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(71) Applicant: **VDL Groep B.V.**  
**5652 AW Eindhoven (NL)**

(72) Inventor: **PÜTT, Thomas**  
**47495 RHEINBERG (DE)**

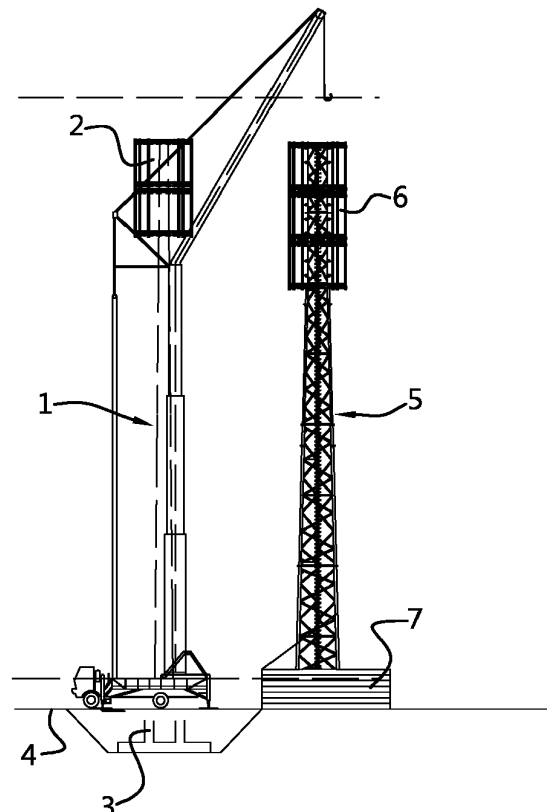
(74) Representative: **EP&C**  
**P.O. Box 3241**  
**2280 GE Rijswijk (NL)**

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(54) **REPLACEMENT OF A TELECOMMUNICATIONS TOWER**

(57) In a method for the replacement of a telecommunications tower (1) placed on an existing foundation (3) and provided with antenna equipment (2), a replacement telecommunications tower (5) is set up next to the existing telecommunications tower (1). A temporary base (7) is deployed next to the existing telecommunications tower (1) and the replacement telecommunications tower (5) is placed on the temporary base (7). The replacement telecommunications tower (5) is provided with antenna equipment (6). The replacement telecommunications tower (5) is set into operation and the existing telecommunications tower (1) is shut down. The existing telecommunications tower (1) is removed from the existing foundation (3). The replacement telecommunications tower (5) is removed from the temporary base (7) and transferred to the existing foundation (3). The temporary base (7) is removed from the site.

**Fig. 1**



## Description

**[0001]** The present invention relates to a method for the replacement of a telecommunications tower placed on an existing foundation and provided with antenna equipment.

**[0002]** Telecommunications towers are widely used and carry antennas at elevated heights to support cellular phone and high-speed wireless communications. The continuous development of the telecom networks causes that existing telecommunications towers may not meet the requirements anymore, for example because the towers cannot carry the new generations of antennas or the increasing amount or load of antennas. In such cases the tower is usually replaced.

**[0003]** Methods to avoid replacement of the tower and upgrade or reinforce the existing tower are known for example from US 6,108,996 and US 10,132,098. These methods avoid the disruption of the operation of the antennas.

**[0004]** US 2011/0078976 relates to a method for constructing a large structure intended to replace an existing structure and aiming to minimize downtime during initial and replacement construction of structures associated with the ongoing operations.

**[0005]** GB 2380322 relates to a method for installation of a cellular telephone antenna near an existing overhead power line. Conductors of the existing overhead power line are transferred from the pole of the overhead power line to an antenna support of the antenna, after which the pole of the overhead power line is removed.

**[0006]** Temporary telecommunications towers placed on a temporary base are known in the field. A temporary tower operates in the communications network and can for example take over the operation of an existing tower in the network during maintenance, revision or replacement work on the existing tower, such that disruption of the communications is avoided as much as possible. After the work on the site is finished the temporary tower is removed again and can be used on another site.

**[0007]** The present invention has for an object to provide an efficient method to replace existing telecommunications towers.

**[0008]** This object is achieved by a method according to claim 1.

**[0009]** The gist of the invention is that the replacement tower is initially used as a temporary tower placed on a temporary base. While the removal work on the old tower takes place the temporary tower takes over the operation. When the existing tower is removed from its foundation, the replacement tower is removed from the temporary base and integrally, i.e. including the antennas, transferred to the existing foundation on which the old tower used to be placed. An advantage of this method is that only one tower, i.e. the replacement tower has to be transported to and erected on the site of the old tower. Only one tower, i.e. the old tower, has to be transported away from the site. This contrary to the known method in which

a replacement tower and a temporary tower are transported to the site and erected there, and afterwards the old tower and the temporary tower have to be transported away from the site.

**[0010]** A further possible advantage of the method according to the invention is that the technical equipment, the network line(s) and the power connection(s) could already be arranged in the final set-up on the replacement tower in its temporary position, without having to rearrange this later.

**[0011]** Possibly the foundation may be modified before the replacement telecommunications tower is transferred to said foundation. In this way the foundation may be made suitable for the replacement tower.

**[0012]** In one way of performing of the method the replacement telecommunications tower is positioned on the existing foundation and anchored thereto.

**[0013]** In another way of performing the method, before the replacement telecommunications tower is removed from the temporary base the following steps are included:

- positioning an additional tower section on the existing foundation;
- anchoring the additional tower section to the existing foundation;

and wherein the replacement telecommunications tower is positioned on and secured to the additional tower section.

**[0014]** In this latter way of performing the method, the final tower which is replaces the original tower on the foundation has a greater height than the replacement tower that is used as a temporary tower. Thus for example the replacement tower portion constituting the temporary tower may have a height of 35 m, while the final tower may have a height of 45 m by adding the additional tower section of 10 m.

**[0015]** Preferably the replacement telecommunications tower is transferred integrally from the temporary base to the existing foundation. Since the operation of the replacement tower may be disrupted during the transfer of the replacement tower, the integral transfer at least minimizes the downtime of the replacement tower.

**[0016]** In practise the replacement telecommunications tower may be removed from the temporary base and transferred towards the existing foundation by means of a crane, which lifts the replacement tower integrally from the temporary base and moves it towards the existing foundation.

**[0017]** The replacement telecommunications tower may be shut down before it is removed from the temporary base and wherein the replacement telecommunications tower is restored in operation when said tower is anchored to the existing foundation. Still, although the replacement tower is shut down, the structure and operation is such that the downtime of the replacement tower is minimal.

**[0018]** Alternatively, since the temporary base can be

positioned close to the existing foundation it is conceivable to maintain the replacement tower in operation, while the tower is transferred.

**[0019]** The invention also relates to a method for successively replacing telecommunications towers on a first site and on a second site using the method as described in the above, wherein the temporary base is removed from the first site and transported to the second site only at the time it is needed at the second site.

**[0020]** According to this method the temporary base is thus used successively on different sites and is transported directly transported from one site to the other. The first site is simply used as a temporary storage for the temporary base. This has the advantage that no additional storage space is needed to store the temporary base in between two tower replacement jobs, which allows a cost saving. Thus also the transportation of the temporary base is reduced to a minimum, which also leads to cost savings.

**[0021]** The invention furthermore relates to a replacement telecommunications tower system including a temporary base and a replacement telecommunications tower adapted to be placed on and anchored to the temporary base, the replacement tower being provided with antenna equipment, wherein the replacement telecommunications tower is furthermore adapted to be removed as an integral unit from the temporary base and transferred to a foundation in the ground.

**[0022]** The replacement tower is adapted to be anchored to the foundation. However it is also possible that the replacement telecommunications tower system furthermore includes at least one additional tower section adapted to be placed and anchored to the foundation in the ground, wherein the additional tower section has an upper end adapted to receive the replacement tower and wherein the lower end of the replacement tower and the upper end of the additional tower section are adapted to be secured to each other.

In a practical embodiment of the tower system the replacement telecommunications tower is a lattice tower. The lattice tower preferably has an equilateral triangular cross section. Such a lattice tower is relatively light in weight and is therefore suitable to be used as a replacement tower that is integrally lifted and transferred to the foundation.

**[0023]** The invention also relates to a telecommunications tower site including a telecommunications tower system as mentioned in the above.

**[0024]** The telecommunications tower site may be in a state, wherein the temporary base is located next to the foundation and the replacement tower is positioned on the temporary base.

The telecommunications tower site may be also be in a state wherein the replacement tower is positioned on the permanent foundation and wherein the temporary base is located next to the foundation. The site may remain in the latter state for the time being as long as the temporary base is not needed at another site.

**[0025]** The invention will be further elucidated with reference to the drawing, in which:

Figs. 1-3 schematically illustrate a method according to the invention,

Fig. 4 shows a top elevational view of a temporary base for a communications tower,

Fig. 5 shows a side elevational view of the temporary base of Fig 4, and

Figs. 6-20 schematically illustrate a further method according to the invention.

**[0026]** In Fig. 1 is shown an existing communications tower 1 in dashed lines. The communications tower 1 is provided at a top end portion with antenna equipment 2 for operation in cellular phone communications and high speed wireless communications, e.g. in a 4G network. The communications tower 1 is positioned on and anchored to a foundation 3 made in the ground 4.

**[0027]** On the site of the existing communications tower 1 a replacement communications tower 5 is located. The replacement tower 5 shown in the figures is a lattice tower with an equilateral triangular cross section (see Fig 4). The replacement tower 5 has a top end portion where antenna equipment 6 is mounted. The replacement tower 5 is positioned on a temporary base 7 and anchored thereto.

**[0028]** The temporary base 7 may be formed for example as shown in Figs. 4 and 5. This exemplary temporary base 7 as a steel base frame 8 with a sort of tripod configuration. Such a base frame 7 may in practise have a weight of about 18 tons. Ballast elements 9, e.g. concrete ballast blocks or plates are placed on the three pods 8A of the frame 8. The concrete plates 9 in the example may in practise have a weight of 7,5 tons each. The entire base 7 may thus have a weight of about 175 tons. First the steel base frame 8 of the temporary base 7 is positioned next to the existing communications tower 1. Next the ballast elements 9 are disposed on the base frame 8. Then the replacement tower 5 is erected and the underside of the replacement tower 5 is connected to the temporary base 7. The antennas 6 are mounted to the replacement tower 5 before or after the tower 5 is erected. Next, the technical equipment, the cables (power lines, network lines etc.) and the corresponding connections can be set-up for the replacement tower 5 in such a way that it is in its final set-up and does not need any significant rearrangement later on.

**[0029]** After all is connected and the set-up is finished, the replacement tower 5 can be set in operation and take over the function of the existing tower 1. The existing tower 1 can now be switched off and the new tower 5 can be switched on. The downtime within the telecommunications network of the tower site consisting of the towers 1 and 5 is therefore minimal.

**[0030]** Now that the replacement communications tower 5 is in operation, the existing tower 1 can be dismantled and removed from the existing foundation 3.

**[0031]** After the existing tower 1 is removed the existing foundation 3 may be prepared for the new tower 5. In some cases the foundation may remain substantially the same, but often it may be necessary to make some modifications to the existing foundation 3. In Fig. 2 is illustrated that an upper portion of the existing foundation 3 is removed and that an additional foundation part 3A is added. After the foundation 3, 3A is finished it is ready for the replacement tower 5.

**[0032]** In Fig. 2 is illustrated that the replacement tower 5 is released from the temporary base 7. A crane 10 lifts the entire replacement tower 5 including the antenna equipment 6 from the temporary base 7. The crane 10 moves the replacement tower 5 to the modified existing foundation 3 and positions the tower 5 on the foundation 3. The bottom end of the replacement tower 5 is anchored to the foundation 3 after which the crane 10 may release the replacement tower 5, which situation is shown in Fig. 3.

**[0033]** Before the replacement tower 5 is lifted and moved from the temporary base 7, it may be shut off and disconnected from the technical equipment and the cables, e.g. power lines, network lines etc. After the replacement tower has been anchored to the foundation 3, the replacement tower may be reconnected to said technical equipment and cables and set into operation again. Preferably the technical equipment and the cables are the same as the ones connected to the tower 5 when it was positioned on the temporary base 7.

**[0034]** The temporary base 7 is removed from the site and can be used on another site where a communications tower has to be replaced.

**[0035]** In Figs 6-20 another way of replacing an existing telecommunications tower according to the invention is illustrated. The same parts will be indicated with the same reference numerals as in Figs 1-5.

**[0036]** Fig. 6 shows an existing communications tower 1 with antenna equipment 2 for operation in cellular phone communications and high speed wireless communications, e.g. in a 4G network. The communications tower 1 is positioned on and anchored to a foundation 3 made in the ground 4.

**[0037]** A temporary base 7 including a metal base frame 8 and ballast elements 9 is placed close to the existing communications tower 1, as is shown in Fig. 6 and as is also described above with reference to Figs 4 and 5. The distance may be 10 m, but this is just an indicative nonlimiting example.

**[0038]** Next, a replacement tower 5 is assembled from tower sections. A bottom tower section 5A is placed on the temporary base 7 by a crane 10 and the bottom tower section 5A is anchored to the temporary base 7 as is illustrated in Figs 6 and 7. A second tower section 5B is positioned with the crane 10 on top of the lower tower section 5A (cf. Fig 7) and an lower end of the tower section

5B is secured to an upper end of the lower tower section 5A (cf. Fig. 8). Next, further respective tower sections 5C and 5D are positioned and secured in the same manner (cf. Figs 8 and 9), until the replacement tower 5 is built up (cf. Fig. 10). In this example the tower sections 5B-5D are hoisted one by one and then secured to the section below, but it is also possible to make an assembly of two or more tower sections 5B-5D and then position that on a lower section.

**[0039]** Next, the antenna equipment 6 is positioned at the top section 5D of the replacement tower 5 and mounted thereto as is illustrated in Figs 10 and 11.

The technical equipment, the cables (power lines, network lines etc.) and the corresponding connections can be set-up for the replacement tower 5 in such a way that it is in its final set-up and does not need any significant rearrangement later on.

**[0040]** After all is connected and the set-up is finished, the replacement tower 5 can be set in operation and take over the function of the existing tower 1. The existing tower 1 can now be switched off and the new tower 5 can be switched on. The downtime within the telecommunications network of the communications tower site consisting of the towers 1 and 5 is therefore minimal.

**[0041]** Now that the replacement tower 5 is in operation, the existing tower 1 can be dismantled and removed from the existing foundation 3, which is illustrated in Figs. 12-14. The existing tower 1 is disassembled into sections 1A, 1B. The tower sections 1A, 1B are transported away from the site by a suitable transportation vehicle 11.

**[0042]** Next the foundation 3 can be modified or revised which is illustrated in Figs. 15 and 16. In Fig. 15 is illustrated that a part of the old foundation 3 is excavated and is partly removed. In Fig. 16 is illustrated that a new part 3A of the foundation 3 is made on top of the remaining part of the old foundation.

**[0043]** An additional tower section may be transported to the site, in particular when the replacement tower 5, operating as a temporary tower is lower than would be desired for the final tower. In Figs. 17 and 18 is illustrated how such an additional tower section 12 is positioned on the foundation 3 by means of the crane 10. The additional tower section 12 is anchored at a lower end thereof to the foundation 3.

**[0044]** Next, the replacement communications tower 5, i.e. the temporary communications tower, is released and lifted integrally from the temporary base 7 as is illustrated in Fig. 18. The replacement tower 5 is integrally transferred to the foundation 3, i.e. as a unit including the antenna equipment 6, as is illustrated in Fig. 19 and placed and mounted on top of the additional tower section 12 that was already placed on the foundation 3.

**[0045]** Before the replacement tower 5 is lifted and moved from the temporary base 7, it may be shut off and disconnected from the technical equipment and the cables, e.g. power lines, network lines etc. After the replacement tower 5 has been mounted on the additional tower section 12, the resulting tower 5, 12 may be reconnected

to said technical equipment and cables and set into operation again. Preferably the technical equipment and the cables are the same as the ones connected to the tower 5 when it was positioned on the temporary base 7, or at least small modifications are necessary such that the downtime of the tower is minimized.

**[0046]** The temporary base 7 can be placed on a transportation vehicle 13 and removed from the site (cf. Fig. 20). The temporary base 7 can be used on another site where a communications tower has to be replaced.

**[0047]** Advantageously the telecommunications tower site can be used as a temporary storage for the temporary base 7, in that the temporary base 7 is only removed from the site when it is needed for a temporary telecommunications tower on another site. The temporary base is thus transported directly from one telecommunications tower site to another telecommunications tower site. No intermediate storage on another location is necessary, which saves costs and the transportation to and from such an intermediate storage location is avoided, which also saves costs.

**[0048]** Summarizing a method according to the invention for the replacement of a telecommunications tower 1 placed on an existing foundation 3 and provided with antenna equipment 2, comprises the following steps:

- setting up a replacement telecommunications tower 5 next to the existing telecommunications tower 1, wherein a temporary base 7 is deployed next to the existing telecommunications tower 1 and the replacement telecommunications tower 5 is placed on a temporary base 7, and wherein the replacement telecommunications tower 5 is provided with antenna equipment 6;
- setting into operation the replacement telecommunications tower 5;
- shutting down the existing telecommunications tower 1;
- removing the existing telecommunications tower 1 from the existing foundation 3;
- removing the replacement telecommunications tower 5 from the temporary base 7 and transfer the replacement telecommunications tower 5 to the existing foundation 3;
- anchor the replacement telecommunications tower 5 to the existing foundation 3; and
- remove the temporary base 7.

**[0049]** Summarizing another method according to the invention for the replacement of a telecommunications tower 1 placed on an existing foundation 3 and provided with antenna equipment 2, comprises the following steps:

- setting up a replacement telecommunications tower 5 next to the existing telecommunications tower 1, wherein a temporary base 7 is deployed next to the existing telecommunications tower 1 and the replacement telecommunications tower 5 is placed on

the temporary base 7, and wherein the replacement telecommunications tower 5 is provided with antenna equipment 6;

- setting into operation the replacement telecommunications tower 5;
- shutting down the existing telecommunications tower 1;
- removing the existing telecommunications tower 1 from the existing foundation 3;
- positioning an additional tower section 12 on the existing foundation 3;
- anchoring the additional tower section 12 to the existing foundation 3;
- removing the replacement telecommunications tower 5 from the temporary base 7 and transfer the replacement telecommunications tower 5 to the existing foundation 3 and position the replacement telecommunications tower 5 on the additional tower section 12
- secure the replacement telecommunications tower 5 to the additional tower section 12; and
- remove the temporary base 7.

**[0050]** The gist of the above described and summarized methods is that the replacement tower 5 is initially used as a temporary tower placed on a temporary base 7. While the removal work on the old tower 1 takes place, the temporary tower 5 takes over the operation. When the existing tower 1, 2 is removed from its foundation 3, the replacement tower 5 is removed from the temporary base 7 and integrally, i.e. including the antennas 6, transferred to the existing foundation 3 on which the old tower 1 used to be placed. As a result of these methods only the old tower 1 and the temporary base 7 have to be dismantled and transported away from the site afterwards. Advantageously the temporary base may be removed from the site only at the time when it is needed at another site.

## Claims

1. Method for the replacement of a telecommunications tower (1) placed on an existing foundation (3) and provided with antenna equipment (2), comprising the following steps:

- setting up a replacement telecommunications tower (5) next to the existing telecommunications tower (1), wherein a temporary base (7) is deployed next to the existing telecommunications tower (1) and the replacement telecommunications tower (5) is placed on the temporary base (7), and wherein the replacement telecommunications tower (5) is provided with antenna equipment (6);
- setting into operation the replacement telecommunications tower (5);

- shutting down the existing telecommunications tower (1);
  - removing the existing telecommunications tower (1) from the existing foundation (3);
  - removing the replacement telecommunications tower (5) from the temporary base (7) and transfer the replacement telecommunications tower (5) to the existing foundation (3); and
  - remove the temporary base (7).
2. Method according to claim 1, wherein the existing foundation (3) is modified before the replacement telecommunications tower (5) is transferred to said foundation (3).
3. Method according to claim 1 or 2, wherein the replacement telecommunications tower (5) is positioned on the existing foundation (3) and anchored thereto.
4. Method according to claim 1 or 2, wherein, before the replacement telecommunications tower (5) is removed from the temporary base the following steps are included:
- positioning an additional tower section on the existing foundation (3);
  - anchoring the additional tower section to the existing foundation (3);
- and wherein the replacement telecommunications tower (5) is positioned on and secured to the additional tower section.
5. Method according to any of the preceding claims, wherein the replacement telecommunications tower (5) is transferred integrally from the temporary base (7) to the existing foundation (3).
6. Method according to any of the preceding claims, wherein the replacement telecommunications tower (5) is removed from the temporary base (7) and is transferred towards the existing foundation (3) by means of a crane (10), which lifts the replacement tower (5) integrally from the temporary base (7) and moves it towards the existing foundation (3).
7. Method according to any of the preceding claims, wherein the replacement telecommunications tower (5) is shut down before it is removed from the temporary base (7) and wherein the replacement telecommunications tower (5) is restored in operation when the replacement tower (5) is transferred to the existing foundation (3).
8. Method for successively replacing telecommunications towers on a first site and on a second site using the method according to any of the claims 1-7,
- wherein the temporary base (7) is removed from the first site and transported to the second site only at the time it is needed at the second site.
9. Telecommunications tower system including a temporary base (7) and a replacement telecommunications tower (5) adapted to be placed on and anchored to the temporary base (7), the replacement tower (5) being provided with antenna equipment (6), wherein the replacement telecommunications tower (5) is furthermore adapted to be removed as an integral unit from the temporary base (7) and transferred to a foundation (3) in the ground.
10. Telecommunications tower system according to claim 9, furthermore including at least one additional tower section adapted to be placed and anchored to the foundation (3) in the ground, wherein the additional tower section has an upper end adapted to receive the replacement tower and wherein the lower end of the replacement tower and the upper end of the additional tower section are adapted to be secured to each other.
11. Telecommunications tower system according to claim 9 or 10, wherein the replacement telecommunications tower (5) is a lattice tower.
12. Telecommunications tower system according to claim 11, wherein the lattice tower has an equilateral triangular cross section.
13. Telecommunications tower site including a telecommunications tower system according to any of the claims 9-12 and furthermore including a permanent foundation (3) in the ground.
14. Telecommunications tower site according to claim 13, wherein the replacement tower (5) is positioned on the permanent foundation (3) and wherein the temporary base (7) is located next to the permanent foundation (3).
15. Telecommunications tower site according to claim 13, wherein the replacement tower (5) is positioned on the temporary base (7) and wherein the temporary base (7) is located next to the permanent foundation (7).

Fig. 1

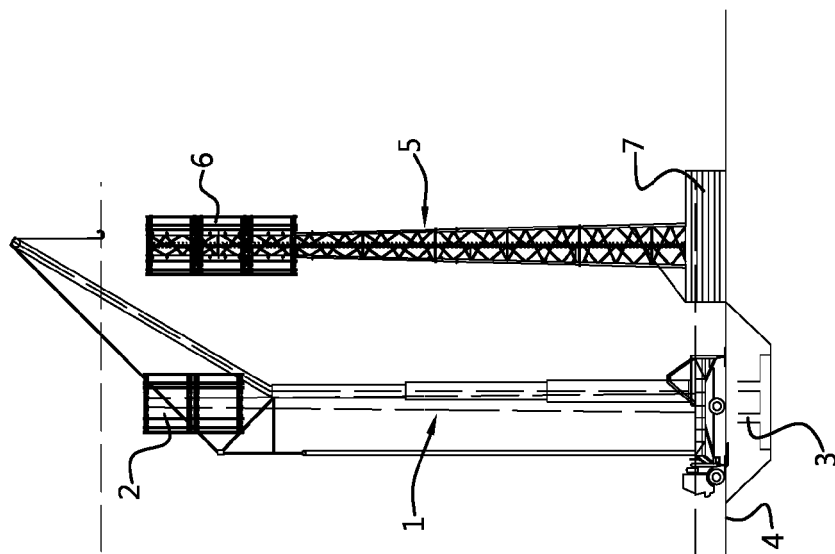


Fig. 2

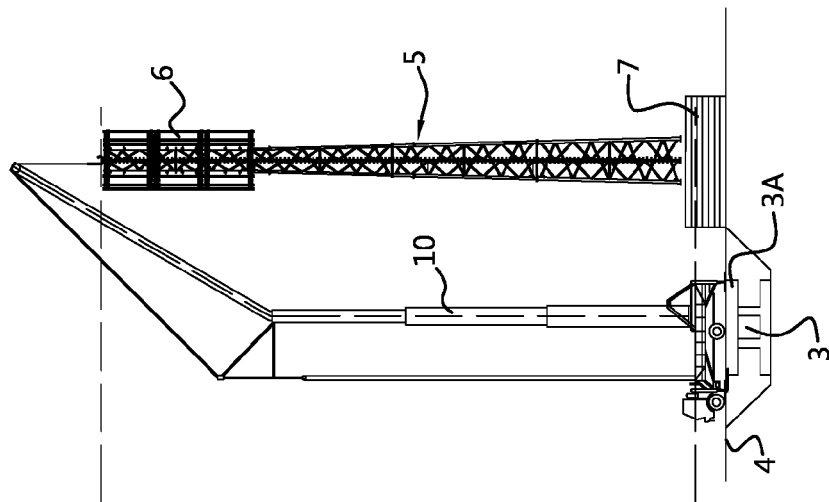


Fig. 3

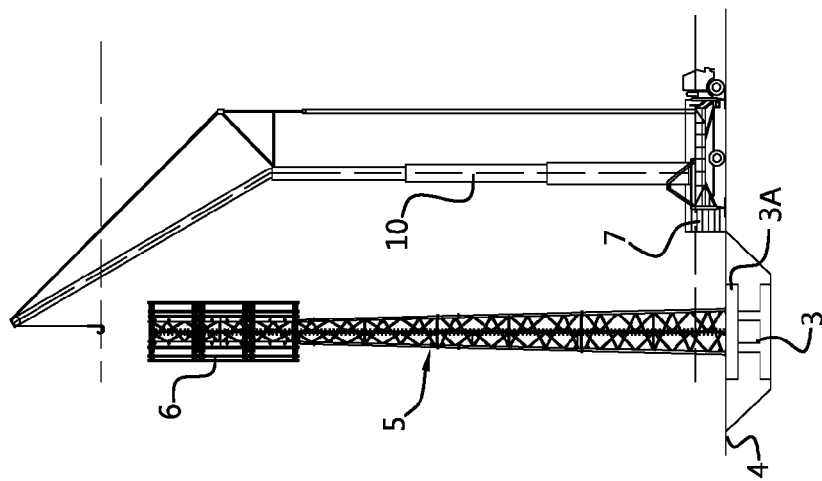


Fig. 4

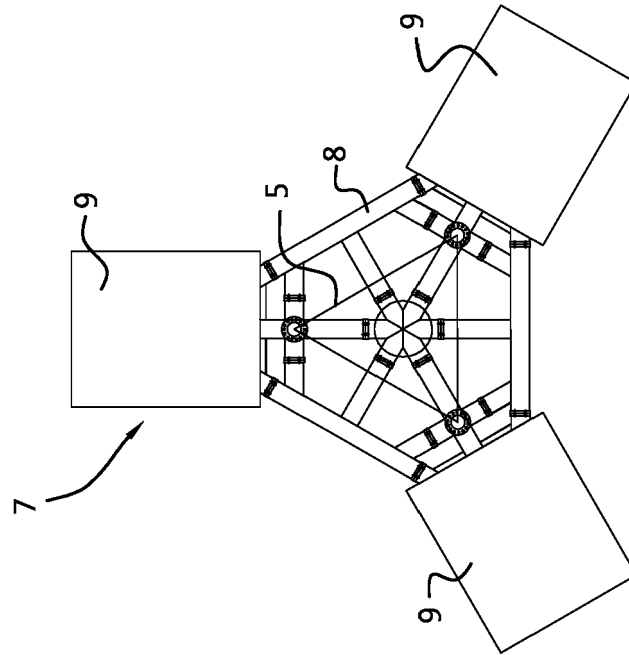


Fig. 5

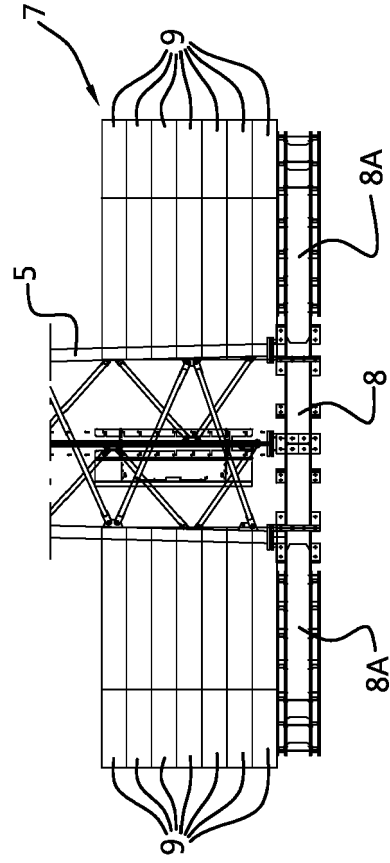




Fig. 6

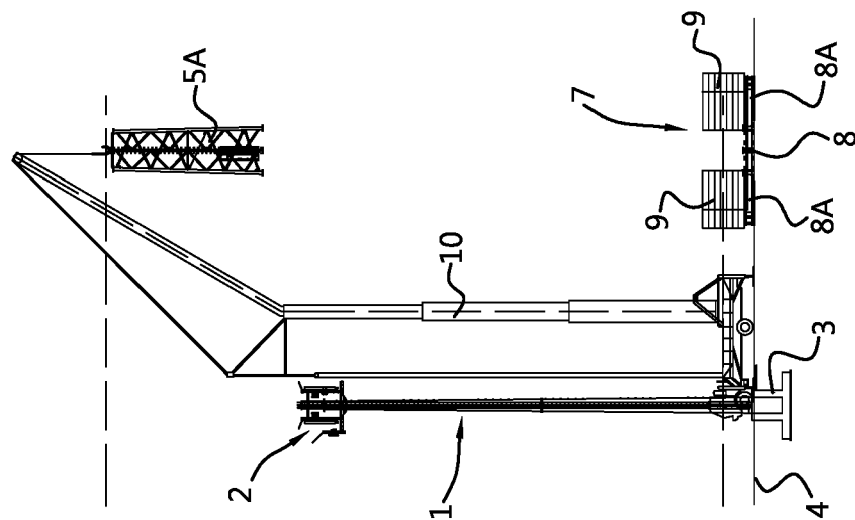


Fig. 7

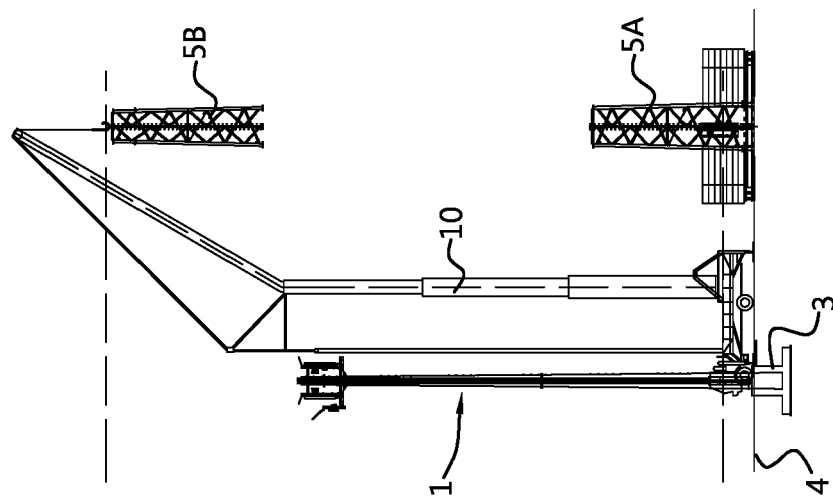


Fig. 8

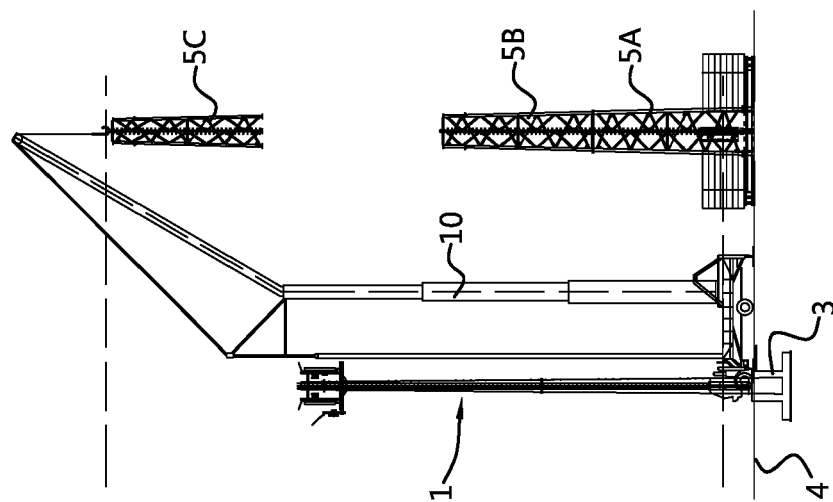


Fig. 9

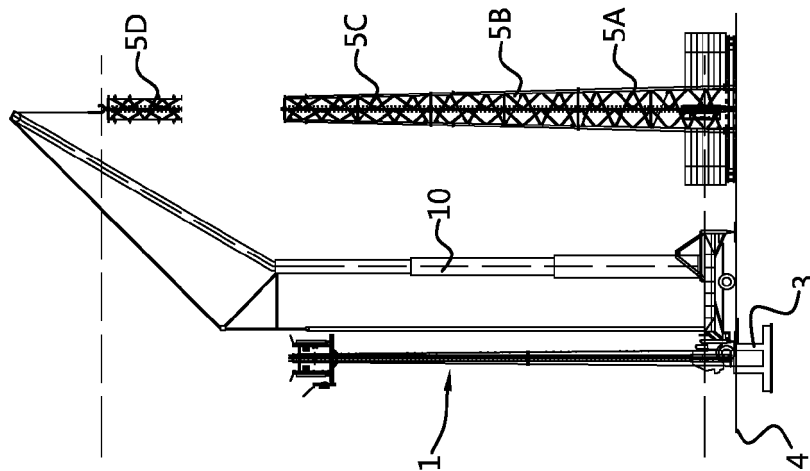


Fig. 10

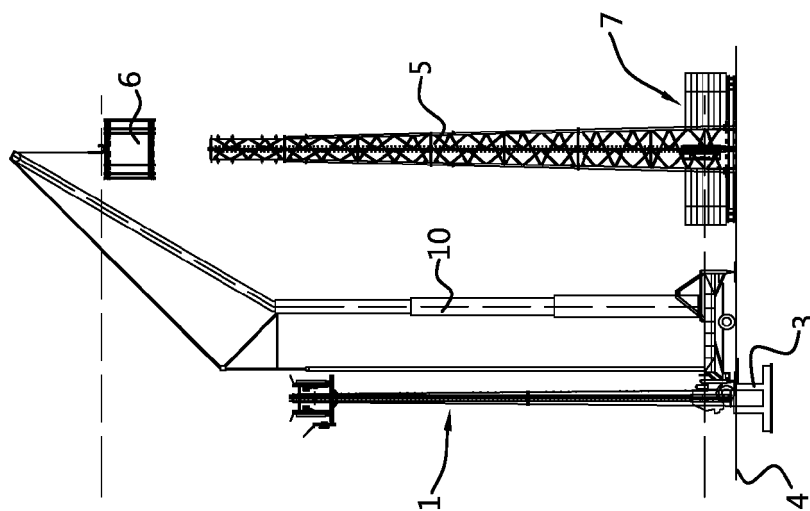


Fig. 11

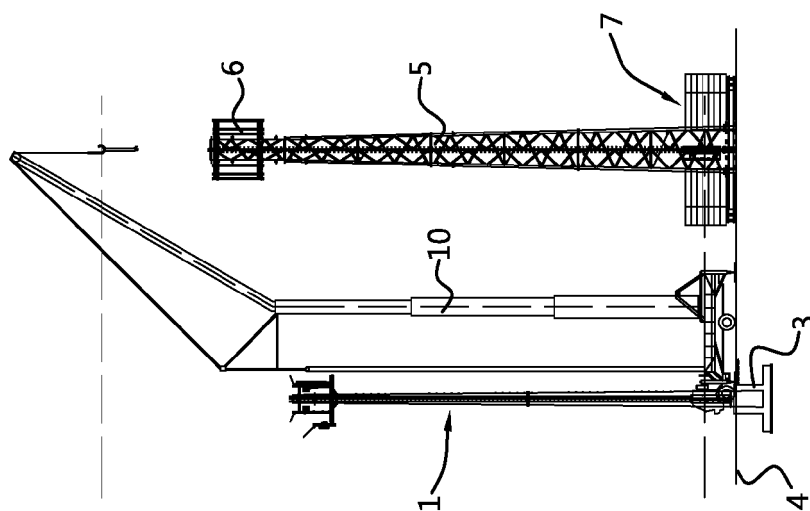


Fig. 12

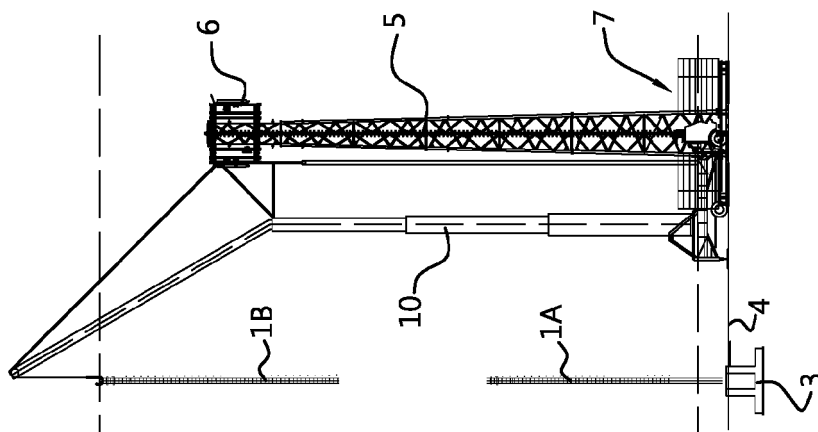


Fig. 13

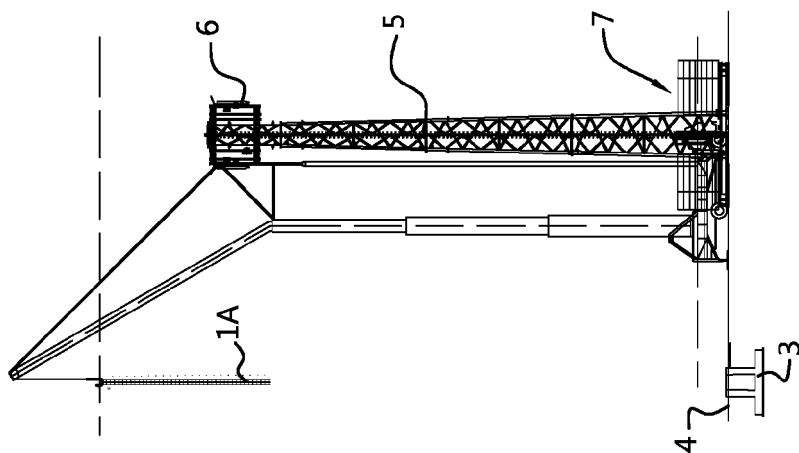


Fig. 14

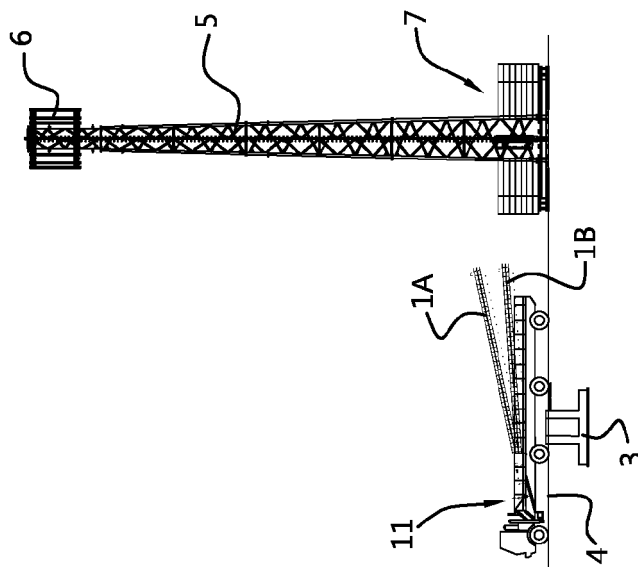


Fig. 16

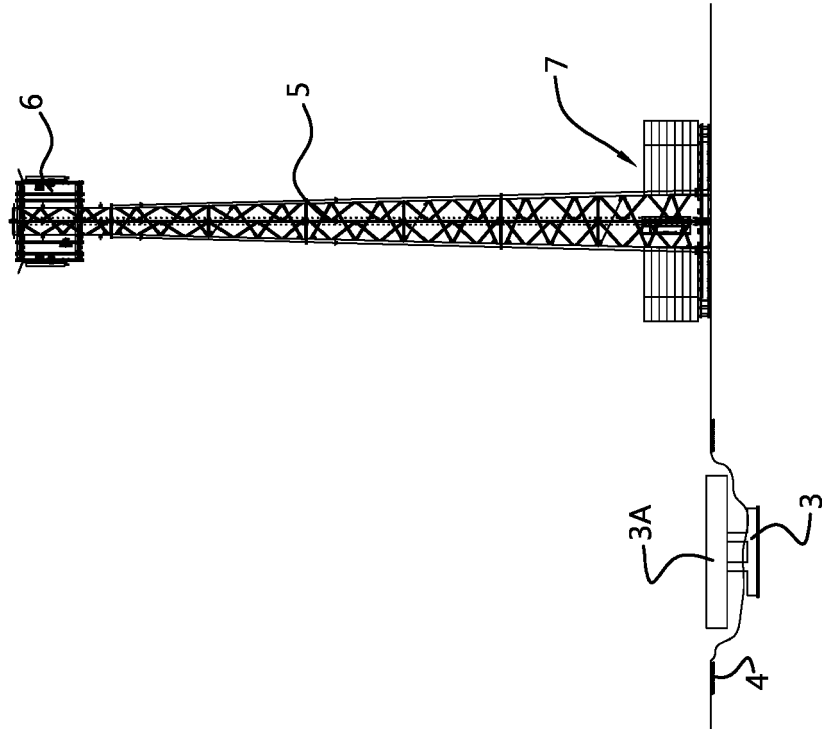


Fig. 15

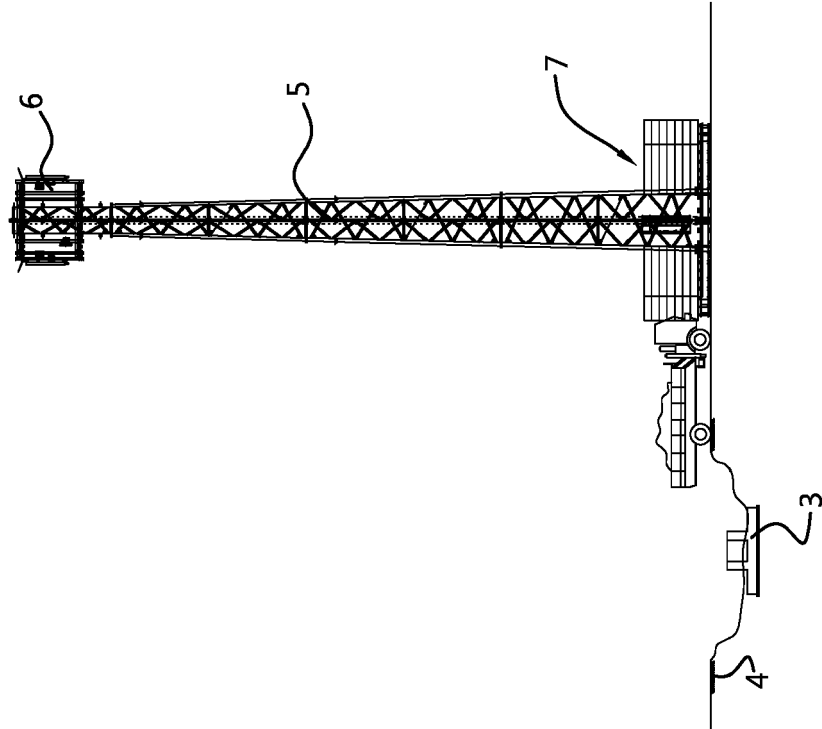


Fig. 17

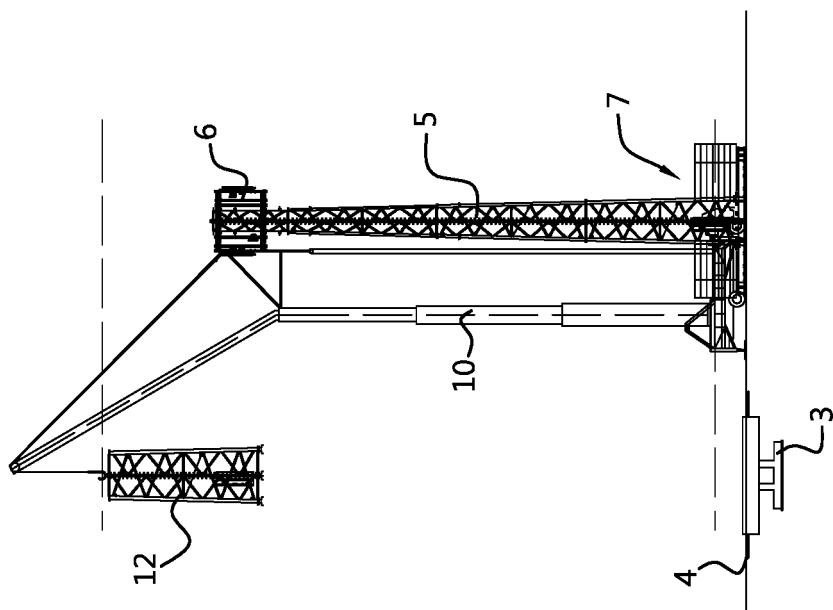


Fig. 18

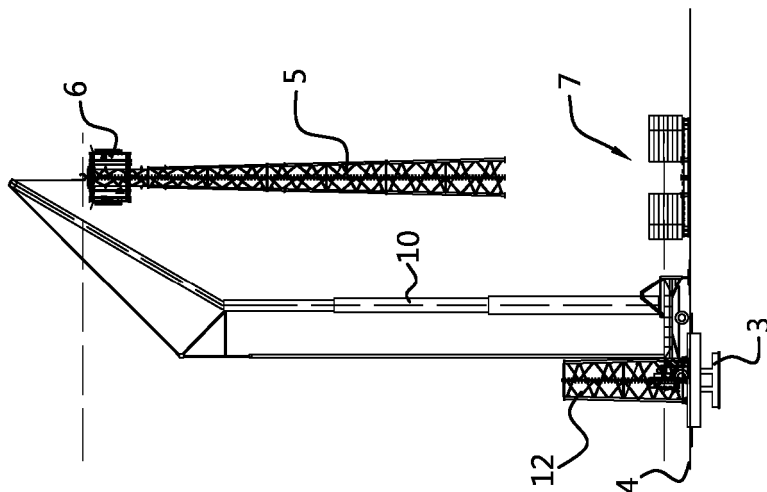


Fig. 19

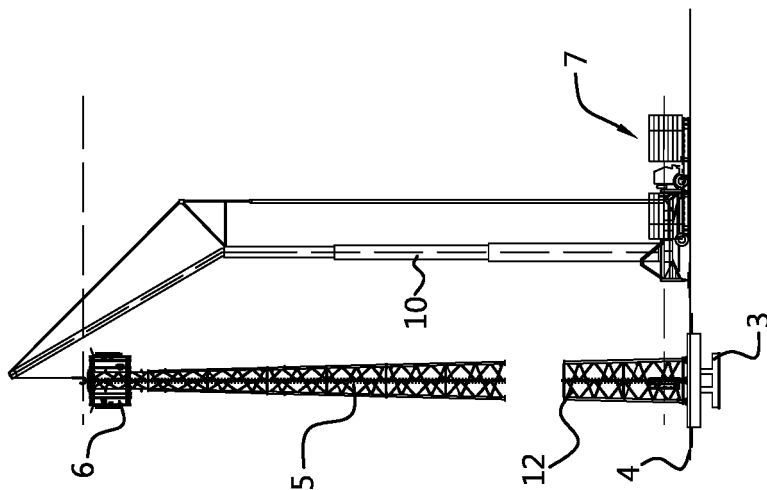
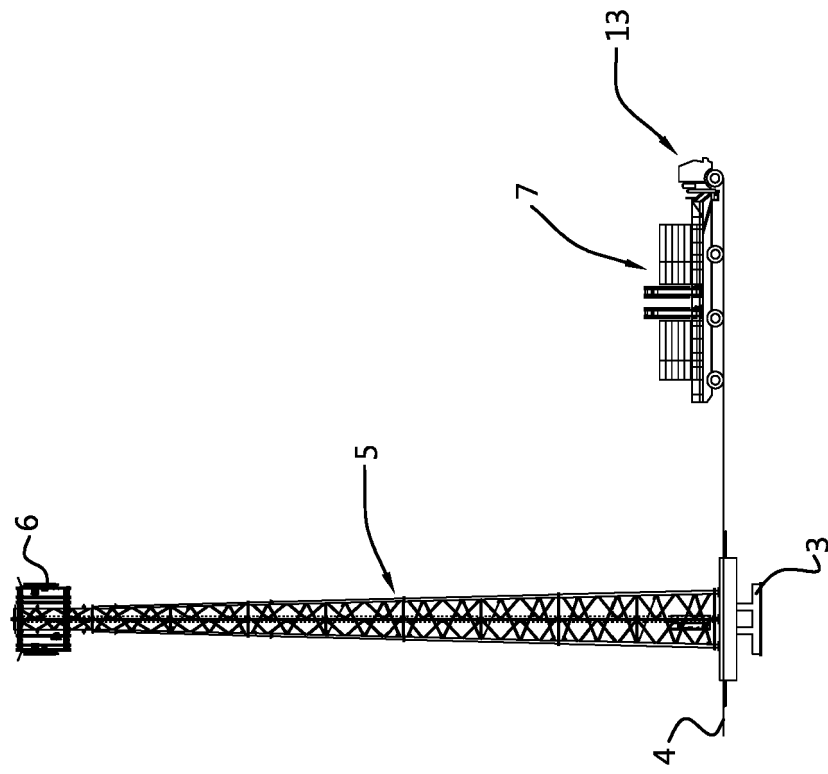


Fig. 20





## EUROPEAN SEARCH REPORT

Application Number

EP 21 20 1806

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EPO FORM 1503 03.82 (P04C01)

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                              |                                                             |                                                             |
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| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Citation of document with indication, where appropriate, of relevant passages                                                                | Relevant to claim                                           | CLASSIFICATION OF THE APPLICATION (IPC)                     |
| A, D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | US 10 132 098 B1 (ATC IP LLC [US])<br>20 November 2018 (2018-11-20)<br>* column 4, lines 1-11 *<br>-----                                     | 1-14                                                        | INV.<br>E04H12/10<br>E04H12/34<br>H01Q1/12                  |
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