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(54) **SYSTEM FOR LIFTING LARGE STRUCTURES**

(57) The invention relates to a large structure lifting system made up of several lifting columns (1), with synchronized operation, allowing the lifting of the structure (2) previously assembled on the ground up to its final position in a single operation, each of the columns comprising at least the following elements:

- a fixed column (3), anchored to the ground, made up of a series of metal sections (7).
- a moving column (4), made up of a series of metal sections (5), which can be vertically displaced with regard to the fixed column (3).
- a pneumatic thrust system (11) causing the vertical displacement of the moving column (4), carrying out alternating up and down cycles.

- a sliding ring (12) arranged externally encircling the fixed column (3) and the moving column (4) and which part of the structure (2) to be hoisted is fixed to through anchoring elements (17).
- an interlocking system (13) provided in the sliding ring (12) to connect the sliding ring (12) to the fixed column (3) and/or to the moving column (4),

the system comprising an electronic control network coordinating the movements of the pneumatic thrust system (11) of each of the lifting columns (1), as well as of the interlocking systems (13) of each column (1), to achieve the synchronized lifting of all the sliding rings (12) and, accordingly, of the structure (2).

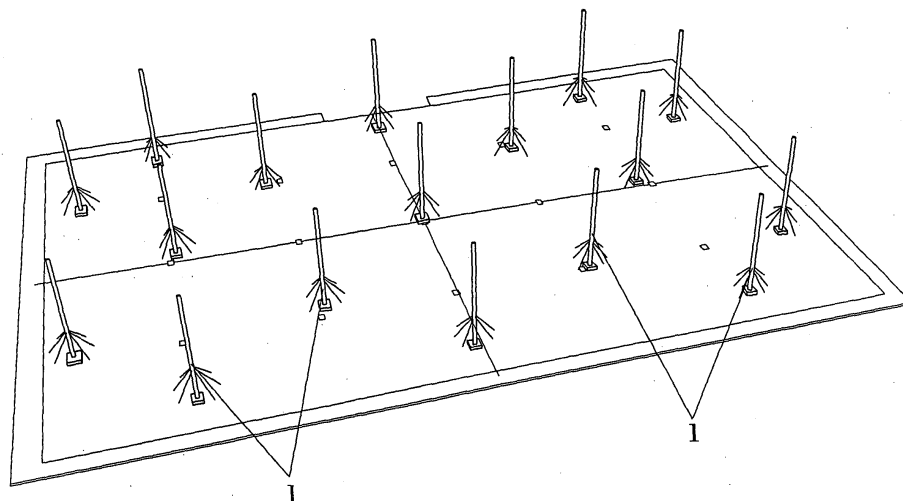


FIG.1

Description

OBJECT OF THE INVENTION

[0001] The system of the invention has the object of lifting large structures, which have previously been completely assembled on the ground, until placing them in their final position, eliminating assembly operations at heights, thus preventing the risks involved with them and reducing the assembly time for both the structure and for the total construction of the building such structure pertains to.

[0002] According to the system of the invention, once the corresponding structure is hoisted, it is then placed on the permanent props or supports thereof, which could have been previously assembled, during or after the construction of the structure itself, and the mechanisms used for lifting it are then disassembled and removed.

BACKGROUND OF THE INVENTION

[0003] Today, large sized high roofs or structures and/or peculiar shapes are assembled today once the support props or structures have been assembled, having to carry out the roof assembly work at heights, which involves considerable risks and makes the tasks to be carried out difficult, and therefore involving more time and greater cost in finishing the complete structure.

[0004] Occasionally the assembly of the roof or structure on the ground is organized and is then hoisted by means of one or several cranes, but this system has a limitation with regard to the size of the structures that can be hoisted or to the geometry thereof, depending on the maximum load that the crane boom can withstand, which prevents using this method for considerably large sized structures, for example, roofs for industrial buildings having a surface that may be two or three times larger than a soccer field.

[0005] Therefore, to assemble large-sized structures using traditional cranes, the parts of such structure, which will be joined together once hoisted, must be lifted. The assembly operations for the different parts of the structure which have been hoisted separately are complicated and must also be carried out at heights.

[0006] Systems or devices based on a lifting tower which is used to hoist a roof or structure are also known but they have the same aforementioned limitation regarding the dimensions that they are able to lift.

[0007] Systems of this type are described for example in US patent no. 6,430,892 relating to a method for building a dome consisting of a tower supporting the dome or structure through a series of cables or stays, with the particularity that the tower increases in height as the dome is being built and assembled. This method has two considerable drawbacks; on one hand it does not allow building very large-sized domes since it uses a single support tower and, in addition, the assembly is rather slow and complicated because for every part or section

which is lifted, a series of additional elements which allow the tower to increase in height must be assembled. The dome must also be gradually assembled as the lifting thereof advances.

[0008] US patent no. 4,199,906 describes a cooling tower supported by a mast or fixed structure which a pair of rings joined together can climb up by means of hydraulic cylinders, the rings forming a structure which supports, through cables, the roof of the tower.

[0009] As in the previous case, the lifting device described in this patent is limited to small-sized roofs or structures.

DESCRIPTION OF THE INVENTION

[0010] The system of the invention is designed to achieve a fast and safe operation for lifting large-sized structures, allowing the complete assembly of the structure on the ground. Working at heights, which is always more complicated and dangerous, is thus eliminated.

[0011] The system is made up of a series of lifting columns, which are suited in number and position to the size of the structure to be hoisted, connected to a control system allowing a joint, controlled and synchronized operation of all the columns for lifting the entire structure step-by-step up to its final position.

[0012] Each of the lifting columns comprises the following elements:

- A fixed column, made up of a series of metal sections joined together through horizontal beams, anchored to a support base on the ground.
- A moving column, made up of a series of metal sections joined together through horizontal beams, which is arranged such that it is intercalated with the fixed column and can vertically move with regard to the former, carrying out alternating up or down movement cycles.
- A pneumatic thrust system acting on the lower end of the sections of the moving column, to cause the latter to move up or down with regard to the fixed column, according to the step of the corresponding operating cycle.
- A sliding ring externally encircling the moving column and the fixed column and supporting the structure to be lifted during the entire hoisting operation thereof, either through pulling anchoring means, such as cables, chains or stays in general, or through thrust means such as bearing sections.
- interlocking means, arranged in the sliding ring, connecting the sliding ring to the fixed column and/or to the moving column and, specifically, pneumatic thrust cylinders actuating thrust bolts which can be interlocked in holes provided along the metal sections forming the moving column, as well as pneumatic retention cylinders actuating retention bolts which can be interlocked in holes provided along the metal sections forming the fixed column.

[0013] By combining the up and down movements of the moving column with the interlocking and release of the thrust and retention bolts, the sliding ring climbs up, step-by-step, being anchored respectively in the fixed column and in the moving column, until reaching the calculated and expected position for the structure.

- Hydraulic cylinders, connected to the sliding ring and, respectively, to each of the anchoring means of the structure, all the cylinders of each column being connected to the control system to allow the individual regulation of the stress existing on each anchoring means.
- A guiding system for the fixed column and for the moving column which further allows preventing buckling and lateral displacements. This system is made up of one or several guiding rings anchored to the fixed column and provided with bearing rollers, required by thrust springs, on which the moving column is supported, allowing its vertical up and down displacement in a guided manner. These rings are preferably arranged at the upper and lower part of the fixed column.
- An additional guiding system for the central area of the column, when the height thereof requires it. This system comprises extensible rings, connected together and to the sliding ring, such that as the sliding ring moves upwards, the extensible rings are positioned along the column. These rings can be similar to the guiding rings provided at the upper and lower part of the column.

[0014] The electronic control system, allowing the synchronized operation of all the columns, coordinates the movements of the pneumatic thrust systems causing the vertical displacement of the moving columns of each lifting column, as well as the synchronized activation and deactivation of the pneumatic thrust and retention cylinders of all the sliding rings.

[0015] A lateral guiding system for the structure to be hoisted can optionally be assembled which is formed by one or more bearing towers collaborating in the absorption of horizontal stress due, for example, to wind loads, and thus preventing the lateral displacement of the structure during the hoisting operation.

[0016] According to the system of the invention, for lifting a structure the number of columns required for lifting it must first be calculated, then such columns are sized and the pressures of each of the hydraulic cylinders of the sliding rings of each column are then calculated.

[0017] Once the structure of the lifting system is sized, the columns are completely assembled, comprising the assembly of the fixed columns, of the moving columns intercalated between them, of the pneumatic thrust systems of the moving columns and of the sliding rings, with their corresponding interlocking systems including, where required, the lateral guiding system to prevent lateral displacements of the structure during the hoisting

operation. The structure to be lifted is then anchored to the sliding rings of each of the columns.

[0018] Once the columns are assembled and the structure is anchored, such structure is then lifted, step-by-step, actuating in a synchronized manner the pneumatic thrust systems causing the vertical displacement of the moving columns, according to alternating up and down cycles of the moving columns, as well as the interlocking systems of the sliding rings, the sliding rings climbing up the columns and accordingly causing the hoisting, also step-by-step, of the entire structure until reaching the previously planned final position.

[0019] The complete lifting of the structure occurs by repeating a lifting cycle by means of which the structure is lifted a height equivalent to the distance or spacing existing between two consecutive holes of the sections forming the fixed and moving columns, or a multiple of the distance between holes, which cycle comprises the following steps:

- The thrust cylinders actuate the thrust bolts to interlock them in the corresponding holes of the sections of the moving column and the retention cylinders cause the retraction of the retention bolts to separate them with regard to the fixed column, the sliding ring thus being connected to the moving column.
- The actuation of the pneumatic thrust system causes the upward movement of the moving column dragging in its displacement the sliding ring and the latter in turn dragging the structure, until reaching the position corresponding to the height or spacing established for the lifting cycle which may correspond to the distance between two consecutive holes of the metal sections or to a multiple of this distance.
- The retention cylinders actuate the retention bolts to house them in holes of the metal sections of the fixed column and then acts on the thrust cylinders moving the thrust bolts, retracting them and causing them to be extracted from the holes of the sections of the moving column in which they were housed, thus disconnecting the sliding ring with regard to the moving column.
- The pressure is released from the pneumatic thrust system, allowing the downward movement of the moving column down to its lower starting position, while the structure is retained through the sliding ring which is connected to the fixed column.

[0020] By repeating this cycle, the sliding ring climbs up with regard to the fixed and moving columns and, accordingly, the structure gradually and slowly moves upwards, step-by-step, until reaching its final position.

[0021] Once the final position of the structure has been reached, its final assembly on the bearing elements that will support it during its service life and the subsequent removal of the columns and other components of the lifting system are then carried out.

DESCRIPTION OF THE DRAWINGS

[0022] To complement the description being made and for the purpose of helping to better understand the features of the invention according to a preferred practical embodiment thereof, a set of drawings is attached as an integral part of said description which, with an illustrative and non-limiting manner, shows the following:

Figure 1 schematically shows a step of the lifting of the structure, in which the lifting columns are assembled.

Figure 2 schematically shows a step of the lifting of the structure, in which the lifting columns are assembled and the assembly of the structure to be lifted has begun on the ground.

Figure 3 schematically shows a step of the lifting of the structure, in which the lifting columns are assembled and the assembly of the structure on the ground has been completed.

Figure 4 schematically shows a step of the lifting of the structure, in which the lifting columns are assembled and the structure is already lifted.

Figure 5 schematically shows a step of the lifting of the structure, in which the lifting columns are assembled, the structure is in its final lifting position and the permanent bearing elements have already been assembled.

Figure 6 schematically shows a step of the lifting of the structure, in which the lifting columns have been disassembled and the structure is supported by the permanent bearing elements.

Figure 7 shows a lifting column, including the sliding ring, the upper and lower guiding rings and three extensible rings arranged in their working positions. Figure 8 shows a detailed perspective view of a sliding ring, with the hydraulic cylinders regulating the stress of the anchoring elements.

Figure 9 shows a perspective view of a moving column, made up of four metal sections.

Figure 10 shows a perspective view of a fixed column, made up of four metal sections, anchored to a bearing base on the ground including the pneumatic lifting system.

Figure 11 shows a perspective view of three steps of the lifting of the sliding ring with the corresponding positioning of the extensible rings.

Figure 12 shows a view of a lifting column including the different steps of a lifting cycle of the structure.

PREFERRED EMBODIMENT OF THE INVENTION

[0023] As can be clearly seen in Figure 1, the system is made up of a series of lifting columns (1) duly distributed, in number, position and dimensions, according to the size of the structure (2) to be hoisted which allow, as can be seen in the Figures 4, 5 and 6, the simultaneous and controlled lifting of the entire structure (2) previously

assembled on the ground.

[0024] To that end, all the lifting columns are connected together by means of an electronic control system for controlling all the pneumatic elements as well as the movement and position of each of the columns so that the lifting occurs with a height position difference that is less than a predetermined value which has previously been programmed into the control system. This value will represent the maximum deviation considered allowable among the columns during the entire structure lifting process. By way of example, it can be approximately 10 mm.

[0025] The lifting process occurs slowly and step-by-step, all the system parameters being controlled at all times, but completely hoisting the structure in a few hours, such that the complete assembly of the structure is carried out in less time and at a lower cost than with traditional processes, further minimizing the risk to the operators since the assembly is done on the ground and lifting it is done automatically by means of the control system.

[0026] Each of the lifting columns (1) is made up of a fixed column (3) and a moving column (4) which are assembled such that they are intercalated with one another, such that the moving column (4) can be displaced according to an up and down movement with regard to the fixed column (3).

[0027] Figures 7 to 12 show a specific embodiment for the lifting column (1) in which the fixed column (3) is made up of four metal sections (5) joined together through secondary beams (6), forming an integral assembly. The moving column (4) is also made up of four metal sections (7) joined together through secondary beams (8) forming a second integral assembly.

[0028] Each fixed column (3) and moving column (4) incorporates several groups of secondary beams (6), (8), arranged at different heights which are spaced from one another a distance that is greater than the spacing or height that the structure is lifted in each lifting cycle to prevent interferences between the fixed column (3) and the moving column (4) in the vertical up and down displacements of the moving column (4).

[0029] The fixed column (3) is anchored to a structure or bearing base (9), fixed to the ground, while the moving column (4), intercalated with the fixed column (3), is borne on a thrust plate (10) under which a pneumatic thrust system (11) is assembled which is responsible for causing the up and down displacement of the moving column (4).

[0030] The pneumatic thrust system (11) is preferably formed by means of two horizontal flat plates, a lower fixed plate and an upper moving plate, on the perimeter of which the ends of an elastic annular belt are fitted, fixing them with respective flanges, thus forming a leak-tight elastic chamber, such that as gas under pressure is introduced in said chamber, the upper plate is lifted which in turn pushes and displaces the moving column (4). The pneumatic system can be formed, in a simplified

manner, from an air cushion.

[0031] Each column also incorporates a sliding ring (12), which is assembled such that it externally encircles the fixed column (3) and the moving column (4), and with-

stands the weight of the space frame (2) to be hoisted through anchoring means (17).
[0032] The sliding ring (11) incorporates an interlocking system (13) allowing it to be connected to the fixed column (3) and to the moving column (4), such that when it is connected to the moving column (4) it can be displaced with said column in its upwards movement with regard to the fixed column (3). In a preferred embodiment shown in Figure 8, the interlocking system (13) comprises thrust cylinders (13') actuating thrust bolts (14') which are provided to be anchored in holes (15) of the moving column (4), and retention cylinders (13'') actuating retention bolts (14'') which are interlocked in holes (15) of the fixed column (3), allowing, as will be described below, the lifting of the sliding ring (12) with regard to the column (1) and, accordingly, of the structure (2).

[0033] The structure (2) is joined to the sliding ring (12) through anchoring means formed, either by means which work under pulling, such as high-strength cables, chains or stays (17), or by means of thrust sections, which anchoring means (17) are joined to the sliding ring (12) with the cooperation of hydraulic cylinders (18), which are communicated together and with the control system for regulating the stress of the anchoring elements (17) of each of the lifting columns (1).

[0034] The sliding ring (12) also incorporates a series of rollers (19) resting on the fixed column (3) and moving column (4), so as to allow the guided displacement of the ring (12) in its up and down movements.

[0035] The system also comprises guiding rings (20), arranged in the upper and lower part of each column (1), anchored to the fixed column (3) and provided with bearing rollers (21), required by thrust springs, on which the moving column (4) is borne, allowing its vertical up and down displacement in a guided manner.

[0036] The system can also incorporate guiding means in the central area of the columns when the height thereof requires it. This system comprises extensible rings (22), connected together and to the sliding ring (12), such that as the sliding ring moves upwards, the extensible rings (22) are positioned along the column, as can be seen in Figure 11. These rings can be similar to the guiding rings provided in the upper and lower part of the column.

[0037] The lifting of the sliding ring (12), and accordingly of the structure, with regard to the columns (1) is carried out by repeating a lifting cycle comprising the following operative steps:

- Actuation of the thrust cylinders (13') for bolting the moving column (4) into holes (15).
- Actuation of the retention cylinders (13'') for the unbolting with regard to the fixed column (3).
- Activation of the pneumatic thrust system (11) caus-

ing the upward vertical movement of the moving column (4), dragging in turn the sliding ring (12) and, accordingly, the structure (2) to be lifted.

- When the sliding ring (12) reaches the expected position in its lifting, corresponding to the distance or spacing existing between two consecutive holes (15) or a multiple of this distance, the pneumatic system (11) stops being inflated.
- Actuation of the retention cylinders (13'') which are bolted into the fixed column (3), thus holding the sliding ring (12) and, therefore, the structure (2) to be lifted.
- Actuation of the thrust cylinders (13') to be unbolted from the moving column (4).
- Deflation of the pneumatic thrust system (11) and subsequent downward movement of the moving column (4) to its initial or rest position.

[0038] The assembly of the actuators of the lifting columns is connected forming a pneumatic network fed by one or several compressors, all of its components, i.e. filters, electrovalves and pumps, being connected through a programmable electronic control system.

[0039] The lifting columns are also joined by means of an electronic network controlled through a second programmable electronic control system which all the other subsystems of the lifting system depend on such that all the movements of the lifting columns are programmed and controlled to achieve a coordinated actuation of all the movements allowing the hoisting of the structure with very low tolerances between all its points.

[0040] Specifically, two control boxes are used for the control system of each lifting column, one of them in each ring for the control and synchronized activation/deactivation of the electrovalves and other elements for actuating the assembly of hydraulic cylinders (18) for regulating the anchoring means (17) of the structure and another one being located at the base of each column and distributing and controlling the actuators of the pneumatic thrust system (11) and the assembly of retention cylinders (13'') and thrust cylinders (13').

[0041] According to the described structural features, the structure lifting and assembly process would have at least the following operative steps of the lifting system, shown in Figures 1 to 6:

- Calculation of the number of columns (1), their necessary dimensions and positioning for hoisting the structure (2) up to its permanent position.
- Assembly of each of the lifting columns (1) in its working position.
- Assembly, connection and programming of each electronic control system according to the prior calculations.
- Anchoring of the structure (2) to be hoisted to the different sliding rings (12) of each of the lifting columns (1).
- Activation of the pneumatic thrust system (11) ac-

cording to the corresponding lifting cycle which is repeated until the structure (2) reaches its permanent height.

- Assembly of the structure (2) on the permanent bearing elements (23) which will support it during its service life.
- Disassembly and removal of the lifting columns (1).

Claims

1. A large structure lifting system comprising:

- at least two lifting columns (1),
- an electronic control system connected to the at least two lifting columns (1) for their synchronized operation, allowing the lifting, up to its final position, of a structure (2) previously assembled on the ground and connected to the lifting columns.

2. A large structure lifting system according to claim 1, **characterized in that** each of the at least two lifting columns (1) comprises the following elements:

- a fixed column (3), anchored to the ground, made up of a series of metal sections (7).
- a moving column (4), made up of a series of metal sections (5) which can be vertically displaced with regard to the fixed column (3).
- a pneumatic thrust system (11) causing the vertical displacement of the moving column (4), carrying out alternating up and down cycles.
- a sliding ring (12) arranged externally encircling the fixed column (3) and the moving column (4) and which part of the structure (2) to be hoisted is fixed to through anchoring elements (17).
- an interlocking system (13) provided in the sliding ring (12) for connecting the sliding ring (12) to the fixed column (3) and/or to the moving column (4).

3. A large structure lifting system according to claim 2, **characterized in that** the electronic control system coordinates the movements of the pneumatic thrust system (11) and the interlocking system (13) of each of the at least two lifting columns (1) to achieve the synchronized lifting of all the sliding rings (12) and, accordingly, of the structure (2).

4. A large structure lifting system according to claim 2, **characterized in that** the metal sections (7) and (5) of the fixed column (3) and moving column (4) are provided with holes (15) distributed at regular spacings along their length.

5. A large structure lifting system according to claim 4, **characterized in that** the interlocking system (13)

provided in the sliding ring (12) is made up of a pneumatic actuation system actuating anchoring means (14) for their introduction into or extraction from the holes (15) of the metal sections (7) and (5).

6. A large structure lifting system according to claim 5, **characterized in that** the interlocking system (13) comprises thrust cylinders (13') actuating thrust bolts (14') to interlock them into the holes (15) of the metal sections (5) and retention cylinders (13'') actuating retention bolts (14'') for interlocking them into the holes (15) of the metal sections (7).

7. A large structure lifting system according to claim 6, **characterized in that** the holes (15) provided in the metal sections (7) and (5) have a lower circular section housing with a smaller radius than the hole (15) to ensure good bearing between the thrust bolts (14') and retention bolts (14'') and the metal sections (7) and (5).

8. A large structure lifting system according to claim 2, **characterized in that** the metal sections (7) are joined together by means of secondary tie beams (8), whereas the metal sections (5) are joined by means of secondary beams (6).

9. A large structure lifting system according to claim 2, **characterized in that** it incorporates guiding means to prevent the lateral displacements of the fixed column (3) and moving column (4), formed by at least one ring (20) integral with the fixed column (3) and provided with cylinders or bearing rollers (21), which are borne against the moving column (4), allowing its vertical up or down displacement with regard to the fixed column (3).

10. A large structure lifting system according to claim 9, **characterized in that** it comprises two rings (20) arranged respectively at the upper and lower part of each column (1).

11. A large structure lifting system according to claim 2, **characterized in that** the lifting column (1) incorporates additional guiding means formed by an assembly of extensible moving rings (22) connected together and in turn to the sliding ring (12), rings (22) which, as the mentioned sliding ring (12) moves upwards, are positioned along the length of the column (1), simultaneously encircling the fixed column (3) and the moving column (4) and being borne thereon through cylinders or bearing rollers (23).

12. A large structure lifting system according to claim 2, **characterized in that** the moving column (4) is borne on a thrust plate (10), under which plate the pneumatic thrust system is arranged.

13. A large structure lifting system according to claim 2, **characterized in that** the pneumatic thrust system of the moving column is made up of two horizontal flat plates, a lower fixed plate and another upper moving plate on the perimeter of which the ends of an elastic annular belt are fitted, fixing them with respective flanges, thus forming a leak-tight elastic chamber, such that as gas under pressure is introduced into said chamber, the upper plate is lifted which in turn pushes and displaces the moving column borne thereon.
14. A large structure lifting system according to claim 2, **characterized in that** the anchoring elements (15) of the structure are joined to the sliding ring (12) through respective hydraulic cylinders (18) which allow controlling the stress withstood by the anchoring elements of the structure during the entire lifting process.
15. A large structure lifting system according to claim 2, **characterized in that** the sliding ring (12) incorporates one or several sliding rollers (19) for guiding it with regard to the fixed column (3) and moving column (4).
16. A large structure lifting system according to claim 1, **characterized in that** the control system incorporates control means distributed in each of the columns (1) and, specifically, control means arranged in the sliding ring (12) for the activation and deactivation of the elements causing the actuation of the hydraulic cylinders (18) and control means arranged at the base of the column (1) for distributing and controlling the actuations of the pneumatic thrust system (11) and of the pneumatic thrust cylinders (13') and retention cylinders (13").
17. A large structure lifting system according to claim 1, **characterized in that** it incorporates at least one vertical guiding column of the structure to be lifted which collaborates in absorbing horizontal stress.
18. A large structure lifting system according to claim 2, **characterized in that** the fixed column (3) is formed by four metal sections (7) and the moving column (4) is formed by four metal sections (5).
19. A large structure lifting system according to any of the previous claims, **characterized in that** it comprises the following operative steps:
- Calculation of the number of columns (1), their necessary dimensions and positioning for hoisting the structure (2) up to its permanent position.
 - Assembly of each of the lifting columns (1) in its working position.
 - Assembly, connection and programming of each electronic control system according to the prior calculations.
 - Anchoring of the structure (2) to be hoisted to the different sliding rings (12) of each of the lifting columns (1).
 - Activation of the pneumatic thrust system (11) according to the corresponding lifting sequence which is repeated until the structure (2) reaches its permanent height.
 - Assembly of the structure (2) on the permanent bearing elements (23) which will support it during its service life.
 - Disassembly and removal of the lifting columns (1).
20. A large structure lifting system according to claim 19, **characterized in that** the lifting sequence comprises the following steps:
- Actuation of the thrust cylinders (13') for bolting the moving column (4) into holes (15) of the metal sections (5).
 - Actuation of the retention cylinders (13") for the unbolting with regard to the fixed column (3), the sliding ring being interlocked with regard to the moving column (4).
 - Activation of the pneumatic thrust system (11) causing the upward vertical movement of the moving column (4), dragging in turn the sliding ring (12) and, accordingly, the structure (2) to be lifted.
 - When the sliding ring (12) reaches the expected position in its lifting, corresponding to the distance or spacing existing between two consecutive holes (15) of the fixed column (3), or a multiple of this distance, the pneumatic system (11) stops being inflated.
 - Actuation of the retention cylinders (13") which are bolted into the fixed column (3), thus holding the sliding ring (12).
 - Actuation of the thrust cylinders (13') to be unbolted from the moving column (4), disconnecting it from the sliding ring (12).
 - Deflation of the pneumatic thrust system (11) and subsequent downward movement of the moving column (4) to its initial or rest position.

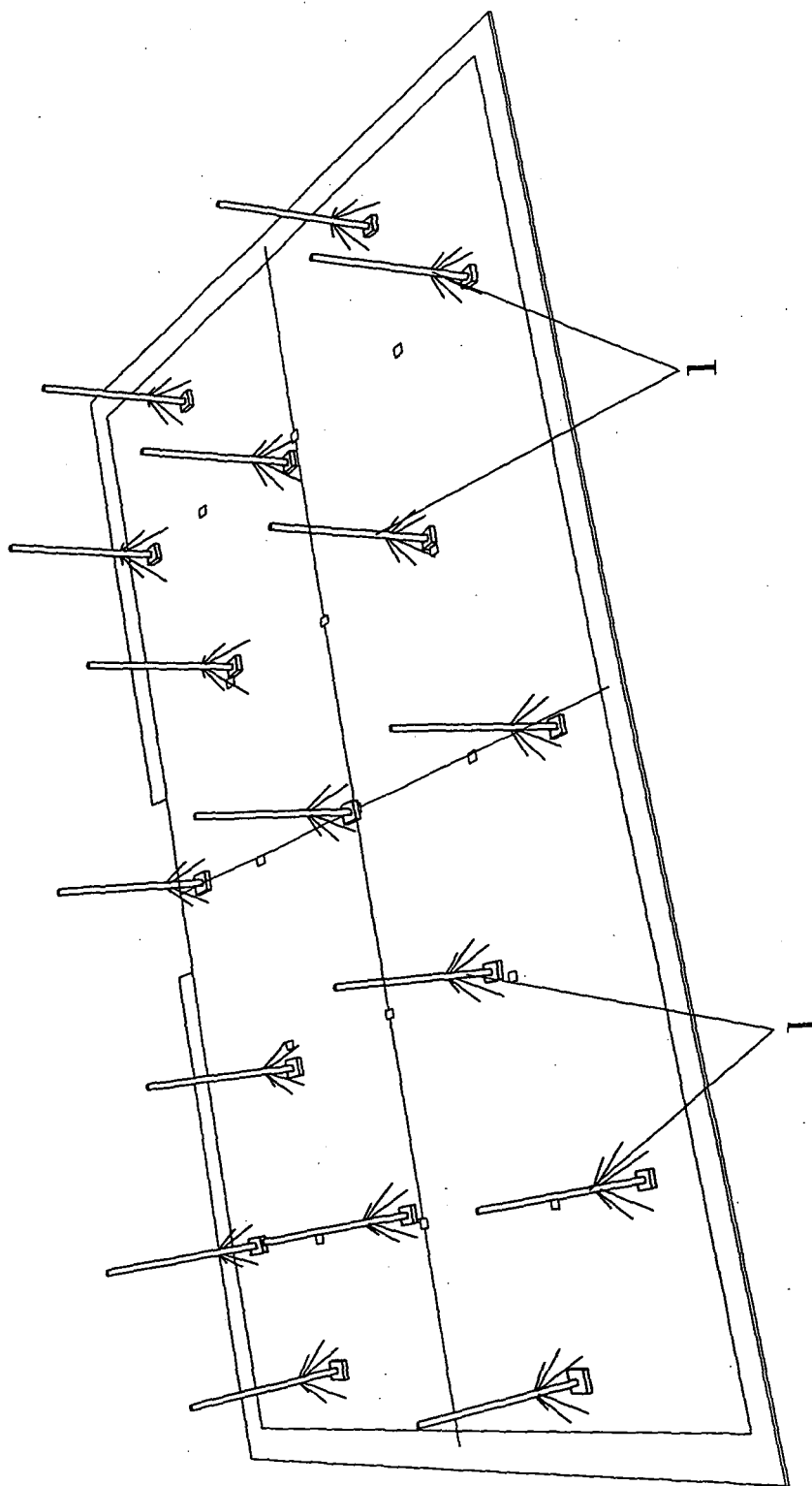


FIG. 1

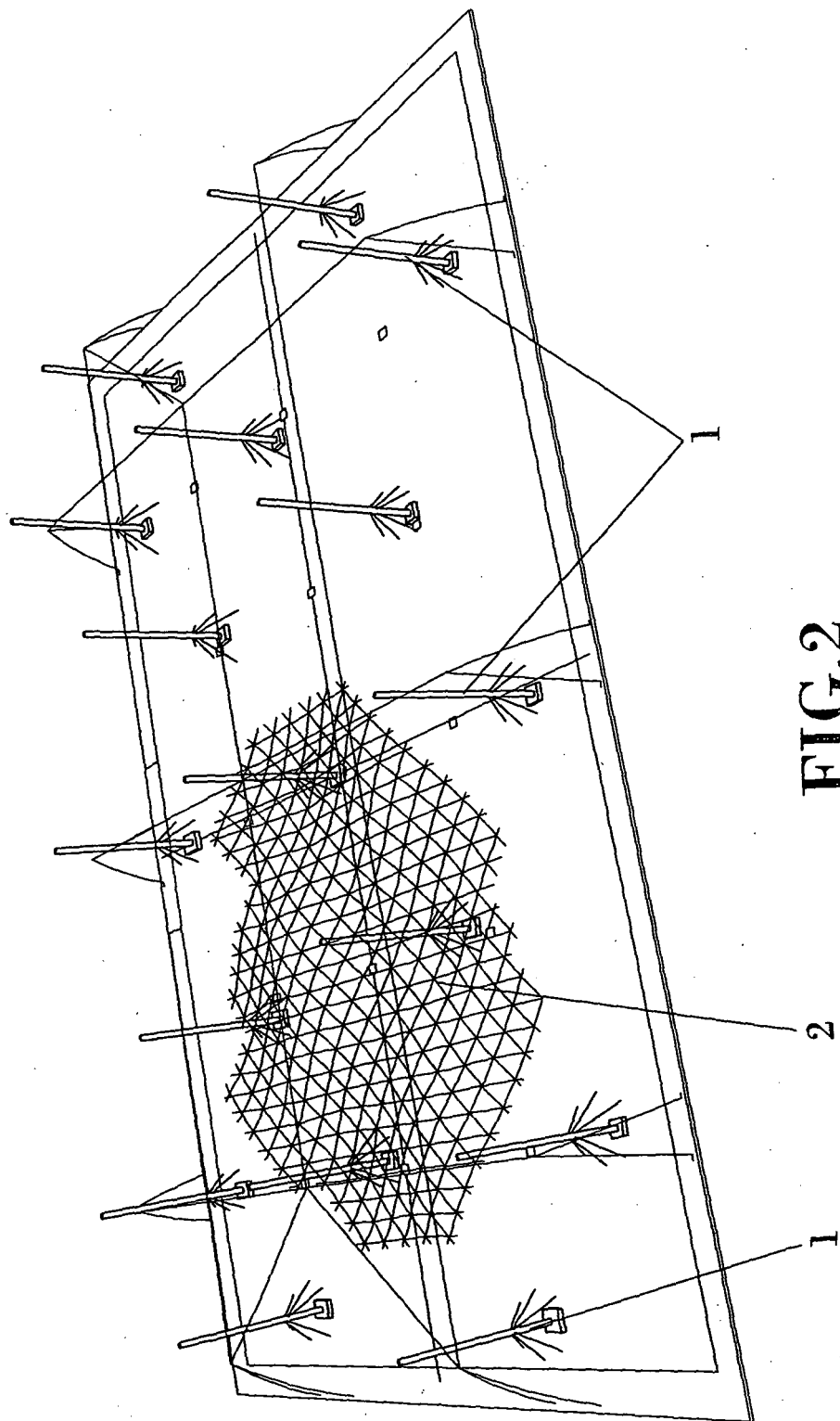


FIG. 2

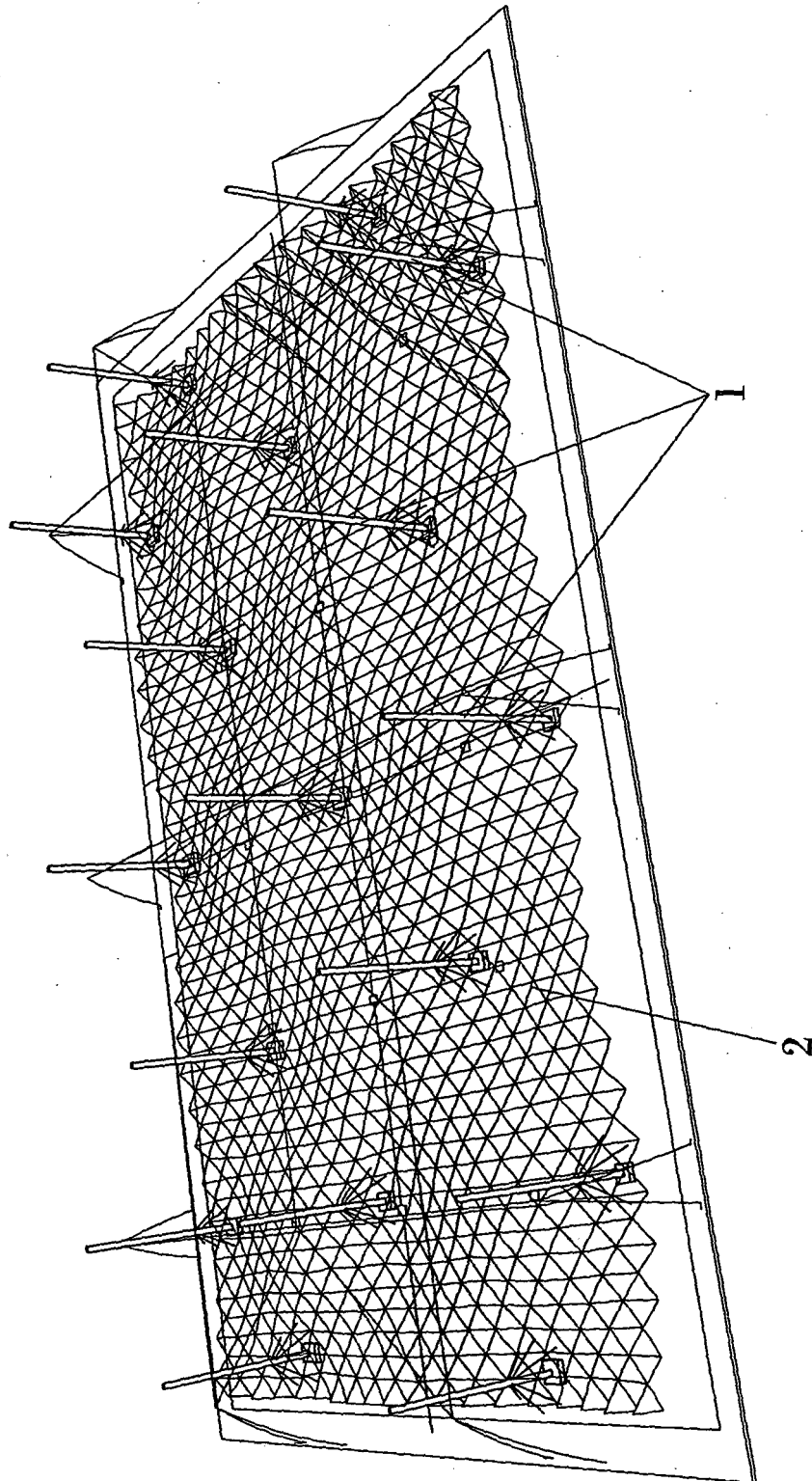


FIG. 3

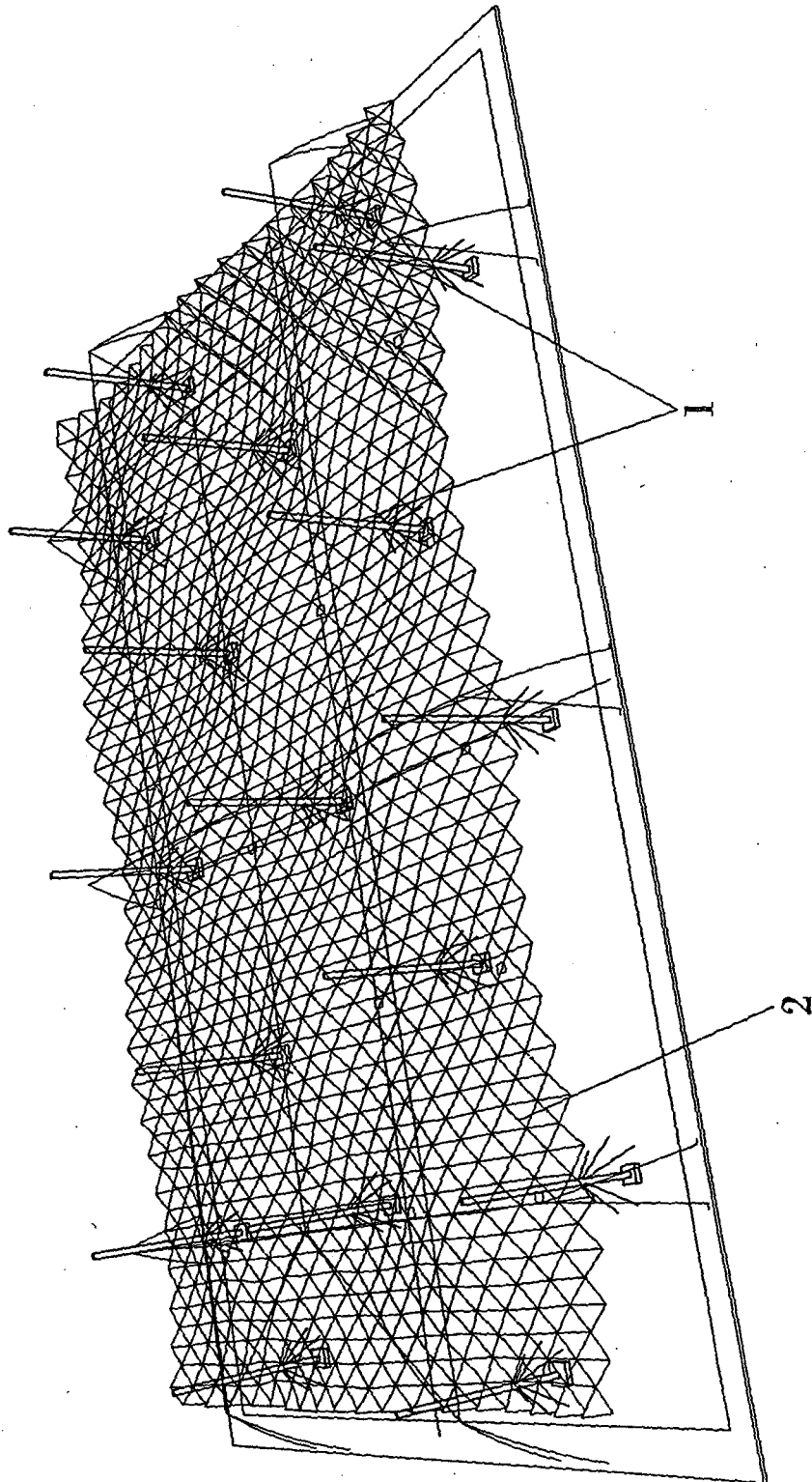


FIG.4

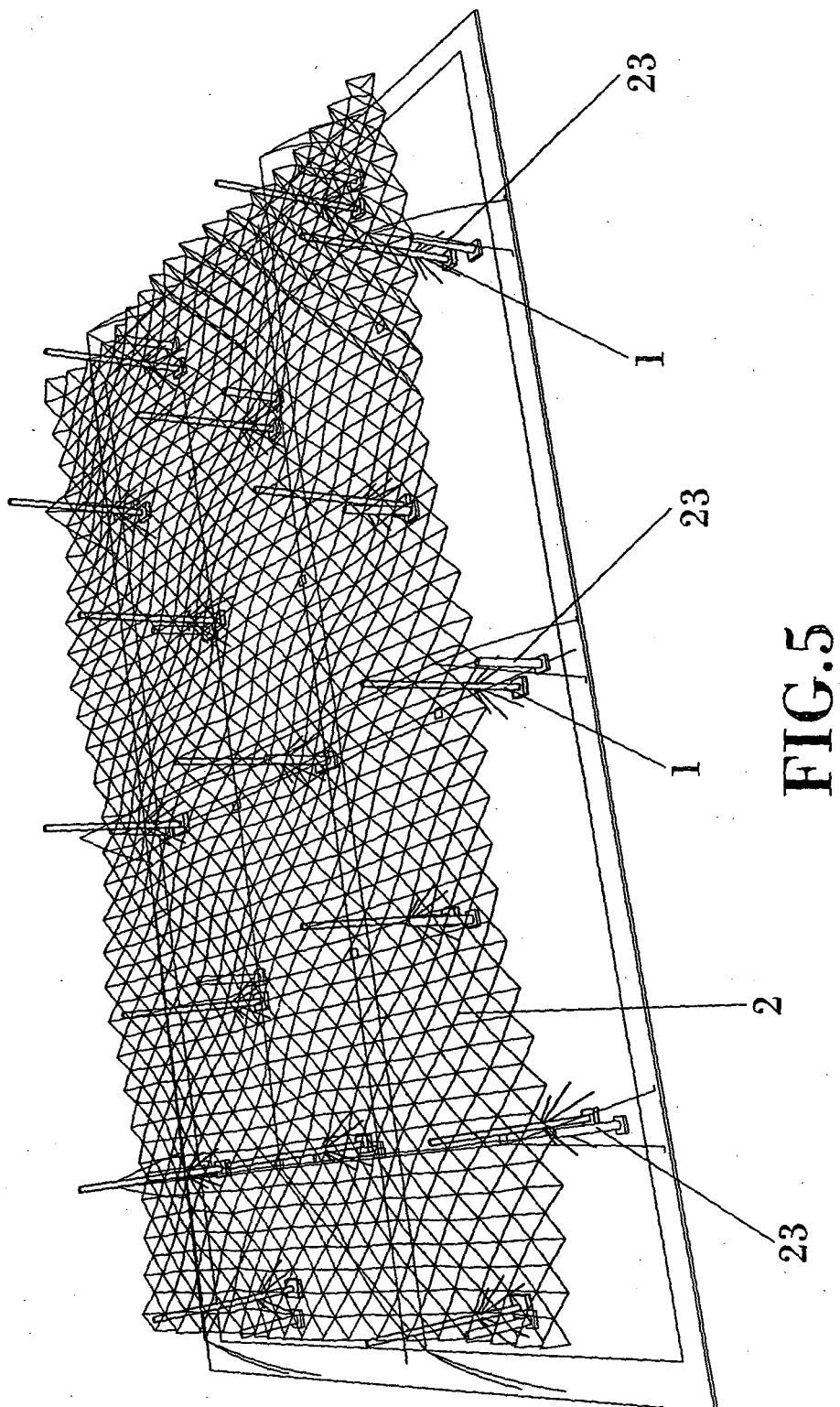


FIG. 5

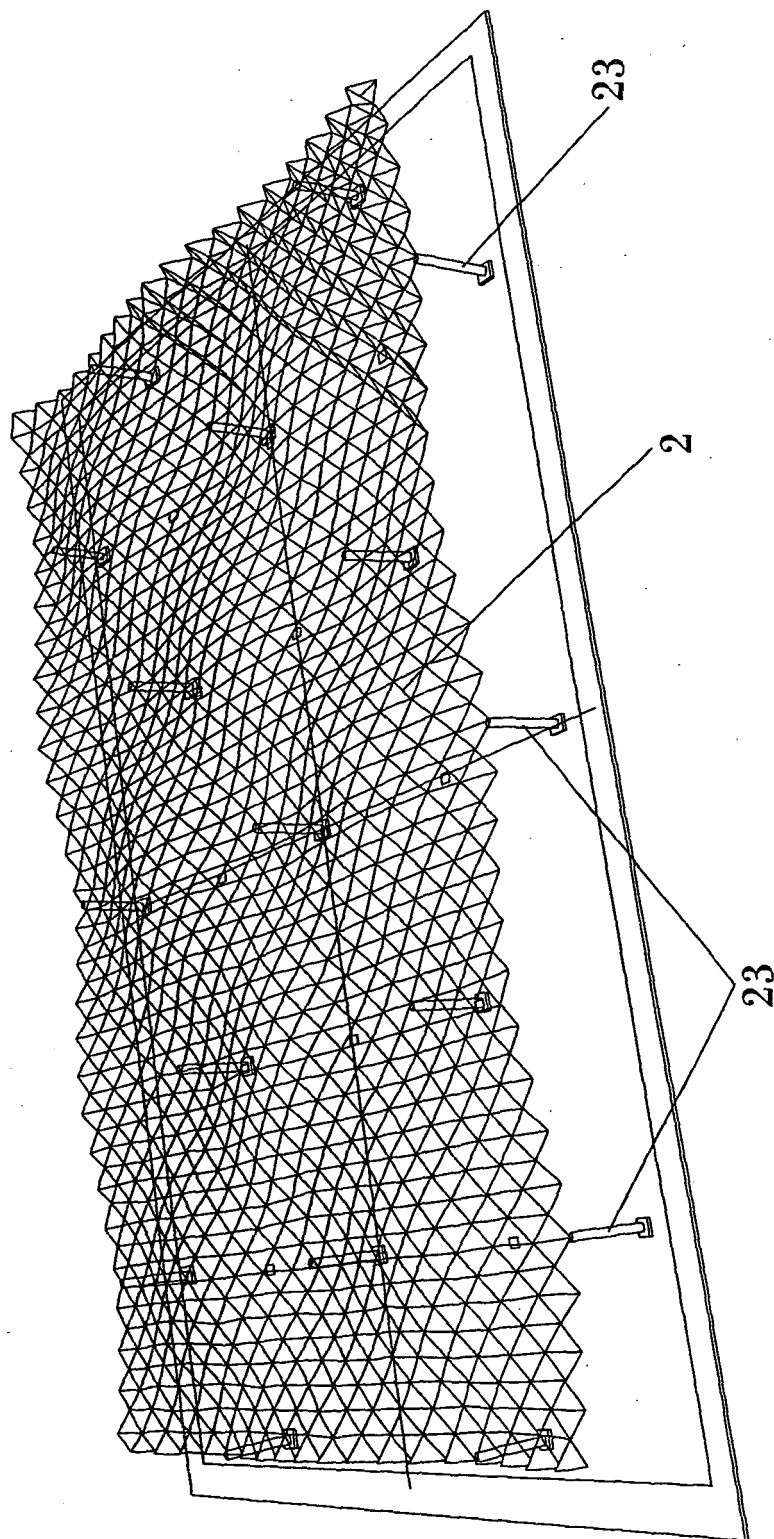


FIG. 6

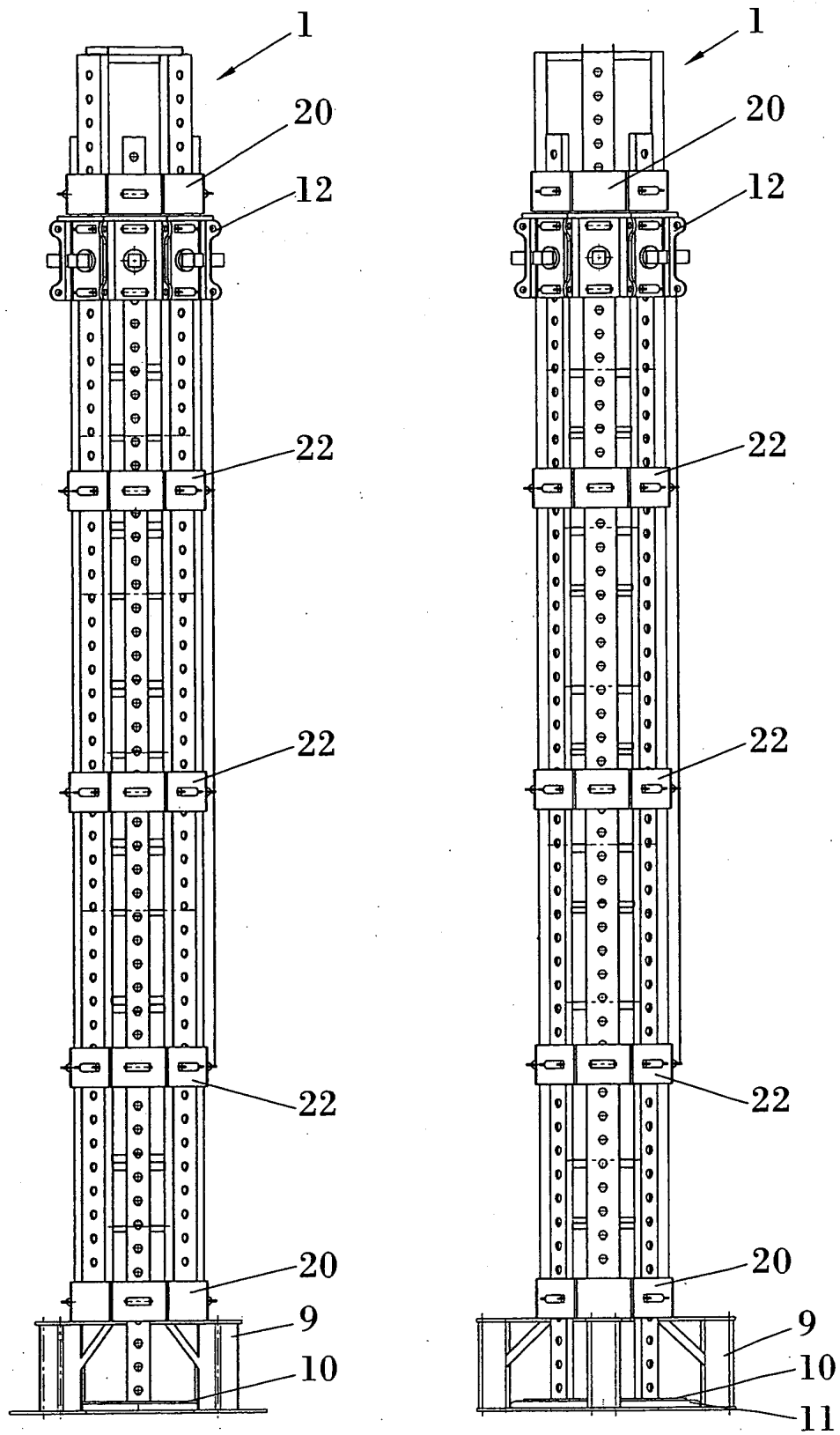


FIG.7

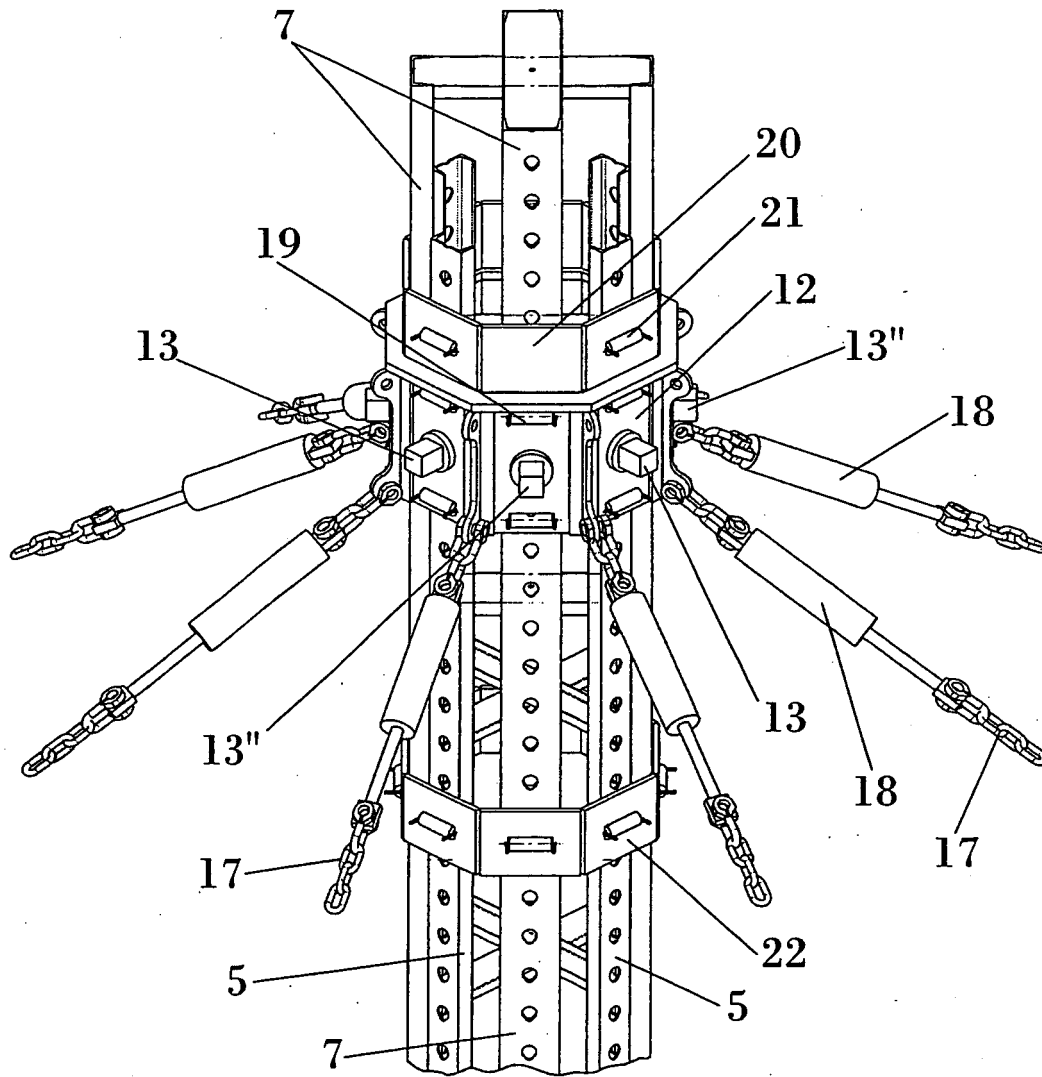


FIG.8

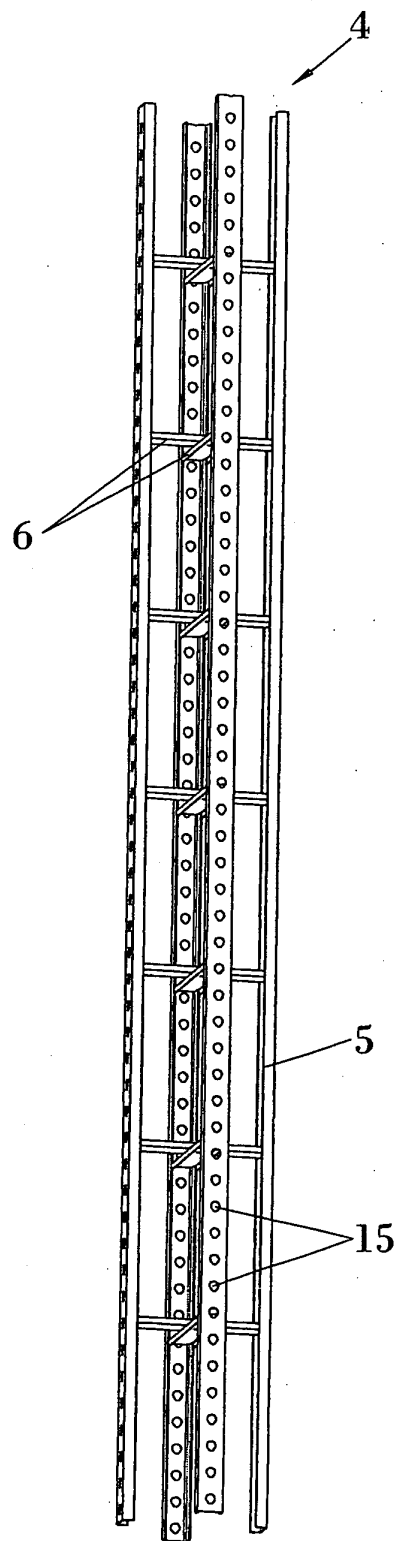


FIG. 9

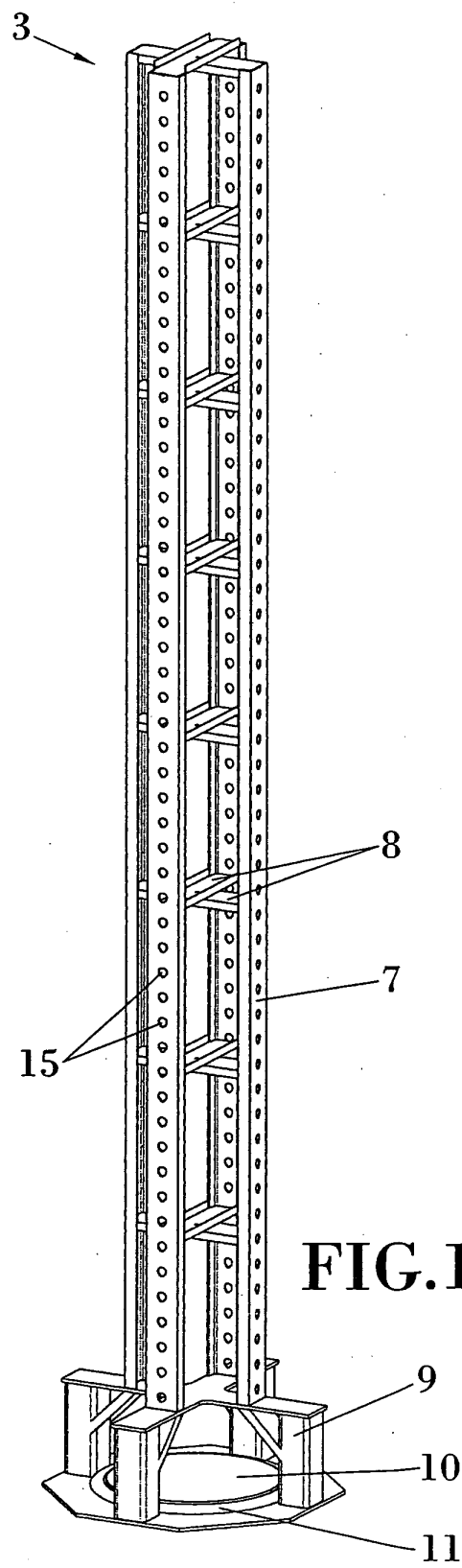


FIG. 10

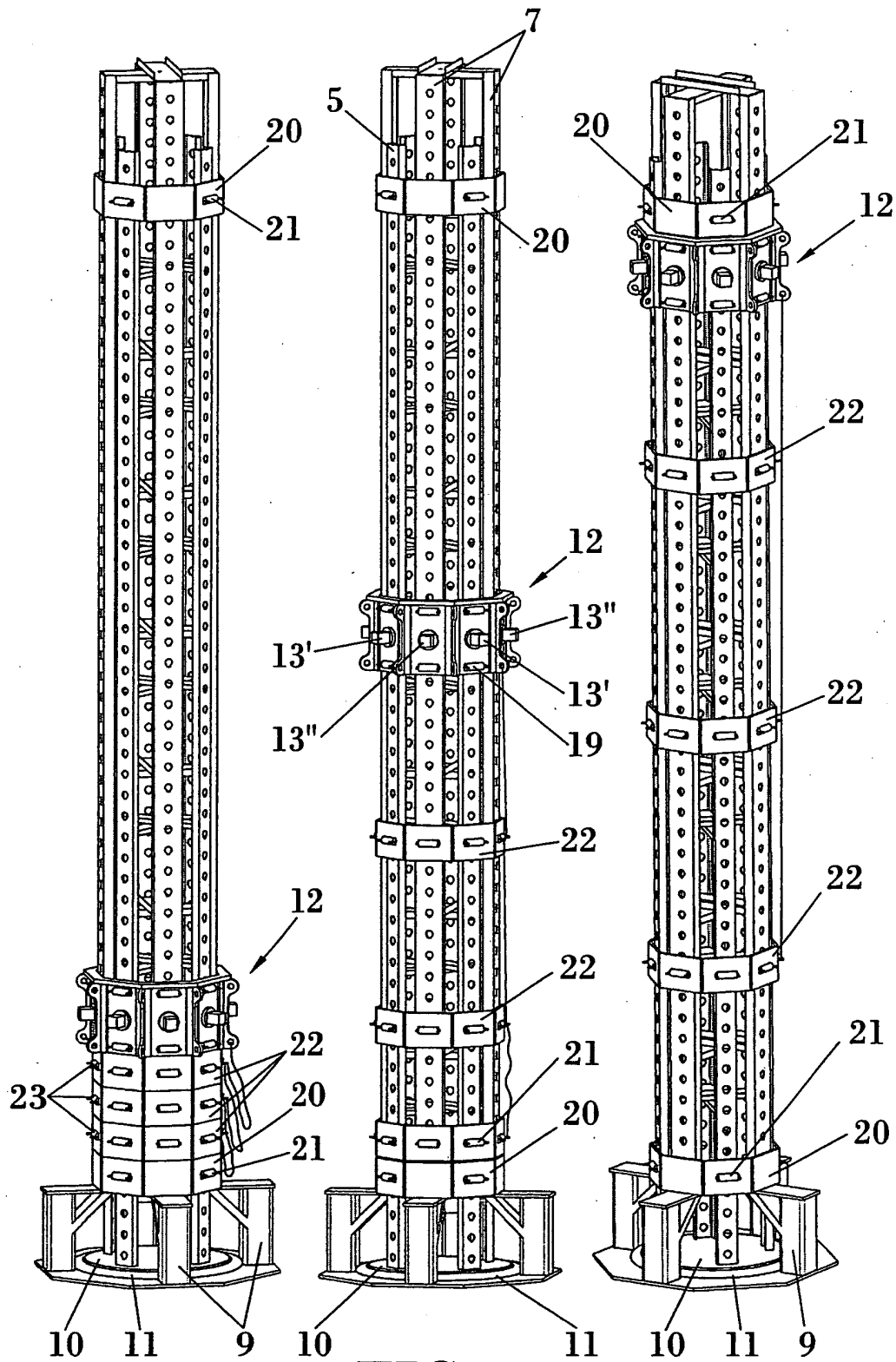
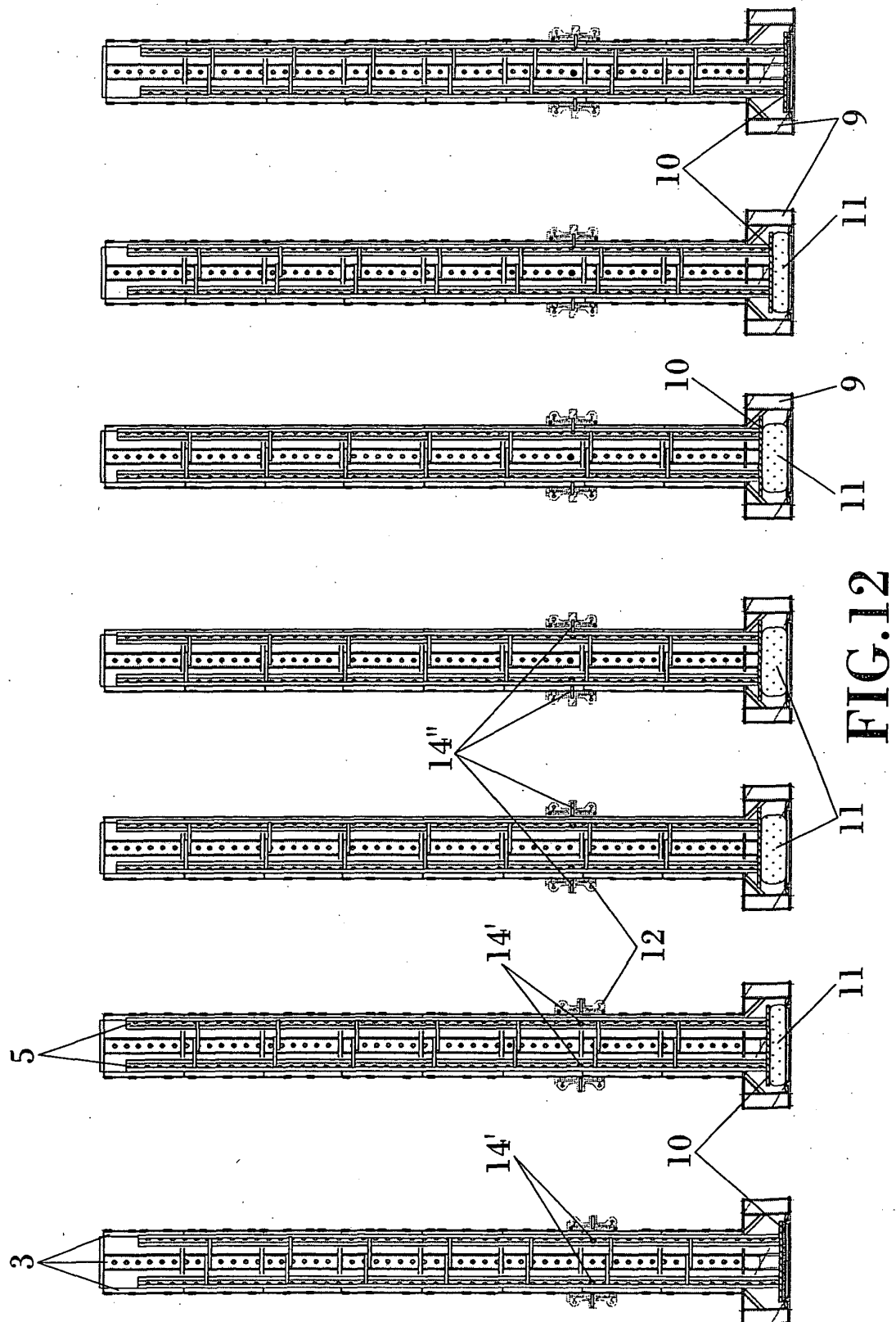


FIG. 11



INTERNATIONAL SEARCH REPORT

International application No.
PCT/ ES 2005/000022

A. CLASSIFICATION OF SUBJECT MATTER see on attached page 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) E04B, E04G, B66F 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)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	US 4251974 A (VANDERKLAUW) 24.02.1981, the whole document	1 19
Y A	FR 2547291 A1 (EPITOEGEPPGYARTO VALLALAT) 14.12.1984, pages 1-3, abstract	1 16
A	US 3096076 A (WALLI) 02.07.1963, the whole document	2
A	US 2867111 A (YOUTZ) 06.01.1959, figures abstract	2
A	PATENT ABSTRACTS OF JAPAN, vol 1995, num 10, (30.11.1995) & JP 7189346 A (ASUKA SEKKEI et al.) 28.07.1995, abstract , figures	2, 4
A	US 4605203 A (HOOPER et al.) 12.08.1986, abstract	2, 13
A	US 6425712 B1 (VANDERKLAUW) 30.07.2002, abstract	17
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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Date of the actual completion of the international search 14 April 2005 (14.04.2005)		Date of mailing of the international search report 28 April 2005 (28.04.2005)
Name and mailing address of the ISA/ Facsimile No.		Authorized officer Telephone No.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/ ES 2005/000022

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INTERNATIONAL SEARCH REPORT

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PCT/ ES 2005/000022

IPC

E04B 1/35 (2006.01)
E04G 21/14 (2006.01)
B66F 3/46 (2006.01)
B66F 3/40 (2006.01)

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