(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 571 044 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
18.06.2025 Bulletin 2025/25

(21) Application number: **23383301.1**

(22) Date of filing: **15.12.2023**

(51) International Patent Classification (IPC):
E21D 11/10 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
E21D 11/10

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(71) Applicant: **Grupo Empresarial Tecozam SL**
28036 Madrid (ES)

(72) Inventors:
- **GÓMEZ ROJO, Rubén**
  28036 Madrid (ES)
- **CASTUERA PINTO, David**
  28036 Madrid (ES)

(74) Representative: **Balder IP Law, S.L.**
Paseo de la Castellana 93
5a planta
28046 Madrid (ES)

(54) TRAVELLING FORMWORK FOR CONCRETE FORMING OF A TUNNEL

(57) The present invention refers to a travelling formwork for concrete forming of a tunnel, comprising a trolley provided with a front pair of legs, a rear pair of legs and a supporting structure attached to the front and rear pair of legs, and a reconfigurable formwork assembly mounted on the supporting structure. The reconfigurable formwork assembly can be configured in a deployed position for concrete casting and in a folded position for its transportation. The length of each leg is variable so that the formwork assembly and the trolley can be lowered when the formwork assembly is in its folded configuration. The travelling formwork can travel through a tunnel having sections of reduced cross-sectional areas, without the need to disassemble the formwork trolley when it has to pass through tunnel sections of reduced cross-sectional area.

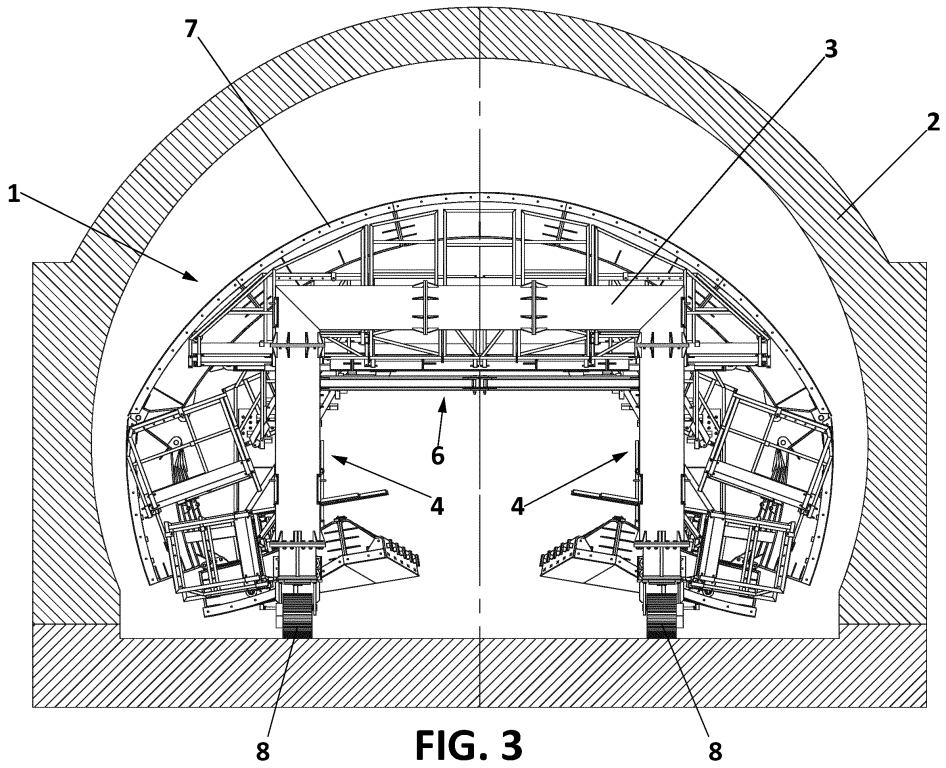

FIG. 3

EP 4 571 044 A1

Description

TECHNICAL FIELD

[0001] The present invention refers in general to formwork machinery for concrete construction of tunnels.

[0002] An object of the invention is to provide a travelling formwork, that can travel through a tunnel having sections of different heights, without the need to disassemble the formwork trolley when it has to pass through tunnel sections of reduced height and/or reduced width.

STATE OF THE ART

[0003] Formwork machinery for internally constructing the interior of a tunnel by concrete casting, are normally mounted on a trolley that moves longitudinally along the tunnel, from one section to the next, supported on wheels, tracks or on pre-laid railway rails on the tunnel's floor.

[0004] The formwork assembly is made up of a series of articulated panels that can be set in two configurations, a deployed and a retracted configuration. In the deployed configuration, the formwork has the shape of the vault and the sides of the tunnel to be constructed. When the formwork is deployed inside a tunnel an annular gap is formed between the formwork and the tunnel rough surface. Then, concrete is injected filling up the gap, and during this process the formwork panels are pressed against the tunnel surface by means of hydraulic cylinders.

[0005] Once the concrete is cured, the articulated panels are folded inwards, allowing the formwork to moved along the tunnel in its retracted configuration, to be positioned for the next batch.

[0006] Normally, tunnels have a similar cross-sectional area along a major part, however occasionally some tunnels have sections of reduced heigh so that a travelling formwork, dimensioned for the rest of the tunnel, cannot pass through these smaller sections. In these cases, the travelling formwork has to be disassembled and transported to the next section of the tunnel with normal height. Obviously, the process of disassembling and assembling again the formwork, are time-consuming and renders the construction process slow and expensive.

DESCRIPTION OF THE INVENTION

[0007] The invention is defined in the attached independent claim, and satisfactorily solves the above-described drawbacks of the prior art, by the provision of a travelling formwork which can be lowered to a great extend in order to reduce is overall size, to be able to travel through tunnel sections of reduced cross-sectional area due to a reduced height and/or reduced width.

[0008] More specifically, the invention refers to a travelling formwork which comprises a trolley provided with a front pair of legs, a rear pair of legs and an overhanging supporting structure attached to the front and rear pair of legs, and positioned in between the front and rear pairs of legs.

[0009] The travelling formwork further comprises a reconfigurable formwork assembly mounted on the supporting structure, wherein the reconfigurable formwork assembly can be configured in a deployed position for concrete casting and in a folded position for its transportation.

[0010] According to the invention, the length of each leg is variable so that the formwork assembly and the trolley can be lowered when the formwork assembly is in its folded configuration, so in this way the travelling formwork is capable of travelling through tunnel sections of reduced height.

[0011] Preferably, the legs are telescopically extendable and retractable in order to vary their length, and are provided with hydraulic means to perform the extension and retraction operations.

[0012] These hydraulic means may comprise a hydraulic cylinder for each leg, which may be operated manually. Alternatively, the travelling formwork may comprise a controller for controlling the operation of each hydraulic cylinder. The controller is adapted to extend and retract all the hydraulic cylinders, when the reconfigurable formwork assembly is in its folded configuration. Retracting of the legs is impeded when the reconfigurable formwork assembly is in its deployed configuration. The controller is adapted to operate al the hydraulic cylinders simultaneously or individually for each leg, depending on the geometry of the cross-sectional area which the travelling formwork has to pass through.

[0013] Each leg has rolling means for the trolley to move on the ground of a tunnel, for example the rolling means are crawler tracks, preferably self-driven tracks.

[0014] The trolley has a passage dimensioned such that vehicles can travel lengthwise and internally trough the trolley, when the legs of trolley are in their extended position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] 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 view of a formwork trolley according to the invention in its deployed configuration inside a tunnel, while the poured concrete is still fresh.

Figure 2.- shows a similar representation than Figure

1 once the concrete has cured, and the formwork is partially retracted.

Figure 3.- shows a similar representation than Figure 2 with the formwork and the trolley's legs, fully retracted.

Figure 4.- shows a similar representation than Figure 1 of an alternative formwork configuration with flat sides.

Figure 5.- shows a longitudinal cross-sectional view taken at plane A-A in Figure 4.

Figure 6.- shows in a perspective view of the embodiment of Figures 4 and 5.

DESCRIPTION OF WAYS OF CARRYING OUT THE INVENTION

[0016] **Figures 1** to **3** show a preferred embodiment of a travelling formwork (1) for concrete construction of a tunnel (2), wherein the travelling formwork (1) has a trolley (3) provided with a front pair (4) of legs, a rear pair (5) of legs and an overhanging supporting structure (6) attached to the front and rear pair of legs (4,5).

[0017] As shown in **Figure 1** for example, the trolley (3) has a passage (12) dimensioned such that vehicles can travel lengthwise and internally trough the trolley, when the legs of the trolley are in their extended position.

[0018] The travelling formwork (1) also has a reconfigurable formwork assembly (7) mounted on the supporting structure (6). The reconfigurable formwork assembly (7) can be configured in a deployed position for concrete casting (**Figure 1**) and in a folded position **(Figure 3)** for its transportation lengthwise in a tunnel.

[0019] According to the invention, the length of each leg is variable so that the formwork assembly (7) and the trolley (3) together can be lowered when the formwork assembly is in its folded configuration, as shown in **Figure 3,** thus, in such configuration the travelling formwork (1) is capable of passing through tunnel sections of reduced cross-sectional areas.

[0020] In this embodiment, the legs are telescopically extendable and retractable in order to vary their length. For that, each leg has a hydraulic cylinder (not shown), which may be manually operated or operated by means of a controller. The controller may be adapted to extend or retract all the hydraulic cylinders simultaneously or individually, when the reconfigurable formwork assembly is in its folded configuration.

[0021] Each leg has a fixed tubular part (9) and a movable part (10) which is insertable inside the fixed tubular part (9). The fixed part (9) is joined to the supporting structure (6), and the movable part (10) is fitted with a crawler track (8) at its free end, so that the trolley can move on the tunnel ground (11). Optionally, the crawler tracks (8) are self-driven.

[0022] Each crawler track (8) is rotatable with respect to the axis of the respective leg, in order to drive the travelling formwork (1) along curved sections of a tunnel. For that, one or more hydraulic cylinders (13) are fitted between the movable part (10) and a part of the crawler track (8) of each leg.

[0023] Conventionally, the formwork assembly (7) is formed by a plurality of articulated panels, and hydraulic means are provided for moving the panels from the deployed configuration to the folded configuration and vice versa. In the embodiment of **Figures 1** to **3,** the formwork assembly (7) has a vault section (7a) and two curved side wall sections (7b, 7c). In the embodiment of **Figures 4** to **6,** the formwork assembly (7) has a vault section (7a) and two flat side wall sections (7b, 7c).

Claims

1. A travelling formwork for concrete forming of a tunnel, comprising:

   a trolley provided with a front pair of legs, a rear pair of legs and a supporting structure attached to the front and rear pair of legs,
   a reconfigurable formwork assembly mounted on the supporting structure, wherein the reconfigurable formwork assembly can be configured in a deployed position for concrete casting and in a folded position for its transportation, and
   wherein the length of each leg is variable so that the formwork assembly and the trolley can be lowered when the formwork assembly is in its folded configuration.

2. A travelling formwork according to claim 1, wherein the legs are telescopically extendable and retractable in order to vary their length.

3. A travelling formwork according to claim 2, further comprising hydraulic means for extending and retracting the legs.

4. A travelling formwork according to claim 3, wherein the hydraulic means comprises an hydraulic cylinder for each leg.

5. A travelling formwork according to claim 4, wherein the travelling formwork further comprises a controller for controlling the operation of each hydraulic cylinder, and wherein the controller is adapted to extend or retract all the hydraulic cylinders simultaneously or individually when the reconfigurable formwork assembly is in its folded configuration, and wherein retraction of the legs is impeded when the reconfigurable formwork assembly is in its deployed configuration.

6. A travelling formwork according to any of the preceding claims, wherein each leg has rolling means for the trolley to move on the ground of a tunnel.

7. A travelling formwork according to claim 6, wherein the rolling means are crawler tracks.

8. A travelling formwork according to claim 7, wherein the crawler tracks are self-driven.

9. A travelling formwork according to any of the preceding claims, wherein the trolley has a passage dimensioned such that vehicles can travel lengthwise and internally trough the trolley, when the legs of trolley are in their extended position.

10. A travelling formwork according to any of the preceding claims, wherein the reconfigurable formwork assembly is formed by a plurality of panels attached to each other in an articulated manner, and wherein travelling formwork has hydraulic means for moving the panels from the deployed configuration to the folded configuration and vice versa.

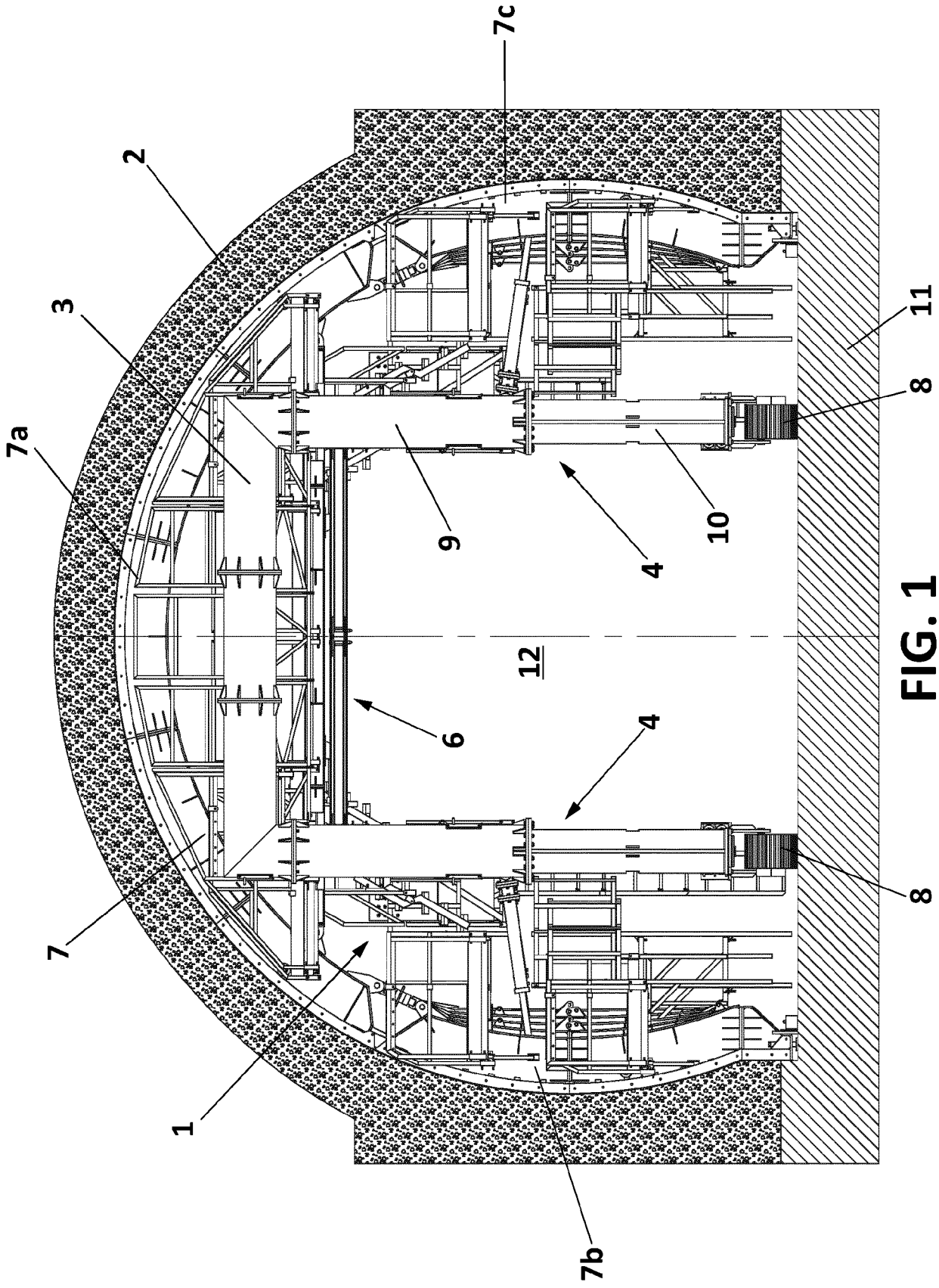

FIG. 1

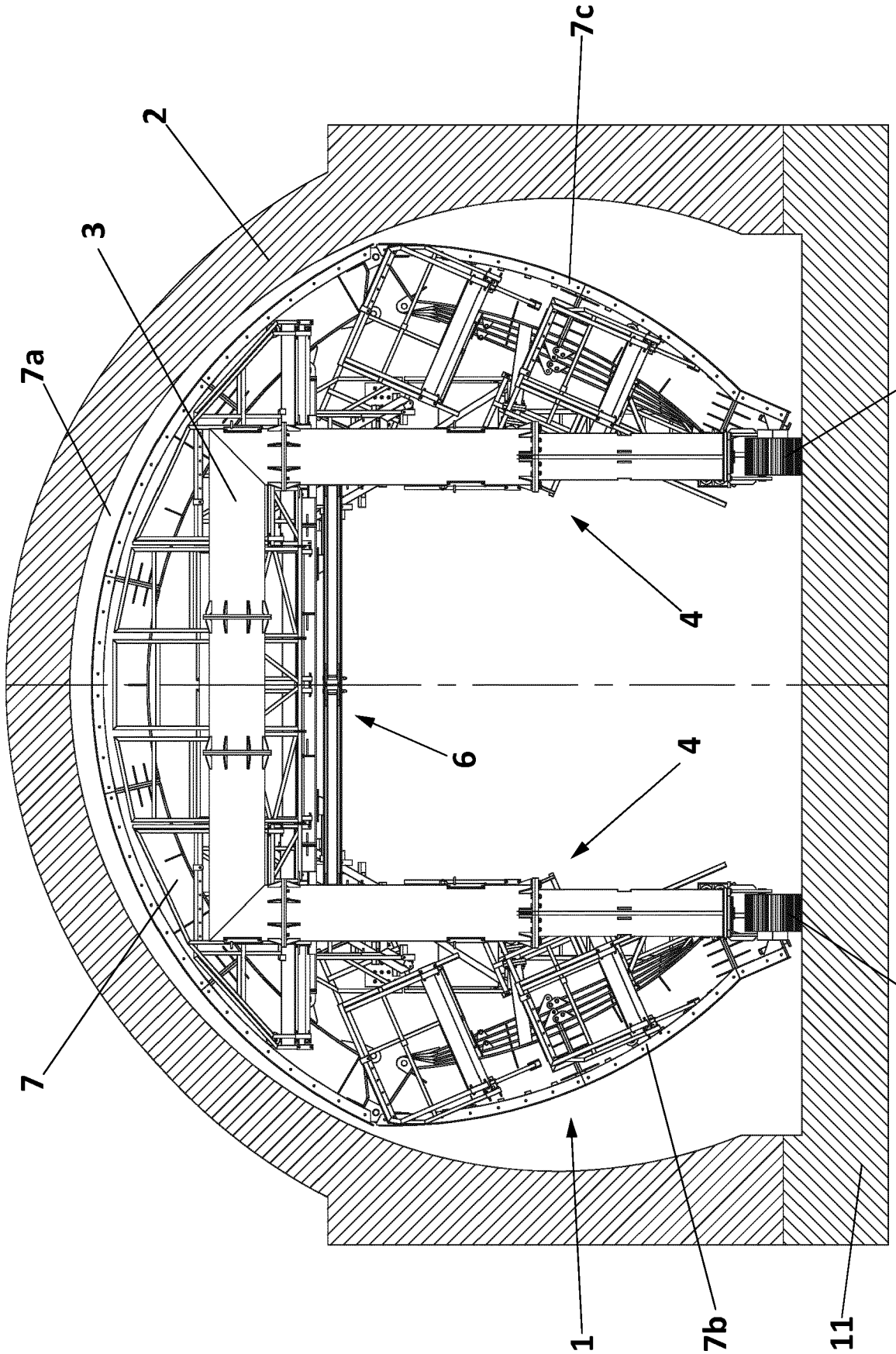

FIG. 2

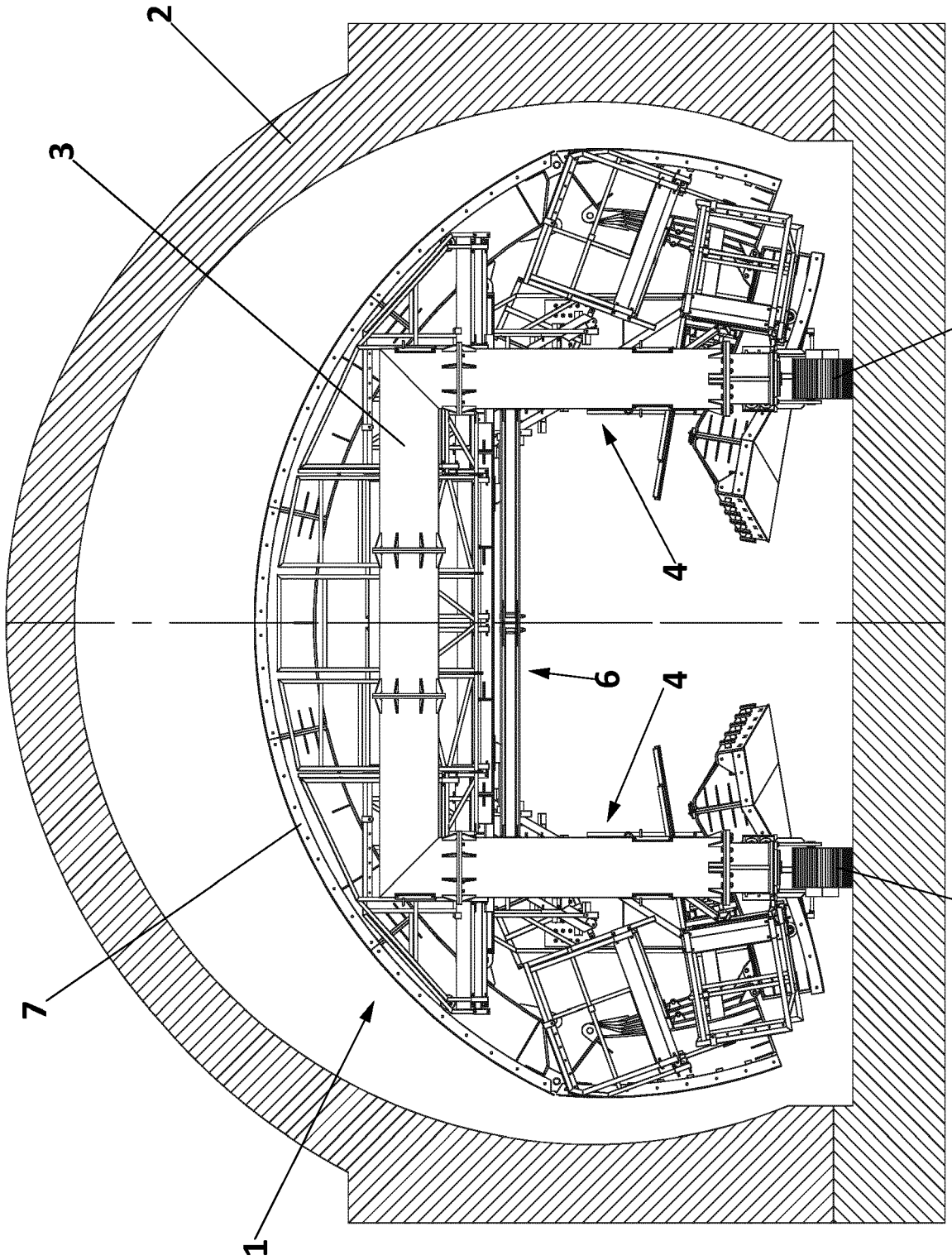

FIG. 3

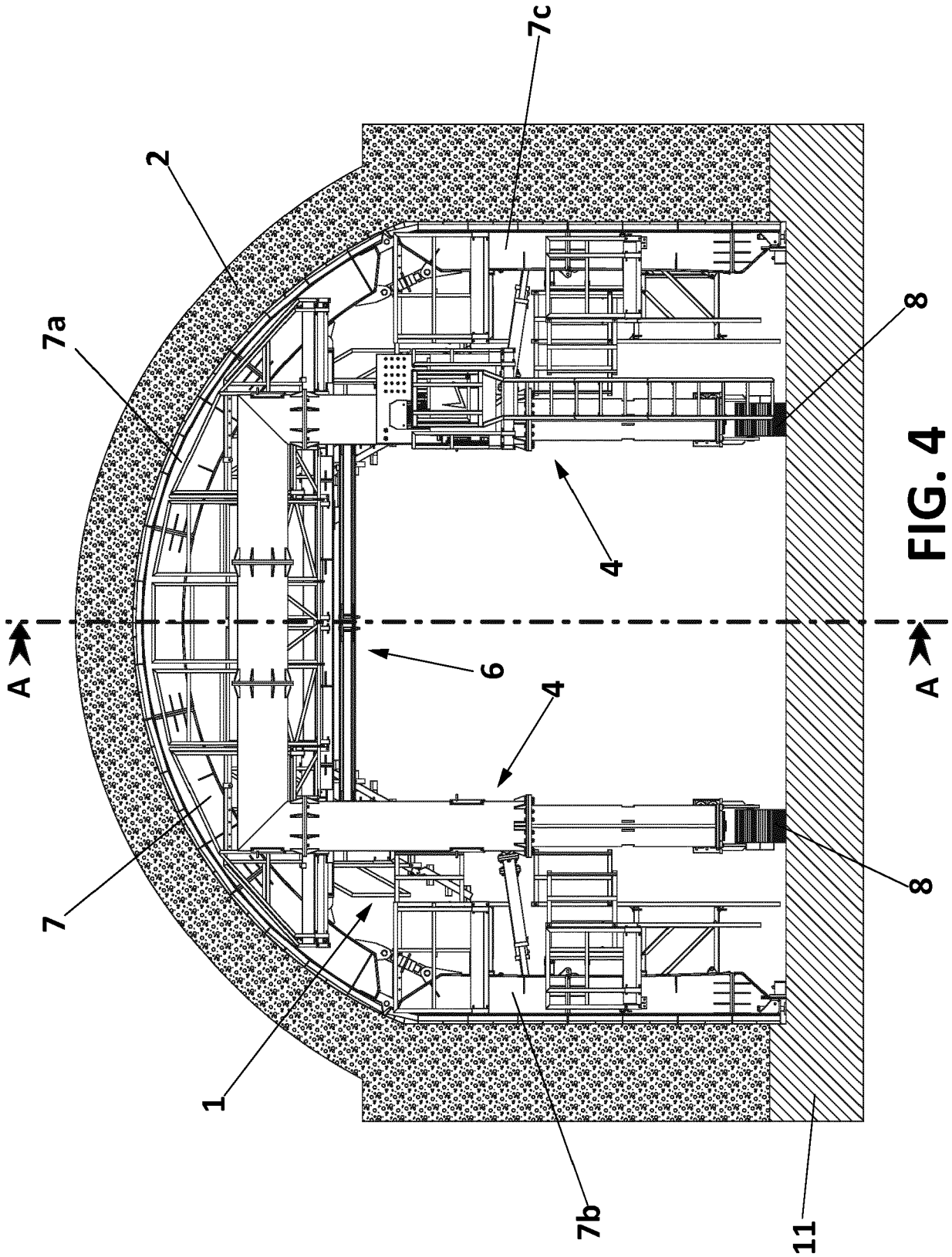

FIG. 4

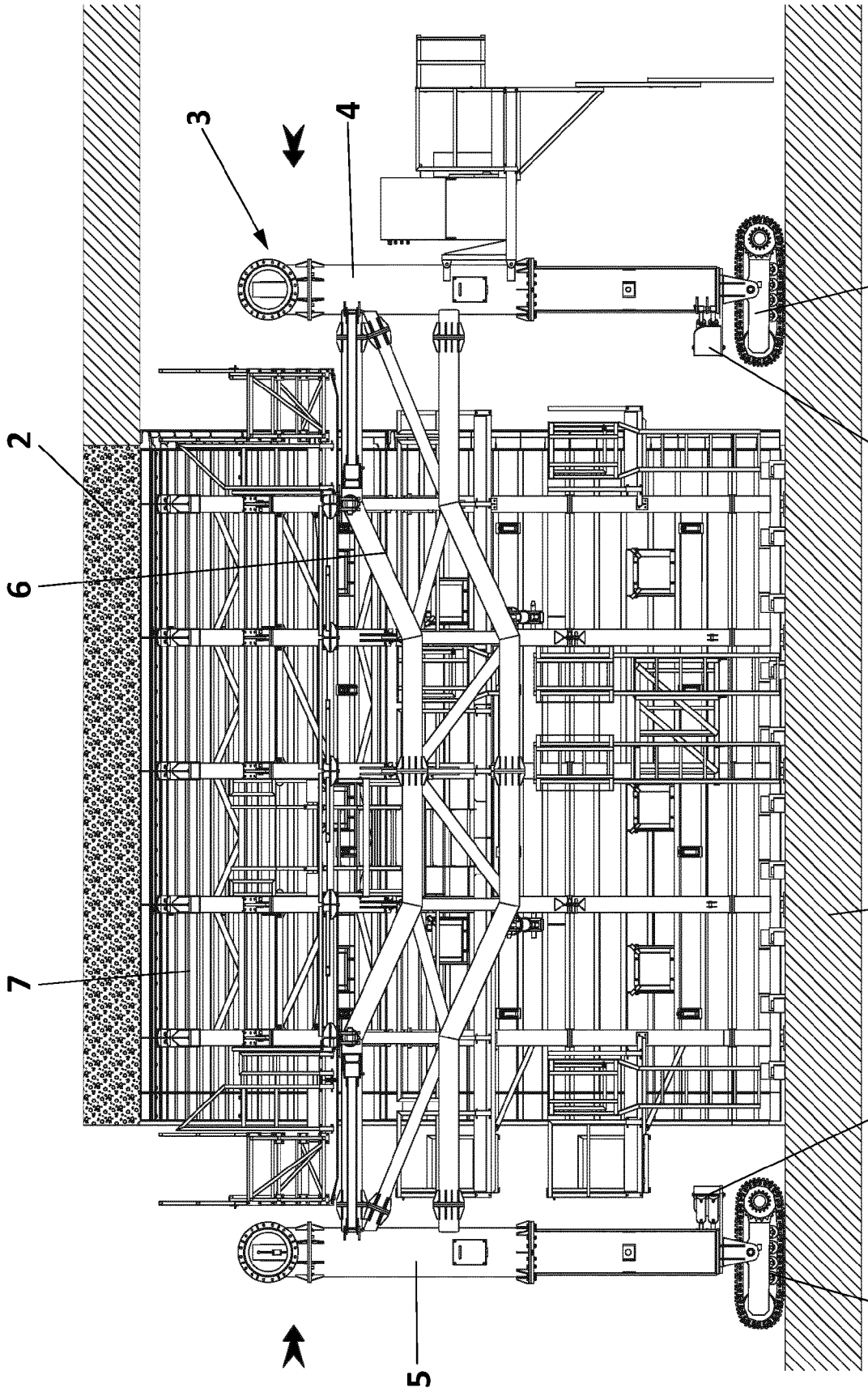

FIG. 5
A-A

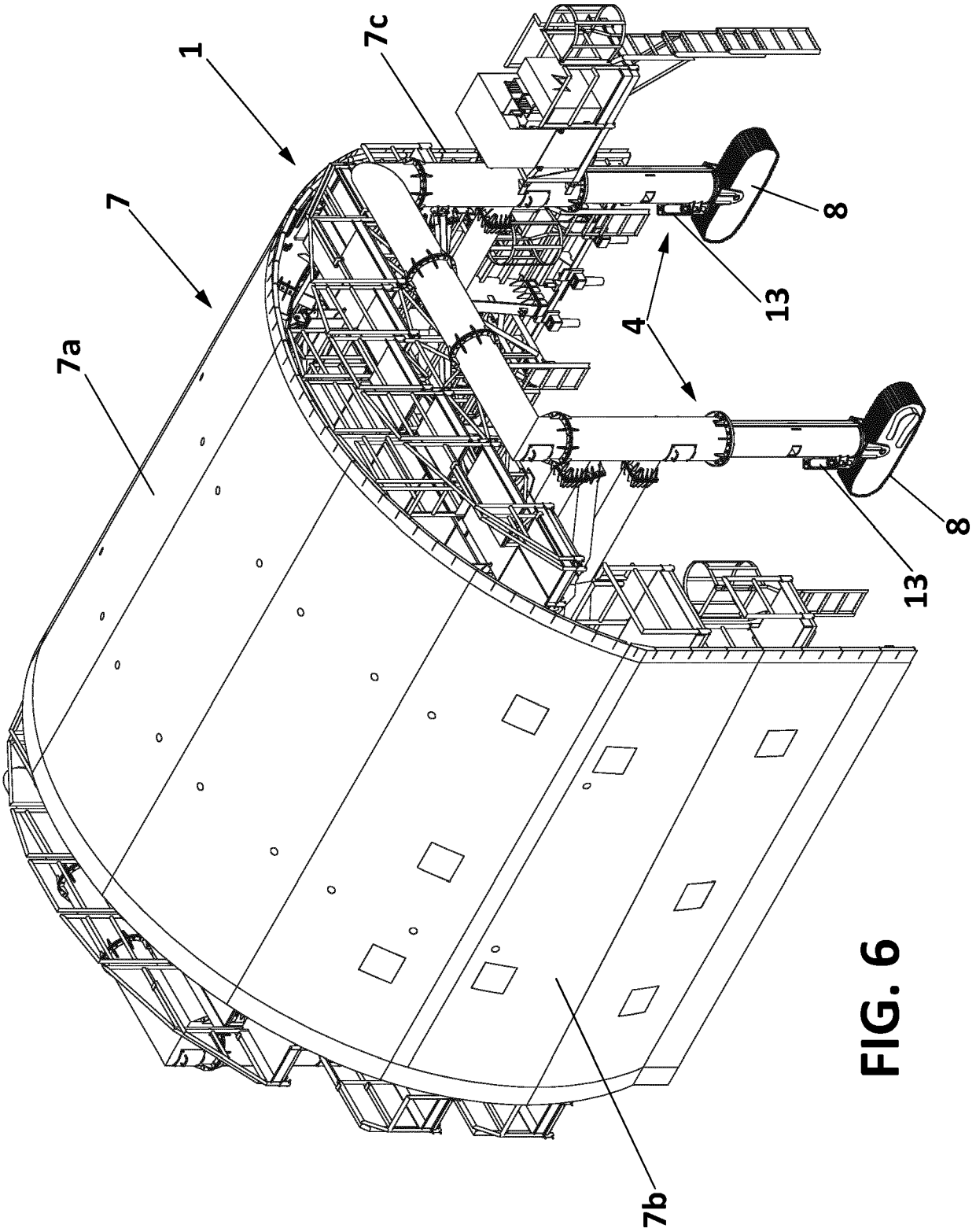

FIG. 6

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 23 38 3301

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 106 593 472 B (HUNAN WUXIN TUNNEL INTELLIGENT EQUIPMENT CO LTD) 31 January 2020 (2020-01-31) * abstract * * figures 1-3 * * Text associated with figures 1 - 3 *	1-10	INV. E21D11/10
X	RS 57 625 B1 (PERI GMBH [DE]) 30 November 2018 (2018-11-30) * abstract * * figures 2,17 * * paragraph [0007] * * paragraph [0025] *	1-10	
X	CA 3 195 183 A1 (TECOZAM ESTRUCTURAS Y DRENAJES SLU [ES]) 21 April 2022 (2022-04-21) * abstract * * figures 1-4 * * page 4, line 6 - line 18 * * page 4, line 30 - page 5, line 4 * * page 7, line 1 - line 11 *	1-10	TECHNICAL FIELDS SEARCHED (IPC) E21D
X	CN 117 145 520 A (CHINA RAILWAY ERJU 4TH ENG CO LTD; CHINA RAILWAY NO 2 GROUP ET AL.) 1 December 2023 (2023-12-01) * abstract * * figures 1-2 * * Text associated with figures 1 - 2 *	1-10	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	21 May 2024	Hustedt, Bernhard

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 38 3301

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

21-05-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 106593472 B	31-01-2020	NONE	
RS 57625 B1	30-11-2018	EP 2472057 A2	04-07-2012
		ES 2442040 A2	07-02-2014
		ES 2683916 T3	28-09-2018
		HR P20181283 T1	05-10-2018
		PL 2472057 T3	31-01-2019
		PT 2472057 T	12-10-2018
CA 3195183 A1	21-04-2022	CA 3195183 A1	21-04-2022
		EP 4230838 A1	23-08-2023
		US 2023417140 A1	28-12-2023
		WO 2022079326 A1	21-04-2022
CN 117145520 A	01-12-2023	NONE	

EPO FORM P0459

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