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

(11) **EP 4 310 275 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.01.2024 Bulletin 2024/04

(21) Application number: **23215077.1**

(22) Date of filing: **12.05.2021**

(51) International Patent Classification (IPC):
E04H 12/22 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
E02D 27/42; E04H 12/2238; E04H 12/2261

(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 MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **14.05.2020 IT 202000011074**

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
21173619.4 / 3 910 114

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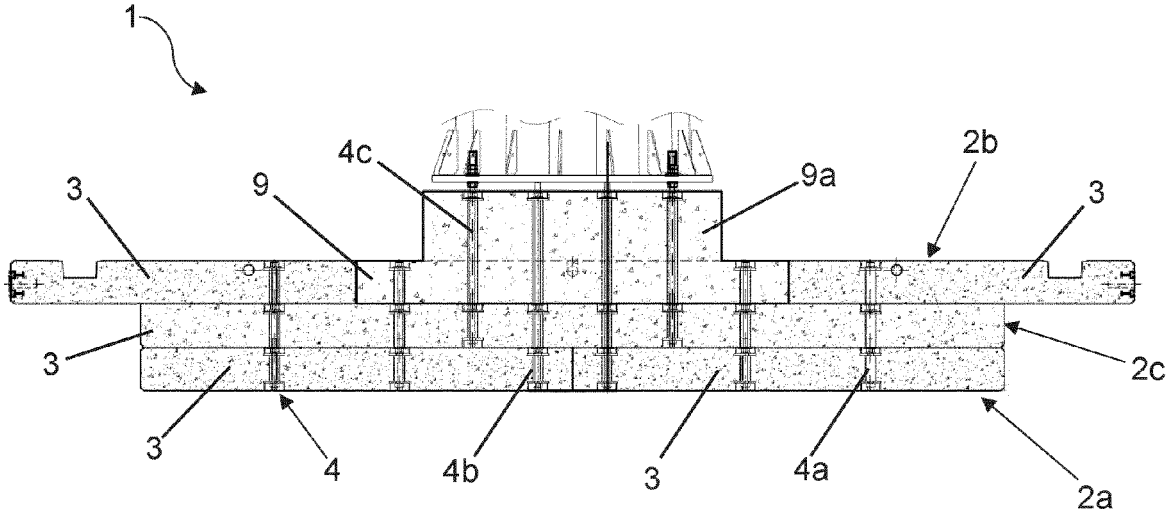
Remarks:
This application was filed on 07.12.2023 as a divisional application to the application mentioned under INID code 62.

(54) **PREFABRICATED PLINTH, BASE RADIO STATION COMPRISING SUCH PLINTH AND METHOD FOR ASSEMBLING A PLINTH**

(57) Prefabricated plinth (1) for metal structures in elevation, comprising:
- a plurality of overlapped layers (2), each of them formed by a plurality of prefabricated reinforced concrete elements (3);
- threaded connection bars (4) which structurally connect the layers (2) together;
- fastening means, interacting with the connection bars (4) and such as to maintain the layers (2) structurally connected in a removable way.

FIG. 2



EP 4 310 275 A2

Description

[0001] The present invention relates to a prefabricated plinth for metal structures in elevation, in particular metal poles over 10 meters in height, a base transceiver station comprising such a plinth and a method for assembling a plinth.

[0002] In particular, the plinth referred to herein is used in the telecommunications sector, specifically in base transceiver stations of the "raw land" type, as a foundation for a pole or pylon on which antennas or parabolas are placed, or in the lighting sector, as a foundation for lighthouse towers.

[0003] In this context, several solutions are known. One known solution consists of systems comprising steel formworks filled with sand as a counterweight, while another known solution consists of steel structures with blocks embedded in the concrete in situ. Such solutions have the disadvantage of not being reusable.

[0004] In particular, the foundations mainly used for metal structures in elevation include the use of a plinth cast in situ. The construction of these foundations is particularly long (in the order of weeks), requires intrusive terrain preparation operations and generates a large amount of terrain and/or carry-over material, which must necessarily be disposed of in landfills. Prefabricated plinths are also known, which therefore do not require to be cast in situ, which however are not capable of supporting most metal structures in elevation (poles), which usually exceed 15 meters in height. In this context, the technical task underpinning the present invention is that of proposing a prefabricated plinth for metal structures in elevation, a base transceiver station and a method for assembling a plinth, which obviate the drawbacks of the prior art cited above.

[0005] In particular, the object of the present invention is to propose a prefabricated plinth for metal structures in elevation which offers at least equivalent performance to a plinth cast in situ, while being reusable.

[0006] Another object of the present invention is to provide a method for assembling a plinth, which is simple, fast and safe for workers.

[0007] A further object of the present invention is to propose a prefabricated plinth for metal structures in elevation, a base transceiver station and a method for assembling a plinth, which do not require invasive intervention on the terrain.

[0008] Another object of the present invention is to provide a prefabricated plinth for metal structures in elevation which is versatile and easily adaptable to various superstructure formats and to the different maximum loads required by the application.

[0009] Another object of the present invention is to provide a base transceiver station which ensures accommodating up to three telephone operators with their relative load of antennas and parabolas necessary for the correct operation of the base transceiver station itself (so-called "co-siting").

[0010] The stated technical task and specified objects are substantially achieved by a prefabricated plinth for metal structures in elevation, comprising:

- a plurality of overlapped layers, each of them formed by a plurality of prefabricated reinforced concrete elements;
- threaded connection bars which structurally connect the layers together;
- fastening means, interacting with the connection bars and such as to maintain the layers structurally connected in a removable way.

[0011] Preferably the layers have holes for the insertion of the connection bars, with which housings to facilitate the insertion of the connection bars are associated.

[0012] In accordance with an embodiment, the housings are positioning cups drowned in the prefabricated elements.

[0013] In accordance with an embodiment, the threaded connection bars are threaded at the ends and the elements of the inferior layer have a threaded core at an inferior portion, drowned therein and being part of the fastening means, in which a corresponding connection bar is screwed from above.

[0014] In accordance with an embodiment, the superior layer comprises a central element having a portion protruding in height with respect to the other elements of the layer, the top of the central element being intended to be connected to a base of a metal structure in elevation.

[0015] In accordance with an embodiment, the layers are three: a first inferior layer in contact with the terrain, a second superior layer intended to be constrained to a metal structure in elevation and a third intermediate layer interposed between the first and the second layer.

[0016] In accordance with an embodiment, the first layer comprises two prefabricated elements placed side by side along a first direction, on which two prefabricated elements lie, forming the intermediate layer, which have a second direction substantially orthogonal with respect to that of the elements of the first layer.

[0017] In accordance with an embodiment, the fastening means comprise perforated counterplates which are inserted on the superior end of the connection bars and clamping nuts which are screwed in a removable way on the superior end of the connection bars in order to clamp the counterplates against the elements of the superior layer.

[0018] In accordance with an embodiment, the plinth comprises provisional centering elements which are screwed on the end of one or more threaded connection bars in such a way to guide the positioning of a layer on the inferior one already in position, said provisional centering elements being removable.

[0019] According to an aspect of the invention, the consecutive layers are formed by a different number of elements and/or different configuration of elements. The stated technical task and specified objects are substan-

tially achieved by a base transceiver station, comprising:

- a plinth as described;
- a pole connected to the superior layer of the plinth.

[0020] According to an aspect of the invention, the base transceiver station comprises a fence, at least a layer of the plinth is formed by elements laterally provided with guides for the positioning of the fence on each side of the plinth.

[0021] The stated technical task and specified objects are substantially achieved by a method for assembling a plinth, comprising the steps of:

- arranging at least a first and a second layer of prefabricated reinforced concrete elements, each layer comprising corresponding holes, and a plurality of connection bars;
- positioning the first layer of elements in contact with a support surface, e.g., a terrain;
- assembling in a removable way the connection bars on the elements of the first layer from above;
- bringing the second layer of elements, one at a time, above the first layer in such a way that the holes face the corresponding connection bars;
- making each element of the second layer descend until it comes in contact with the first layer;
- fastening in a removable way the layers as connected above.

[0022] Further features and advantages of the present invention will more fully emerge from the non-limiting description of a preferred but not exclusive embodiment of a prefabricated plinth for metal structures in elevation, a base transceiver station and a method for assembling a plinth as illustrated in the accompanying drawings, in which:

- figure 1 shows a top view of a prefabricated plinth, according to the present invention;
- figure 2 shows a section of the plinth of figure 1 according to the axis A-A;
- figure 3 shows a detail (Halfen type guides or equivalent) of the plinth of figure 1;
- figure 4 shows a detail (overlapped and structurally connected elements) of the plinth of figure 1;
- figures 5a-5b show two different steps of assembling the plinth of figure 1;
- figures 6a-6c show an embodiment of the inferior, intermediate and superior layers, respectively;
- figure 7 shows a base transceiver station comprising the plinth of figure 1.

[0023] With reference to the figures, number 1 denotes a prefabricated plinth for metal structures in elevation.

[0024] The plinth 1 comprises a plurality of overlapped layers 2, each of them formed by a plurality of prefabricated reinforced concrete elements 3. In particular, the prefabricated elements 3 of a layer 2 are placed side by side, in a horizontal direction.

[0025] The layers 2 are structurally connected together by threaded connection bars 4, henceforth also referred to more simply as threaded bars 4.

[0026] In the embodiment described and illustrated herein, the connection bars 4 are threaded at the ends. Preferably, the connection bars 4 are hot-dip galvanized.

[0027] Preferably, there are threaded bars of a first length 4a, used to connect the layers 2 together, and of a second length 4b,4c, greater than the first length, to connect the layers 2 with a superstructure.

[0028] Preferably, the layers 2 have holes 5 for the insertion of the threaded bars 4, with which housings 6 facilitating the insertion of the threaded bars 4 are associated.

[0029] Preferably, the housings 6 are positioning cups drowned in a prefabricated element 3. Preferably, the positioning cups are hot-dip galvanized. Preferably, the layers 2 have a plurality of holes 5 at which the threaded bars 4 are mounted.

[0030] Preferably, the prefabricated elements 3 of the inferior layer 2 have a threaded core at the inferior portion, preferably consisting of a nut 7, drowned in the element, in which a corresponding threaded bar 4 is screwed from above in a removable way. Preferably, a further positioning cup to which the nut 7 is welded is arranged at the inferior portion.

[0031] This allows the assembly of the threaded bars 4 avoiding that one or more operators must be positioned below the layer itself during casting, as occurs in the known solutions, thus increasing the safety of the workers and at the same time reducing the times for the operation.

[0032] Preferably, the positioning cups are provided with plaits with bolted cable terminals or mechanically connected with the reinforcing bars so as to also ensure the electrical continuity and grounding of the connection bars 4. Preferably, the connection bars 4 are removably fastened to elements 3 of the superior layer 2 with clamping nut 15 and perforated counterplate 16, at the housing 6. Preferably, the nut and counterplate are hot-dip galvanized. Preferably, the plinth 1 comprises provisional centering elements 8 which screw on the superior end of one or more threaded bars 4 in such a way to guide the positioning of a layer 2 on the inferior one already in position, which are subsequently unscrewed. This allows a faster positioning of the layers 2 and at the same time reduces the possibility that the connection bars 4 bend for an incorrect positioning.

[0033] Threaded cores 7, clamping nuts 15 and counterplates 16 constitute fastening means, interacting with the connection bars 4 and such as to maintain the layers 3 structurally connected in a removable way.

[0034] In the embodiment described and illustrated herein, the layers 2 are three: a first inferior layer 2a placed in contact with the terrain, a second superior layer 2b intended to be constrained to a metal structure in el-

evation and a third intermediate layer 2c interposed between the first and the second layer 2a,2b.

[0035] The superior layer 2b comprises a central element 9 having a portion 9a protruding in height with respect to the other elements 3 of the layer 2b. The base of the superstructure is arranged and secured on the top of such a protruding portion 9a. The connection between the superior layer 2b and the superstructure occurs through the threaded bars 4 protruding from the central portion 9a.

[0036] In the embodiment described and illustrated herein, the first layer 2a comprises two prefabricated elements 3 placed side by side along a first direction. Two prefabricated elements 3 lie thereon, forming the intermediate layer 2c, which have a direction substantially orthogonal with respect to that of the elements 3 of the first layer 2a.

[0037] The first and third layers 2a,2c have load-bearing function. The threaded bars of a second length 4b, 4c, which serve to support the superstructure, are arranged centrally, i.e. at the central portion 9a of the second layer 2b. The threaded bars of a second length 4b have the inferior end thereof connected to the first inferior layer 2a, the threaded bars of a second length 4c to the intermediate third layer 2c so as to distribute the load on both layers. Preferably, the threaded bars of a second length 4b, connected to the first layer 2a, are more internal relative to the central portion 9a than the threaded bars of a second length 4c, connected to the third layer 2c.

[0038] The second superior layer 2b comprises the aforementioned central element 9 and a plurality of ballast elements 3 arranged around it. In particular, the elements 3 are arranged so as to surround the central element 9 on each side. For example, according to the configuration shown in figure 6c, the superior layer 2b consists of a load-bearing central element 9 to which the pole is constrained and four elements 3 with only the ballast function. In particular, the arrangement of the four elements 3 around the central one 9 is obtained so that the superior layer 2b and therefore the entire plinth 1 is symmetrical.

[0039] In the embodiment shown in figure 6c, the central element 9 seen from above substantially depicts a square. On two opposite sides of the central element 9, two elements 3a of a first type of length are arranged substantially equal to the side of the central element 9. On the other two opposite sides, two elements 3b of a second type are arranged extending for a length equal to the central element 9 and the other two elements 3a of the first type.

[0040] Preferably, the elements 3 and consequently the layers 2 have a rectangular section. Preferably, the elements 3 and consequently the layers 2 substantially have the form of parallelepipeds.

[0041] Preferably, the first layer 2a and the third layer 2c are arranged below the level of the surrounding terrain. In particular, the superior face of the third layer 2c is substantially at the level of the surrounding terrain.

[0042] By way of example, the plinth 1 has plan dimensions of 6.5x6.5 meters and height equal to 1150 mm.

[0043] It is also important to note that the aforementioned configuration of layers 2 consisting of elements 3 of modest size (maximum width 2.50 meters) and shapes such that each layer 2 is at most 30 tons and can be loaded on a single pivot. Consequently, two pivots and a further one are sufficient for the metal structure. This is particularly important in terms of the stackability and transportability of the plinth 1.

[0044] In an embodiment, the layers 2 of elements 3 are kept structurally connected by means of threaded vertical bars 4 which screw into threaded cores 7 inserted in the elements 3. Preferably, these threaded cores 7 are nuts.

[0045] Preferably, the vertical bars 4b, 4c (which transmit the stresses of the metal structure in elevation to the plinth 1) are completely integral, both in traction and in compression, with the plinth 1 itself by means of the interposition in the positioning cups 6 both below and above the nut 15 of load distribution plates 16 so that there are no spaces, i.e., plays, in the reciprocal movement between vertical bars 4b,4c and layers 2.

[0046] The number 10 indicates a base transceiver station, object of the present invention.

[0047] The base transceiver station 10 comprises:

- a prefabricated plinth 1 as described above;
- a pole 11 connected to the superior layer 2b of the plinth 1.

[0048] The pole 11 is the superstructure mounted above plinth 1.

[0049] Preferably, the base transceiver station 10 comprises a fence 12 surrounding the base structure.

[0050] Preferably, at least one layer 2 of the plinth 1 is formed by elements 3 laterally provided with guides 13 for the positioning of the fence 12 on each side of the plinth 1. Preferably, the guides 13 are arranged along the elements 3 surrounding the central element 9, and extend almost entirely from the side.

[0051] Preferably, there are two guides 13 on each side, one on top of the other.

[0052] Preferably, the guides 13 are of the C type or the Halfen HTA type.

[0053] The fence 12 is connected to such guides 13 and is thus positioned on each side extremely quickly, regardless of the positioning of the platform itself. The fence 12 is provided with an entrance gate which can be positioned indifferently on each side. Preferably, the elements 3 surrounding the central element 9 protrude laterally with respect to the underlying layers 2. Thereby, the fence 12 is mounted at the guides 13.

[0054] A method for assembling a plinth, object of the present invention, is described below. Such a method is advantageously implemented by a prefabricated plinth 1 having one or more of the features described previously.

[0055] The method comprises the step of positioning

the first layer 2a in contact with a support surface, e.g., a terrain.

[0056] Preferably, the step of positioning the first layer 2a occurs by positioning the elements 3 which are intended to compose it one at a time.

[0057] Next, the method comprises the step of assembling in a removable way the connection bars 4 on the elements 3 of the first layer 2a from above. Preferably, the connection bars 4 are threaded at the ends and this step occurs by screwing the connection bars 4 in a corresponding threaded seat. In the embodiment described and illustrated herein, such a seat is a positioning cup with a welded nut.

[0058] At this point, the second layer 2b is brought above the first layer in such a way that the holes present therein face the corresponding connection bars. Next, the method comprises the step of lowering the second layer 2b until it contacts the first layer 2a.

[0059] Preferably, the step of bringing the second layer 2b above the first layer 2a and the step of lowering the second layer 2b occur for each of the elements 3, one at a time, which are intended to compose the second layer 2b.

[0060] The method comprises the step of fastening in a removable way the layers 2 as connected above.

[0061] Preferably, prior to the step of bringing the second layer 2b above the first layer 2a, the method comprises the step of mounting centering elements 8 to the free end of the connection bars 4. Preferably, such a step occurs by screwing the centering element 8 onto the threaded end of the connection bar 4.

[0062] Preferably, the method comprises the step of disassembling the centering elements 8 from the connection bars 4. Such a step occurs after positioning the last layer 3.

[0063] Preferably, the method comprises the step of positioning a third layer 2c of intermediate elements 3, prior to the step of bringing the second layer 2b above the first layer 2a.

[0064] Preferably, prior to the step of positioning the first layer 2a in contact with the terrain, the method comprises the step of preparing the terrain. In particular, such a step occurs by excavating the terrain for a predetermined amount and partially filling the excavation with stabilized quarry stone. This allows to generate a minimum amount of carry-over terrain with respect to the known solutions, which can therefore be disposed of in the surrounding area instead of being moved and transported to landfills.

[0065] From the above description, the features of the prefabricated plinth for metal structures in elevation, the base transceiver station and the method for assembling a plinth, according to the present invention, are clear, as are the advantages.

[0066] In particular, a plinth composed of prefabricated reinforced concrete elements and layered by means of connection bars offers comparable performance to plinths cast in situ. With the configuration described above, the plinth can easily hold poles up to 30 meters in height and more.

[0067] Furthermore, a base transceiver station which uses a plinth of this type allows the so-called "co-siting" of up to three telephony operators (and more depending on the load). In other words, several mobile operators install their transceiver apparatuses on the same site, having a guarantee of stability and reduced deflection of the metal structure in elevation (pole) with the same performance as a plinth cast in situ. This is particularly advantageous, as it reduces the territorial occupation due to base transceiver stations. Furthermore, the individual prefabricated elements are reusable. In fact, it is sufficient to loosen the bolted connection with the threaded bars to remove them.

[0068] Furthermore, to assemble a plinth it is sufficient to position the elements of the inferior layer, mount the connection bars thereto and position the elements of the superior layers. This allows the plinth to be made very quickly and easily. Furthermore, the fact that the bars are positioned from above, with the inferior layer already in place, allows workers to work in total safety, unlike the known solutions.

[0069] Furthermore, the symmetry of the geometry allows any in situ positioning of the structure without any limitation and without hesitation from the workers. The geometric symmetry also allows a free orientation of the entrance gate, the fence as well as the metal structure in elevation and the relative apparatuses serving the base transceiver station.

[0070] Furthermore, the plinth is extremely versatile and easily adaptable to various superstructure formats and the different maximum loads required by the application. In fact, the plinth can be composed of two or more layers, and moreover each layer can consist of any number of elements, with any combination regarding the mutual orientation thereof, as long as it has first been adequately designed and verified in terms of resistance to the loads in play.

Claims

1. Prefabricated plinth (1) for metal structures in elevation, **characterized in that** it comprises:

   a plurality of overlapped layers (2), each of them formed by a plurality of prefabricated reinforced concrete elements (3) placed side by side;
   threaded connection bars (4) which structurally connect the layers (2) together;
   fastening means, interacting with the connection bars (4) and such as to maintain the layers (2) structurally connected in a removable way,
   wherein the layers (2) have holes (5) for the insertion of the connection bars (4), with which housings (6) to facilitate the insertion of the connection bars (4) are associated,

wherein said housings (6) are positioning cups drowned in the prefabricated elements (3),
wherein the threaded connection bars (4) are threaded at the ends,
wherein the elements (3) of the inferior layer (2) have a threaded core (7) at an inferior portion, said threaded core (7) being drowned in said inferior portion and being part of the fastening means, in which a corresponding connection bar (4) is screwed from above.

2. Plinth (1) according to claim 1, wherein the superior layer (2) comprises a central element (9) having a portion (9a) protruding in height with respect to the other elements (3) of the layer (2), the top of said central element (9) being intended to be connected to a base of a metal structure in elevation.

3. Plinth (1) according to any one of the preceding claims, wherein the layers are three: a first inferior layer (2a) in contact with the terrain, a second superior layer (2b) intended to be constrained to a metal structure in elevation and a third intermediate layer (2c) interposed between the first and second layers (2a,2b).

4. Plinth (1) according to claim 3, wherein the first layer (2a) comprise two prefabricated elements (3) placed side by side along a first direction, on which two prefabricated elements (3) lie, forming the intermediate layer (2c) and having a second direction substantially orthogonal with respect to the first direction of the elements (3) of the first layer (2a).

5. Plinth (1) according to claim 1, wherein the fastening means comprise perforated counterplates (16) which are inserted on the superior end of the connection bars (4) and clamping nuts (15) which are screwed in a removable way on the superior end of the connection bars (4) in order to clamp the counterplates against the elements (3) of the superior layer (2).

6. Plinth (1) according to any one of the preceding claims, comprising provisional centering elements (8) which are screwed on the superior end of one or more threaded connection bars (4) in such a way to guide the positioning of a layer (2) on the inferior one already in position, said provisional centering elements (8) being removable.

7. Plinth (1) according to any one of the preceding claims, wherein the consecutive layers (2) are formed by a different number of elements (3) and/or a different configuration of elements (3).

8. Plinth (1) according to claim 1, wherein the threaded core (7) is a nut.

9. Plinth (1) according to claim 8, wherein a further positioning cup (6) is arranged at the inferior portion of the inferior layer (2), said nut (7) being welded to the further positioning cup (6).

10. Plinth (1) according to claim 1, wherein there are threaded bars of a first length (4a), to connect the layers 2 together, and threaded bars of a second length (4b,4c), greater than the first length, to connect the layers (2) with a superstructure.

11. Base transceiver station (10), comprising:

- a plinth (1) according to any one of the preceding claims;
- a pole (11) connected to the superior layer (2) of said plinth (1).

12. Base transceiver station (10) according to claim 11, comprising a fence (12), at least a layer (2) of said plinth (1) being formed by elements (3) laterally provided with guides (13) for the positioning of the fence (12) on each side of the plinth (1).

13. Method for assembling a plinth (1) according to any one of claims 1 to 10, comprising the steps of:

- arranging at least a first and a second layer (2) of prefabricated reinforced concrete elements (3), each layer (2) comprising corresponding holes (5), and a plurality of connection bars (4);
- positioning the first layer (2) of elements (3) in contact with a support surface, e.g. a terrain;
- assembling in a removable way the connection bars (4) on the elements (3) of the first layer (2) from above;
- bringing the second layer (2) of elements (3), one at a time, above the first layer (2) in such a way that the holes (5) face the corresponding connection bars (4);
- making each element (3) of the second layer (2) descend until it comes in contact with the first layer (2);
- fastening in a removable way the layers (2) as connected above,

wherein the connection bars (4) are threaded at the ends and wherein the elements (3) of the first layer (2) have a threaded core (7) at an inferior portion, said threaded core (7) being drowned in said inferior portion, said step of assembling in a removable way the connection bars (4) on the elements (3) of the first layer (2) from above occurs by screwing the connection bars (4) in a corresponding threaded core (7).

FIG. 1

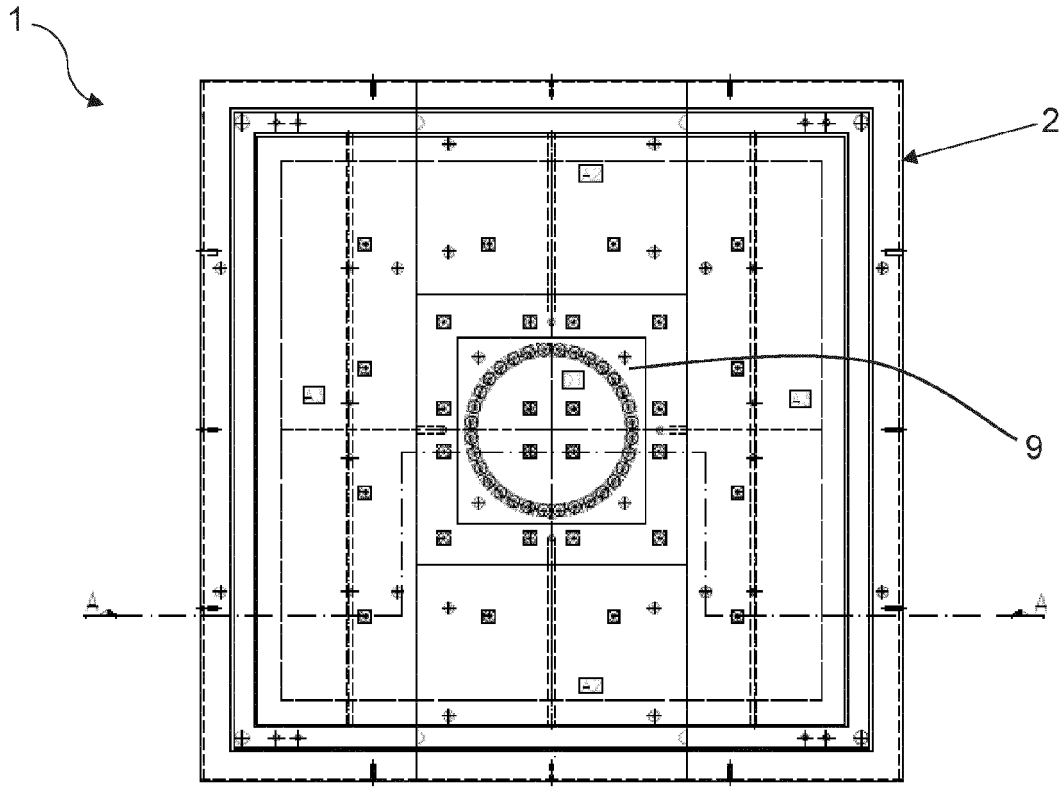


FIG. 2

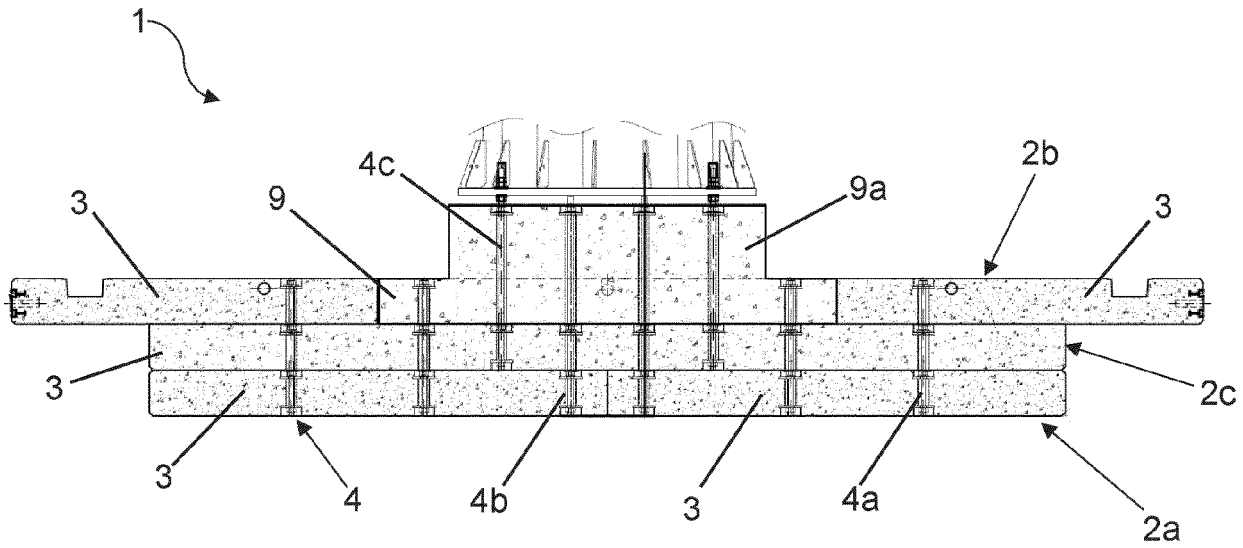


FIG. 3

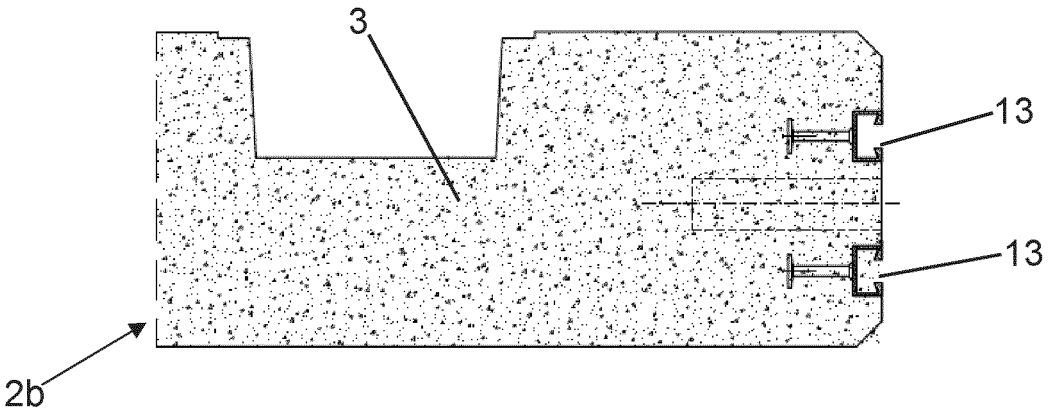


FIG. 4

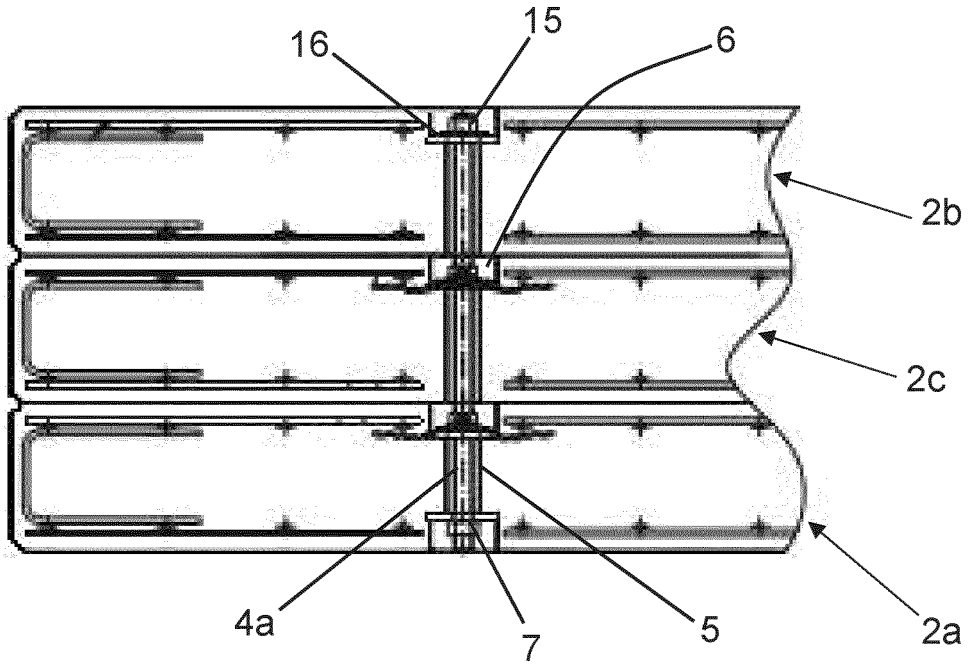


FIG. 5a

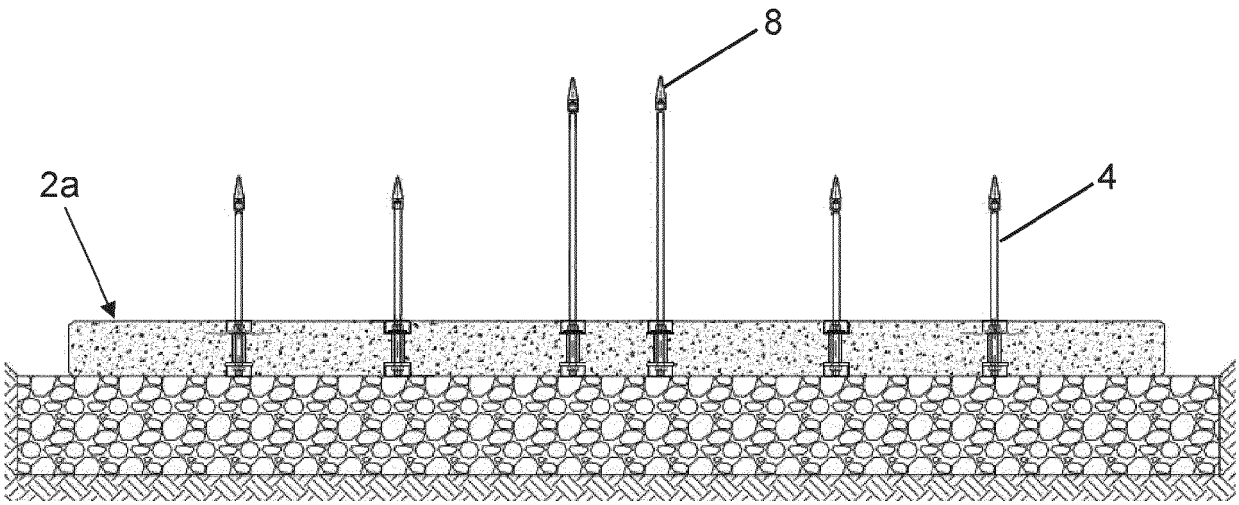


FIG. 5b

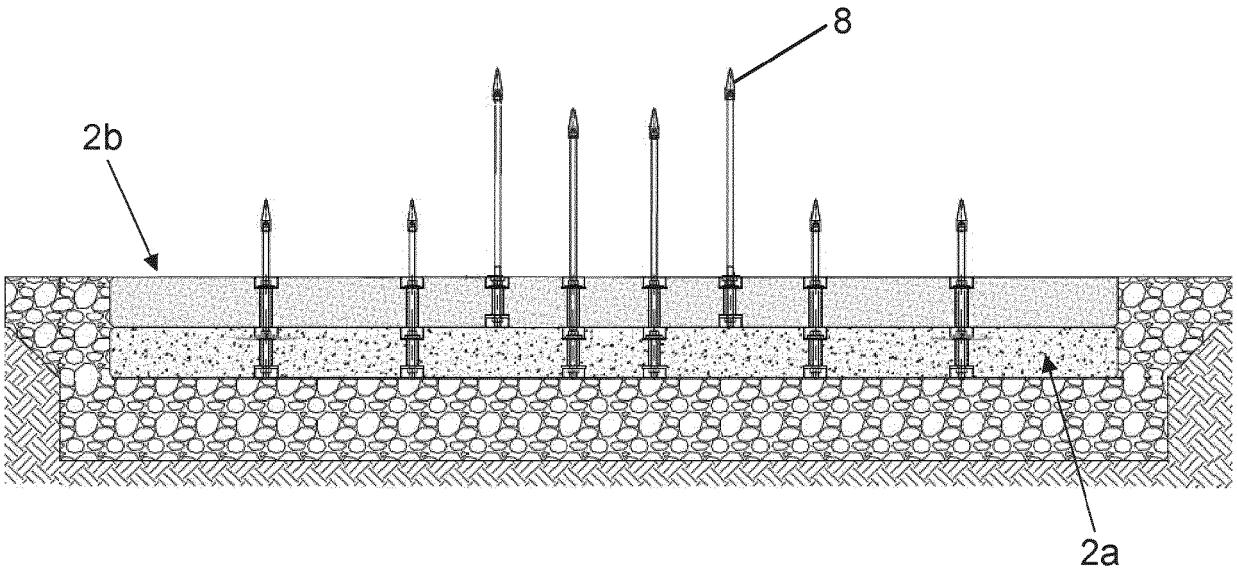


FIG. 6a

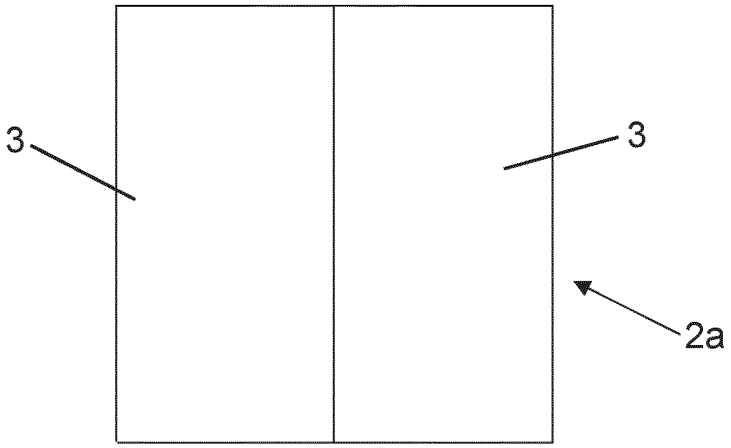


FIG. 6b

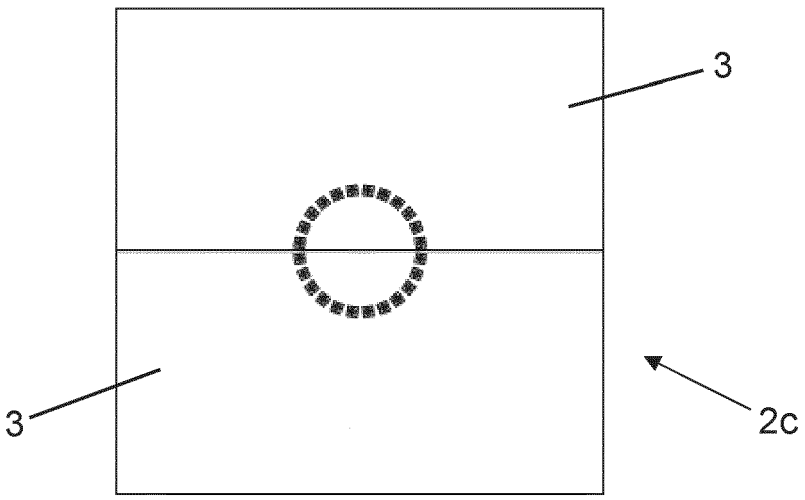


FIG. 6c

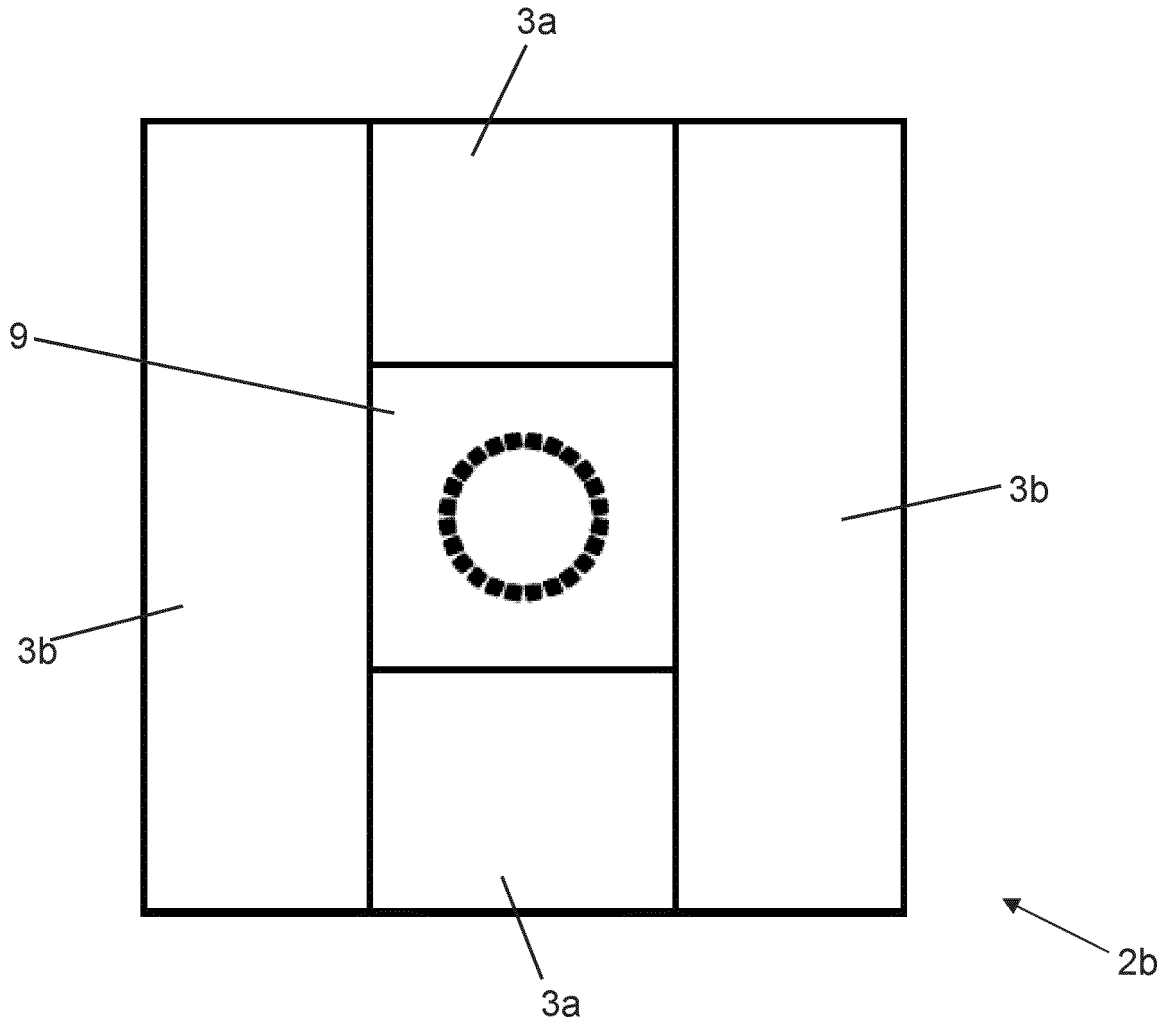


FIG. 7