding structure (10) forward into the tunnel supported by the formwork structure (3) in its deployed configuration, and fixing the guiding structure (10) to a previously casted section of the lining,
folding the formwork structure (3) inwards such that it rests on the guiding structure (10), and moving the formwork structure (3) forward in its folded configuration into the tunnel supported

and guided by the guiding structure (10), and deploying again the formwork structure (3) for lining a subsequent curved section of the tunnel.

14. Method according to claim 13, wherein the guiding structure (10) comprises a pair of rails (11,11') parallel to each other, and wherein the step of fixing the guiding structure (10) to a previously casted section of the lining, is carried out by means of a supporting frame (12) configured for its attachment to a previously casted section of the lining, and for attaching and detaching the rails (11,11').

15. Method according to claim 13 or 14, wherein the formwork structure (3) comprises frame member (5,6,7,8) having a vault segment (5a,6a,7a,8a) and two side segments (5b,5c,6b,6c,7b,7c,8b,8c) articulately coupled with the respective vault segment (5a,6a,7a,8a), and wherein the method comprises the step of anchoring first and second frame members (5,6) to the concrete of a previously lined section (4') of the tunnel, so that third and fourth frame members (7,8) are overhanging supported by first and second frame members (5,6), in the deployed configuration of the formwork structure (3).

16. Method according to claim 15, wherein the formwork structure (3) comprises two or more frame members and preferably four frame members (5,6,7,8).

17. Method according to claim 13, further comprising the step of releasing the supporting frame (12) from the concrete and from the rails (11,11'), and moving the supporting frame (12) forward guided by the rails (11,11').

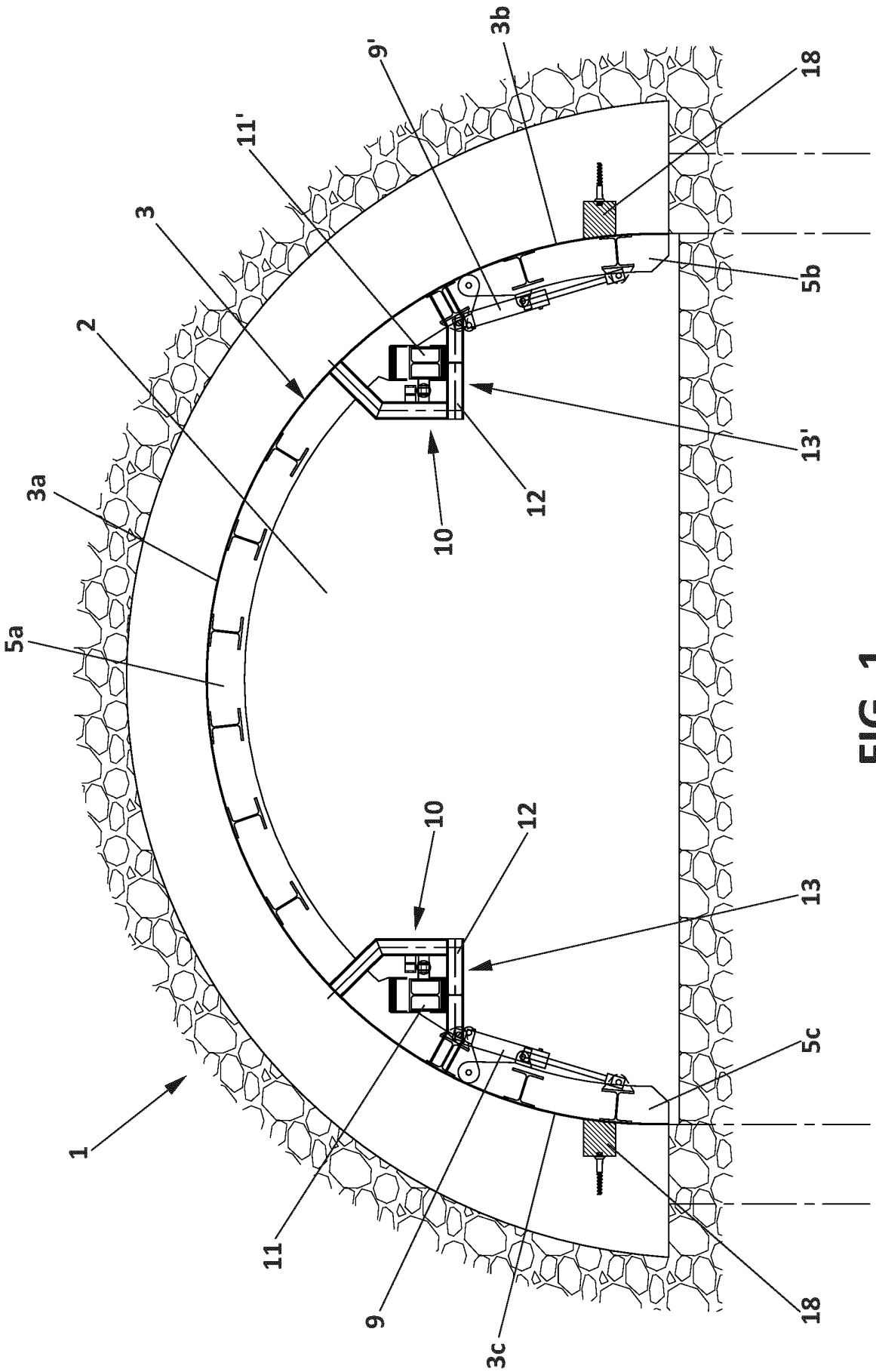

FIG. 1

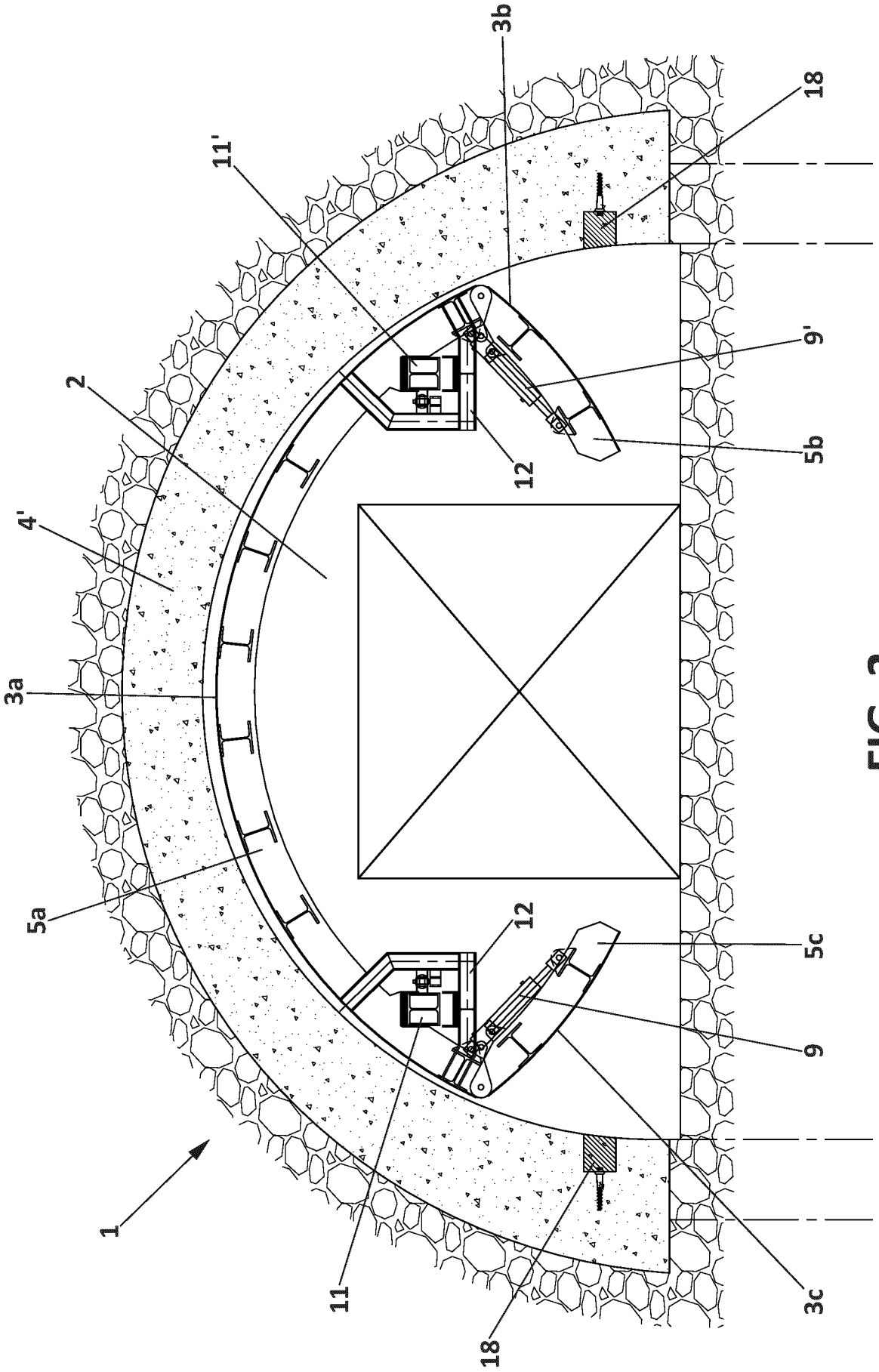

FIG. 2

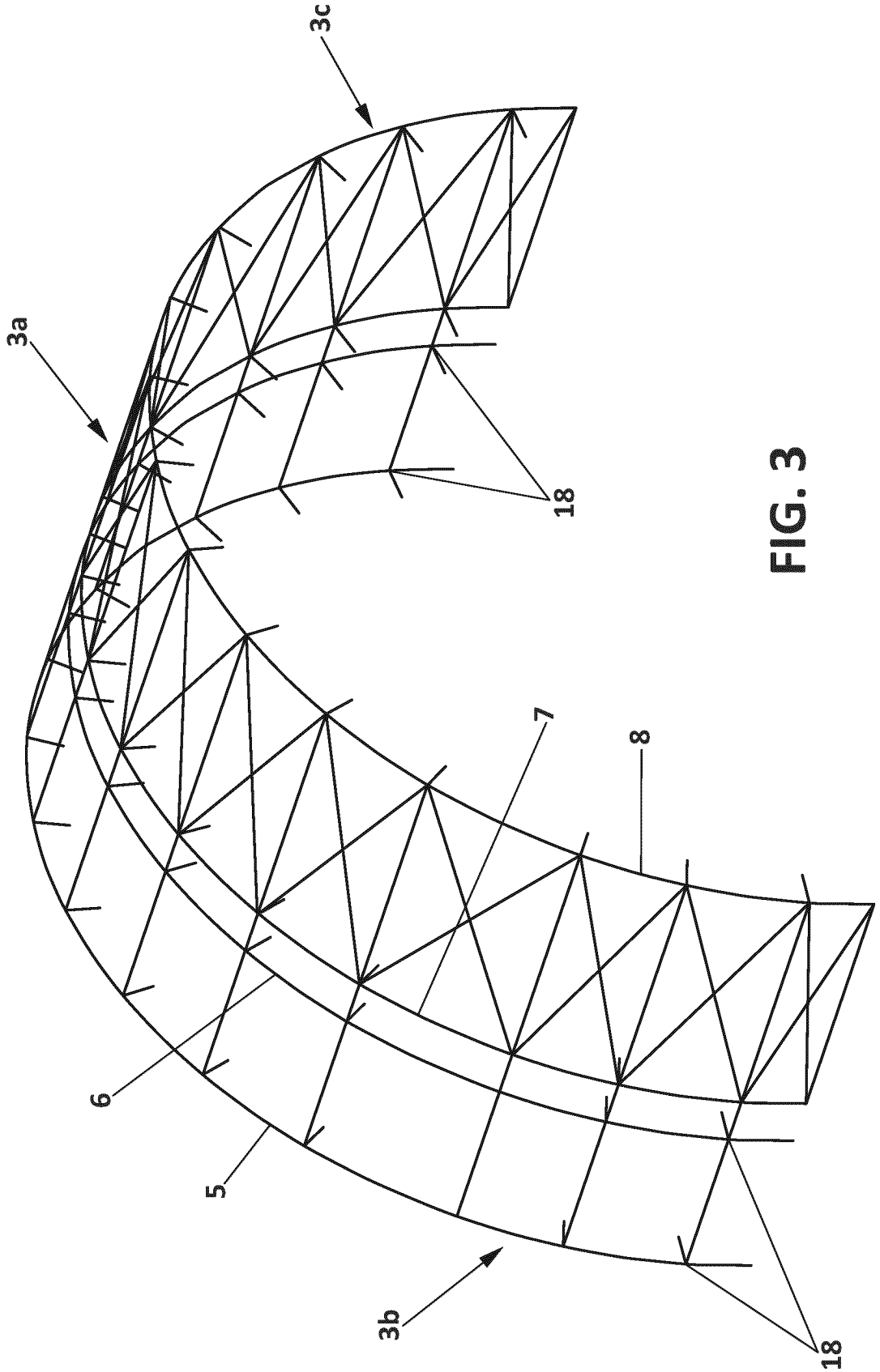

FIG. 3

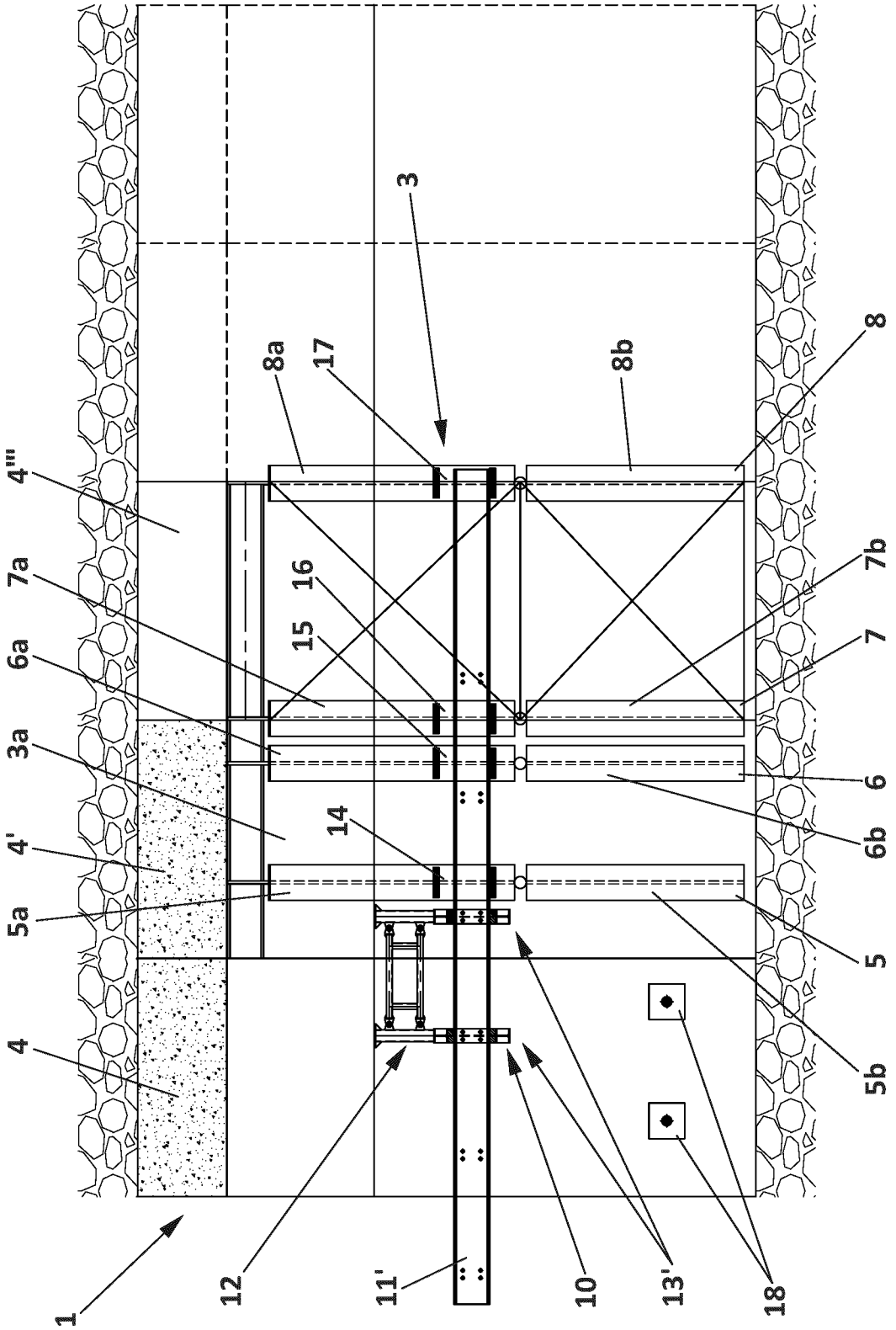

FIG. 4

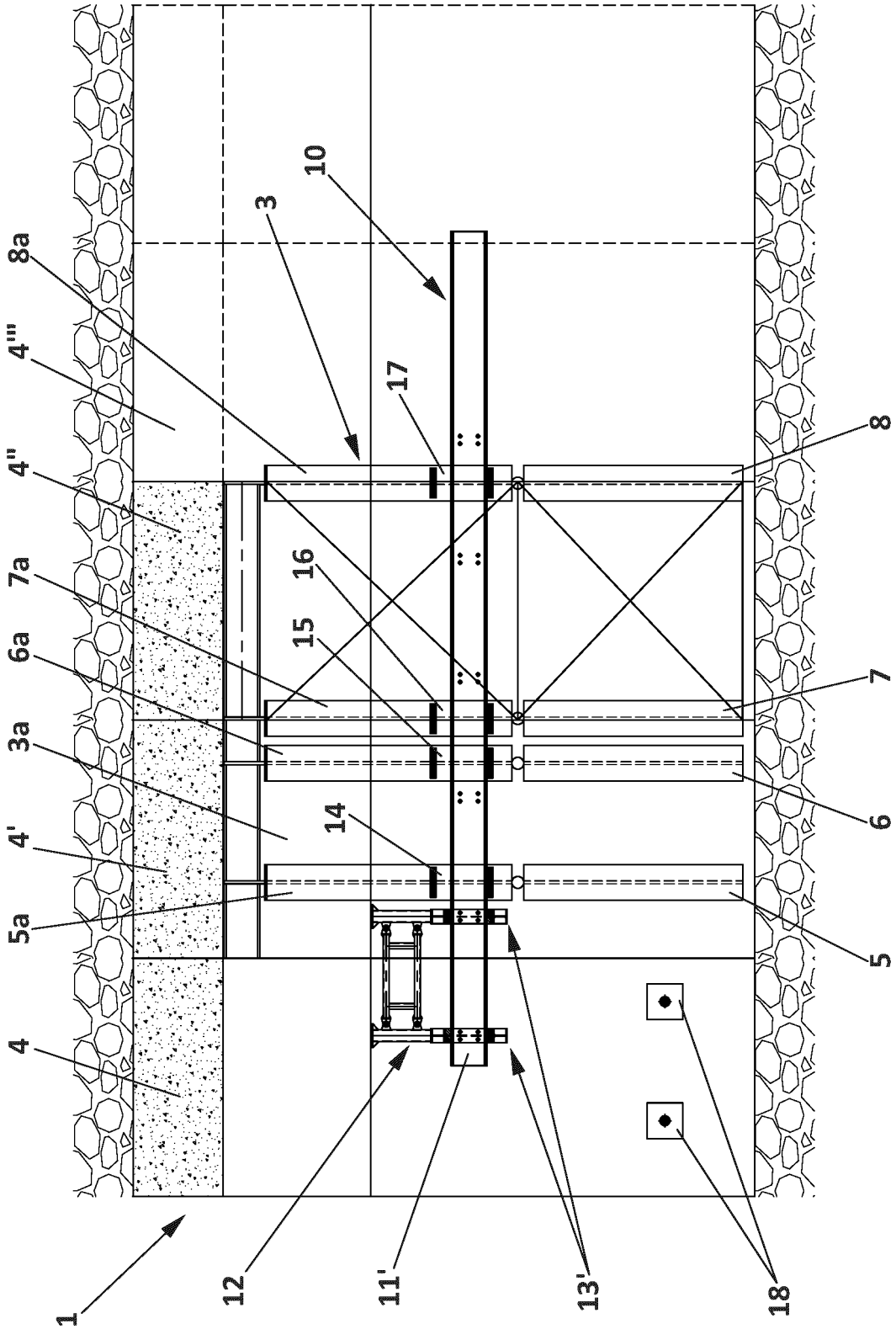

FIG. 5

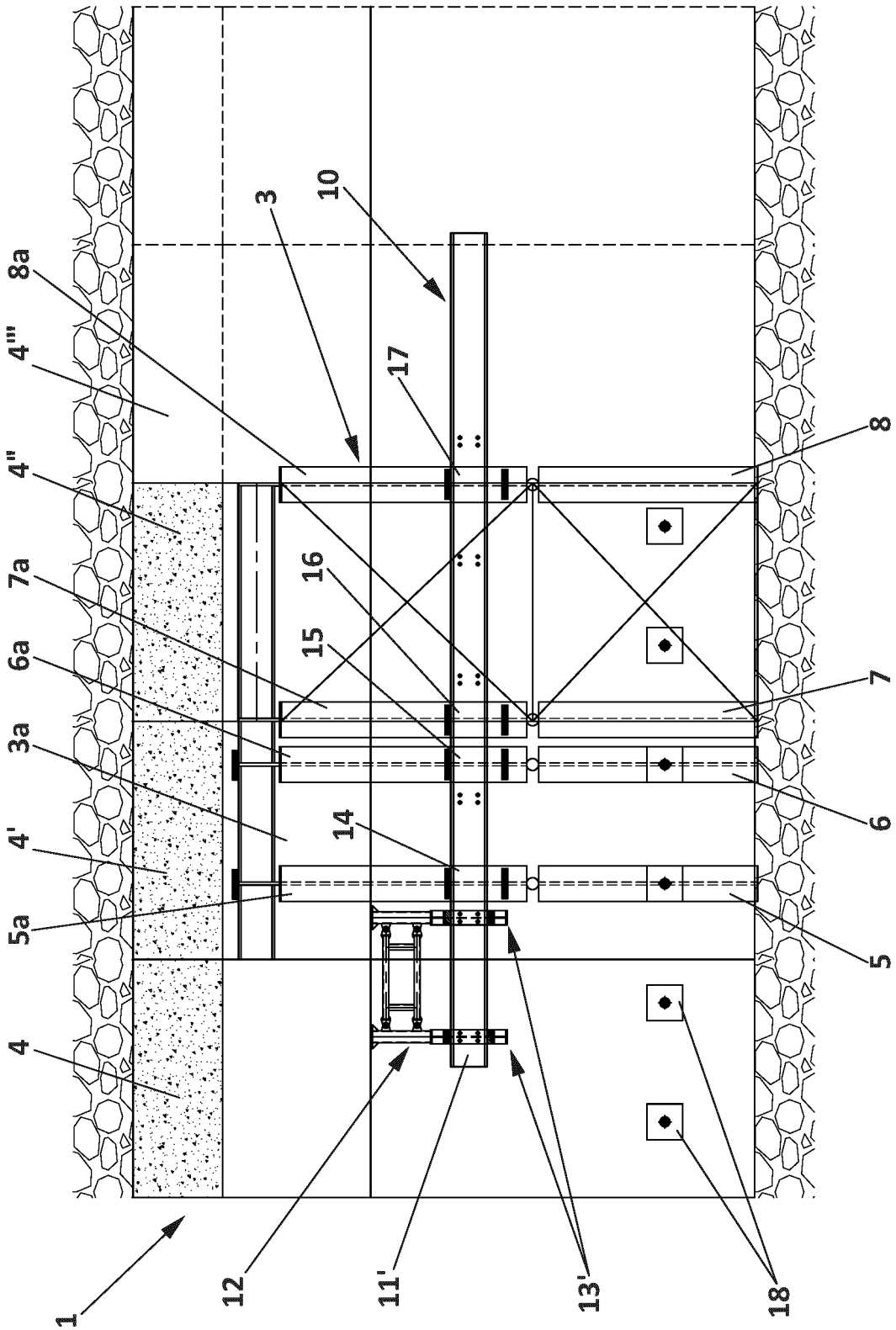

FIG. 6

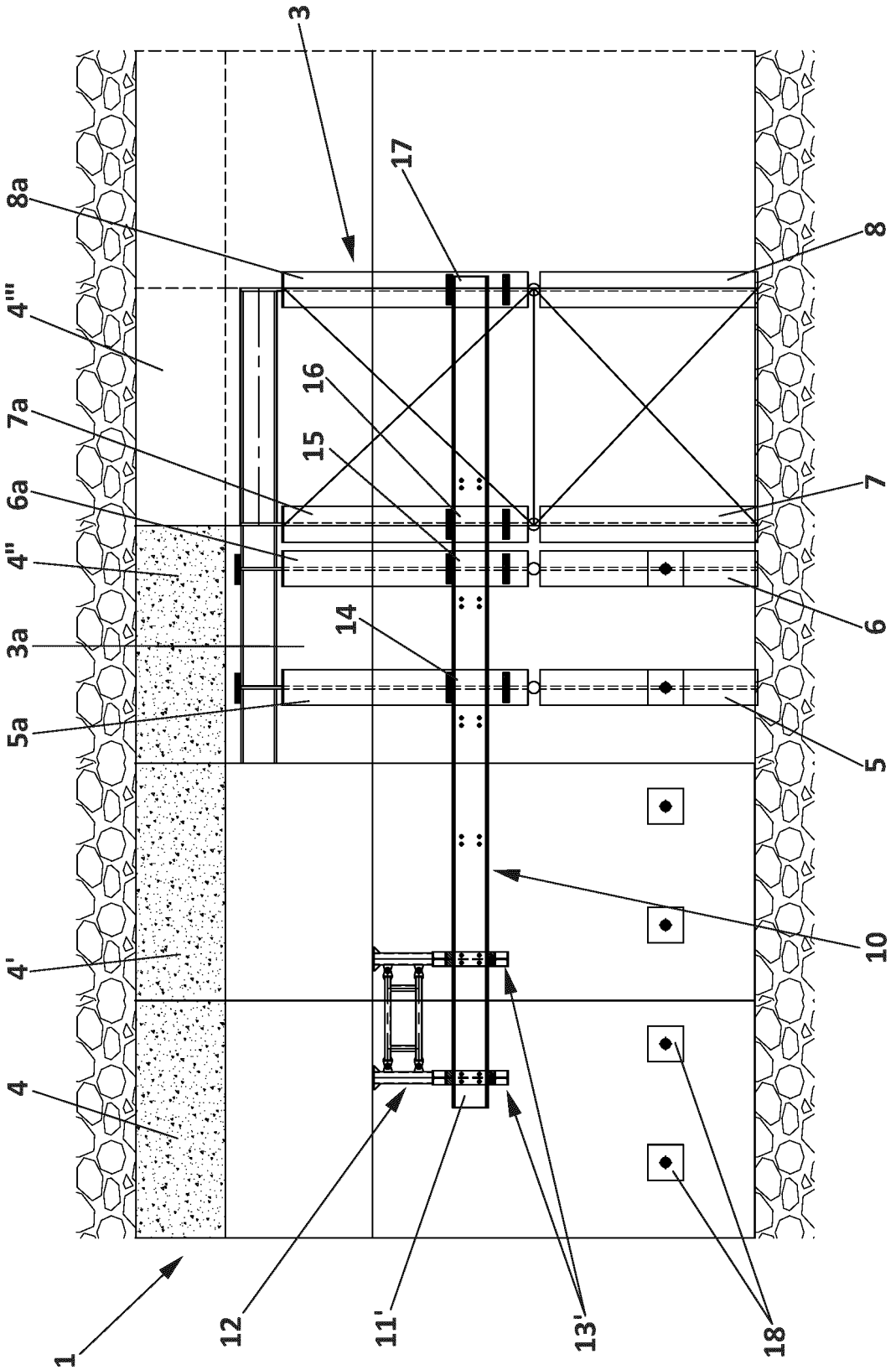

FIG. 7

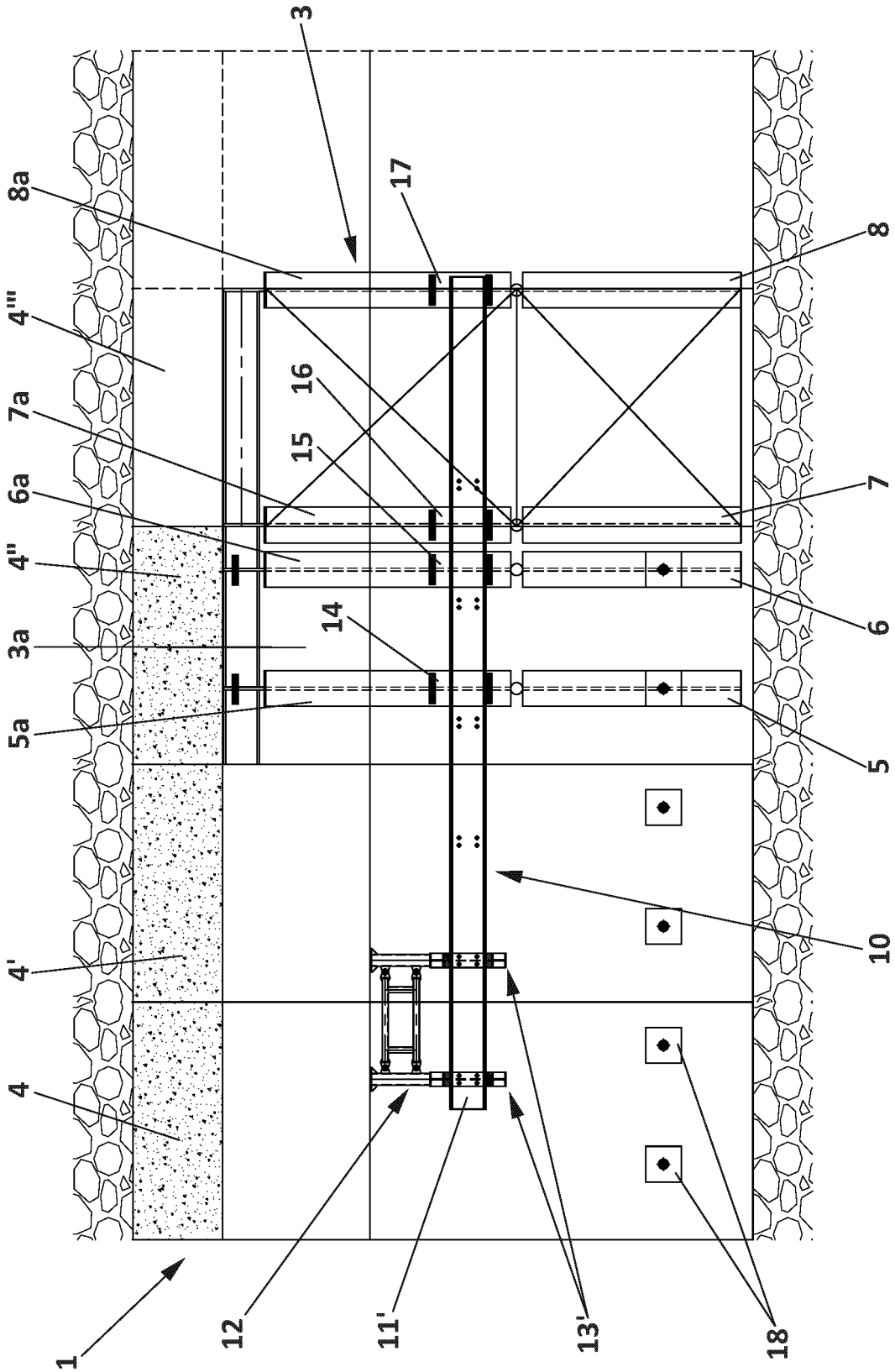

FIG. 8

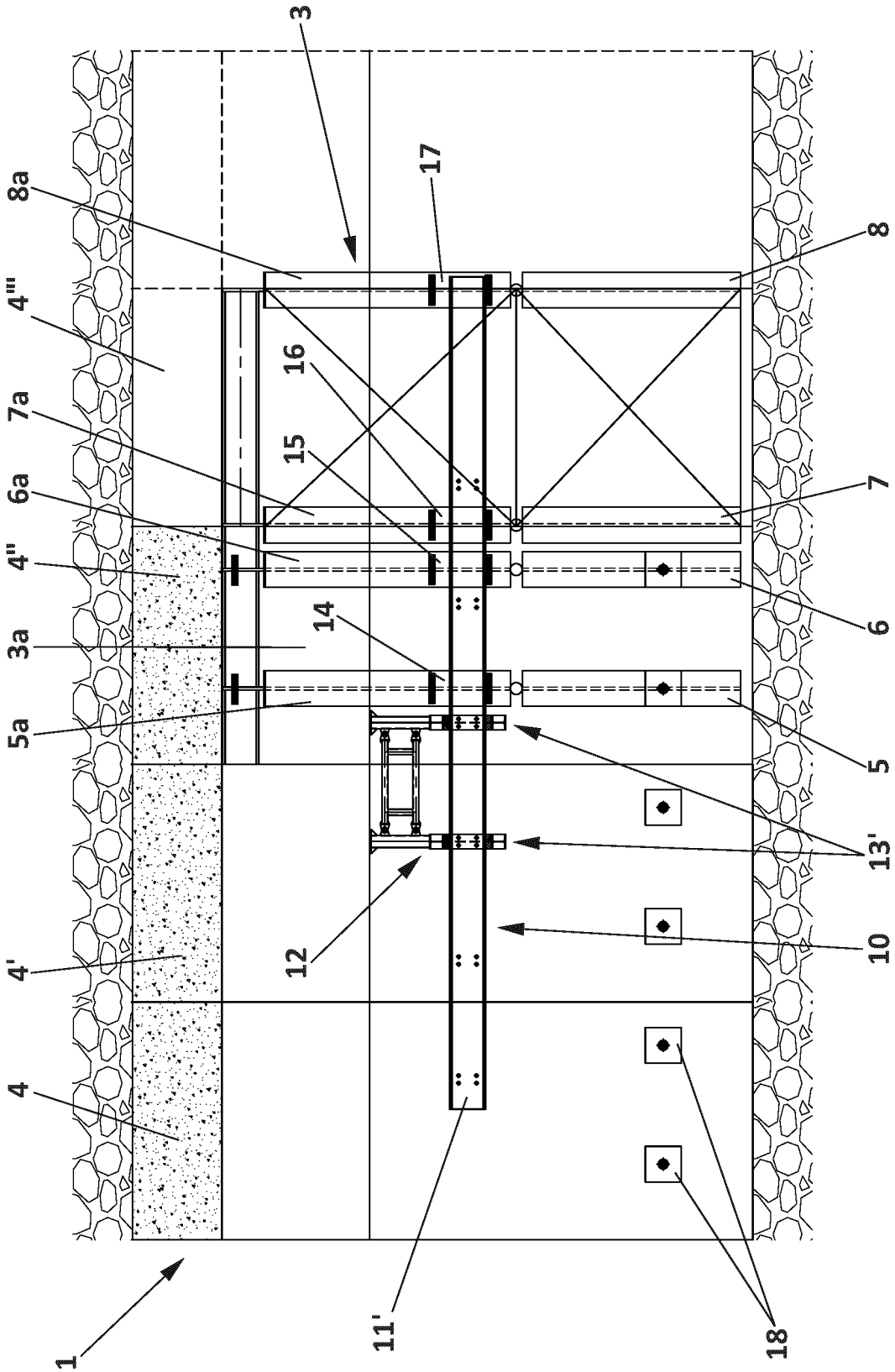

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/ES2022/070406

A. CLASSIFICATION OF SUBJECT MATTER
INV. E21D11/10
ADD.

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)
E21D

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 practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 110 145 341 A (SINOHYDRO BUREAU 7 CO LTD) 20 August 2019 (2019-08-20) figures paragraphs [0022], [0037], [0038]	1-7,12, 13,16
X	CN 114 320 369 A (GUANGDONG XINLONG TUNNEL EQUIPMENT CO LTD) 12 April 2022 (2022-04-12) figures	1-13,17
X	CN 110 566 232 A (LIANYUAN ZHANYU MACHINERY EQUIPMENT CO LTD ET AL.) 13 December 2019 (2019-12-13) figures	1-17

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 February 2023	21/02/2023

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Maukonen, Kalle

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/ES2022/070406

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 110145341 A	20-08-2019	NONE	
CN 114320369 A	12-04-2022	CN 114320369 A	12-04-2022
		CN 114526090 A	24-05-2022
CN 110566232 A	13-12-2019	NONE	

Form PCT/ISA/210 (patent family annex) (April 2005)