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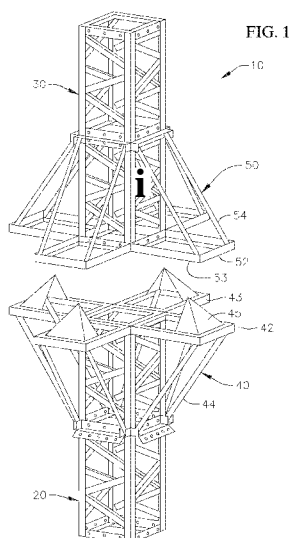
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(54) Title: APPARATUS AND METHOD FOR HELICOPTER ERECTION OF EMERGENCY RESTORATION STRUCTURE



(57) Abstract: An apparatus for helicopter erection of an emergency restoration structure, and a method of helicopter erection of an emergency restoration structure using the same are provided. An apparatus for helicopter erection of an emergency restoration structure includes a first alignment frame portion attachable to a first section of an emergency restoration structure; a second alignment frame portion attachable to a second section of the emergency restoration structure; an alignment portion arranged on at least one of the first alignment frame portion and the second alignment frame portion; and a hook configured to receive a portion of at least one of the first alignment frame portion and the second alignment frame portion.



# APPARATUS AND METHOD FOR HELICOPTER ERECTION OF EMERGENCY RESTORATION STRUCTURE

## FIELD

[0001] Aspects of embodiments of the present invention relate to an apparatus for helicopter erection of an emergency restoration structure, and a method of helicopter erection of an emergency restoration structure using the same.

## BACKGROUND

[0002] A support structure, or tower, for a transmission line may be damaged, such as by acts of nature or sabotage. Typically, restoration of a damaged transmission line requires construction of a new foundation and replacement of damaged tower steel. However, it may not be efficient or economically feasible to perform the necessary repairs to the permanent structures. In order to quickly and reliably restore an electrical power supply through the area of damage, an emergency restoration system may be configured.

[0003] An emergency restoration structure is a component of an emergency restoration system that supports a transmission line which was previously supported by the permanent support structure. The emergency restoration structure may be a truss-like tower or frame of lightweight aluminum components. For example, a pair of emergency restoration structures may be erected to support a transmission line passing therebetween. It may be desirable to transport and erect the emergency restoration structures via helicopter, such as in mountainous regions. However, the emergency restoration structure may be a tall structure with a small foundation and may be erected in a region having high wind speeds. Additionally, the emergency restoration structure typically includes a number of sections to be arranged one on top of another and fastened together, and difficulties arise in aligning the sections when lowering one section onto another using a helicopter. Further, it is dangerous for a worker to be under the helicopter and the sections of the emergency restoration structure during such a process.

## SUMMARY

[0004] According to an aspect of embodiments of the present invention, an apparatus for helicopter erection of an emergency restoration structure provides for safe, efficient, and cost-effective alignment and installation of sections of an emergency restoration structure.

[0005] According to another aspect of embodiments of the present invention, a method of helicopter erection of an emergency restoration structure provides for

1 safe, efficient, and cost-effective alignment and installation of sections of an emergency restoration structure.

[0006] According to another aspect of embodiments of the present invention, an emergency restoration structure includes an apparatus for safe, efficient, and cost-effective helicopter erection of the emergency restoration structure.

[0007] According to one or more embodiments of the present invention, an apparatus for helicopter erection of an emergency restoration structure includes an alignment frame including a bottom portion configured to be coupled to an upper region of a first section of the emergency restoration structure, and a top portion configured to be coupled to a lower region of a second section of the emergency restoration structure.

[0008] According to one or more embodiments of the present invention, an apparatus for helicopter erection of an emergency restoration structure includes: a first alignment frame portion attachable to a first section of an emergency restoration structure; a second alignment frame portion attachable to a second section of the emergency restoration structure; an alignment portion arranged on at least one of the first alignment frame portion or the second alignment frame portion; and a hook configured to receive a portion of at least one of the first alignment frame portion or the second alignment frame portion.

[0009] The alignment portion may include a plurality of inclined surfaces. The hook may extend through an opening of an inclined surface of the plurality of inclined surfaces.

[0010] The apparatus may further include an energy absorbing member extending away from at least one of the first alignment frame portion or the second alignment frame portion and configured to abut an inner surface of at least one of the first section or the second section. The energy absorbing member may include at least one of a rod or a wire.

[0011] The apparatus may further include a counterweight coupled to the hook, the hook may be pivotable about a pivot to receive the portion of the at least one of the first alignment frame portion or the second alignment frame portion, and the counterweight may be configured to maintain the first alignment frame portion or the second alignment frame portion captured in a recess of the hook.

[0012] According to one or more embodiments of the present invention, a method of erection of an emergency restoration structure including a first tower section, a second tower section, and a first alignment frame including a bottom portion coupled to the first tower section and a top portion coupled to the second tower section includes: lowering the second section onto the first section such that the second section is aligned with the first section by an alignment portion of the first alignment

1 frame; and capturing a portion of the alignment frame to a hook of the first alignment frame.

[0013] The second tower section may be lowered onto the first tower section using a helicopter.

5 [0014] The method may further include guying a foundation at ground level; lowering the first tower section onto the foundation; and guying the first tower section to an anchor.

[0015] The method may further include, after lowering the second tower section onto the first tower section, fastening the second tower section to the first tower section, and guying the second tower section to an anchor.

10 [0016] The method may further include, after fastening the second tower section to the first tower section, removing the first alignment frame from the first and second tower sections.

[0017] The method may further include, after fastening the second tower section to the first tower section, lowering a third section of the emergency restoration structure onto the second section such that the third section is aligned with the second section by an alignment portion of a second alignment frame of the emergency restoration structure; and capturing a portion of the second alignment frame to a hook of the second alignment frame.

15 [0018] According to one or more embodiments of the present invention, an emergency restoration structure includes: a first tower section including a first end configured to be mounted to a foundation, and a second end opposite the first end; a second tower section including a first end configured to be coupled to the second end of the first tower section, and a second end opposite the first end of the second tower section; and a first alignment frame including a bottom portion configured to be coupled to the second end of the first tower section, and a top portion configured to be coupled to the first end of the second tower section, the first alignment frame including: an alignment portion arranged on at least one of the bottom portion or the top portion; and a hook configured to receive a portion of at least one of the bottom portion or the top portion.

20 [0019] The alignment portion may include a plurality of inclined surfaces. The first alignment frame may further include an energy absorbing member extending away from at least one of the top portion or the bottom portion and configured to abut an inner surface of at least one of the first section or the second section. The energy absorbing member may include at least one of a rod or a wire.

25 [0020] The emergency restoration structure may further include: a third tower section including a first end configured to be coupled to the second end of the second tower section, and a second end opposite the first end of the third tower

1 section; and a second alignment frame including a bottom portion configured to be  
coupled to the second end of the second tower section, and a top portion configured  
to be coupled to the first end of the third tower section, the second alignment frame  
including: an alignment portion arranged on at least one of the bottom portion of the  
5 second alignment frame or the top portion of the second alignment frame; and a  
hook configured to receive a portion of at least one of the bottom portion of the  
second alignment frame or the top portion of the second alignment frame.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

10 **[0021]** The above and other features and aspects of embodiments of the present  
invention will become better understood with regard to the following description and  
accompanying drawings, where:

**[0022]** FIG. 1 is a schematic perspective view of top and bottom sections of an  
emergency restoration structure with an apparatus for helicopter erection of an  
15 emergency restoration structure, according to an embodiment of the present  
invention;

**[0023]** FIG. 2 is a front view of top and bottom sections of an emergency  
restoration structure with an apparatus for helicopter erection of an emergency  
restoration structure, according to an embodiment of the present invention;

20 **[0024]** FIG. 3 is a top view of a bottom section of an emergency restoration  
structure with a bottom portion of an apparatus for helicopter erection of an  
emergency restoration structure, according to an embodiment of the present  
invention;

**[0025]** FIG. 4 is a top view of a top section of an emergency restoration structure  
25 with a top portion of an apparatus for helicopter erection of an emergency restoration  
structure, according to an embodiment of the present invention;

**[0026]** FIG. 5 is a front view of top and bottom sections of an emergency  
restoration structure with an apparatus for helicopter erection of an emergency  
restoration structure, according to an embodiment of the present invention;

30 **[0027]** FIG. 6 is a front view of top and bottom sections of an emergency  
restoration structure with an apparatus for helicopter erection of an emergency  
restoration structure, according to an embodiment of the present invention;

**[0028]** FIG. 7 is a top view of a bottom section of an emergency restoration  
structure with a bottom portion of an apparatus for helicopter erection of an  
35 emergency restoration structure, according to an embodiment of the present  
invention; and

**[0029]** FIGS. 8 to 16 are schematic views showing tasks of a method of helicopter  
erection of an emergency restoration structure.

**DETAILED DESCRIPTION**

**[0030]** In the following detailed description, certain exemplary embodiments of the present invention are shown and described, by way of illustration. As those skilled in the art would recognize, the described exemplary embodiments may be modified in various ways without departing from the spirit and scope of the present invention. Accordingly, the drawings and description are to be regarded as illustrative in nature, rather than restrictive.

**[0031]** With reference to FIGS. 1-4, an emergency restoration structure with an apparatus for helicopter erection of the emergency restoration structure is shown. According to an embodiment of the present invention, an emergency restoration structure 10 includes a bottom section 20 and a top section 30 configured to be lowered onto and assembled to the bottom section 20. Each of the bottom section 20 and the top section 30 may be assembled as a truss-like structure having four sides and a plurality of beam members or plate members connected to one another, such as by welds, threaded fasteners, rivets, or any other suitable device or combination of devices. The bottom section 20 and the top section 30, in one embodiment, may be formed of aluminum members; however, embodiments of the present invention are not limited thereto and, in other embodiments, may be formed of steel, stainless steel, fiberglass, or any other suitable material. When assembled together, the bottom section 20 and the top section 30 are connected to each other, such as by welds or fasteners, for example. While in the drawings, only the bottom section 20 and the top section 30 of the emergency restoration structure 10 are shown, in other embodiments, the emergency restoration structure 10 may include one or more additional sections arranged on the top section 30, as shown in FIG. 16, for example, and/or one or more additional sections may be arranged below the bottom section 20.

**[0032]** The apparatus for helicopter erection of the emergency restoration structure, in one embodiment, includes an alignment frame including a bottom portion 40 provided on the bottom section 20 and a top portion 50 provided on the top section 30. The alignment frame may be removably attached (e.g., via threaded fasteners) to the bottom section 20 and the top section 30, and may be formed of aluminum or any other suitable material or combination of materials. In one embodiment, as shown in FIG. 1, each of the bottom portion 40 and the top portion 50 of the alignment frame has four same or similar alignment portions arranged (e.g., symmetrically arranged) around a perimeter of the respective bottom section 20 and top section 30.

**[0033]** The bottom portion 40 of the alignment frame, in one embodiment, includes a cross bar 42 and a pair of extending bars 43 connected between the

1 bottom section 20 and opposite ends of the cross bar 42. The bottom portion 40 of  
the alignment frame may further include a pair of support bars 44 connected  
between a region of the bottom section 20 below that at which the extending bars 43  
are connected and opposite ends of the cross bar 42 for providing structural support  
5 to the bottom portion 40. The bottom portion 40 of the alignment frame further  
includes an alignment portion 45 which may be shaped as a section of a pyramid, as  
described in further detail below with reference to FIG. 7. The alignment portion 45  
may be coupled (e.g., welded) to the cross bar 42 and outer portions of the  
extending bars 43. In one embodiment, as shown in FIGS. 2 and 7, the bottom  
10 portion 40 of the alignment frame includes a hook 46 having a recess 47 configured  
to receive and capture a portion of the top portion 50 of the alignment frame when  
the top section 30 is lowered onto the bottom section 20. The hook 46 may be  
coupled to a counterweight 48 and may be pivotable therewith about a pivot 49 to be  
held in a position to receive the portion of the top portion 50 in the recess 47 and  
15 thereafter maintain the portion of the top portion 50 captured in the recess 47.

**[0034]** The top portion 50 of the alignment frame, in one embodiment, includes a  
cross bar 52 and a pair of extending bars 53 connected between the top section 30  
and opposite ends of the cross bar 52. The top portion 50 of the alignment frame  
may further include a pair of support bars 54 connected between a region of the top  
20 section 30 above that at which the extending bars 53 are connected and opposite  
ends of the cross bar 52 for providing structural support to the top portion 50. In one  
embodiment, the cross bar 52 is the portion of the top portion 50 that is configured to  
be received and captured in the recess 47 of the hook 46 of the bottom portion 40.

**[0035]** The apparatus for helicopter erection of the emergency restoration  
25 structure, in one embodiment, further includes one or more energy absorbing  
members 60 at the top of the top section 30. The energy absorbing members 60  
may be rod or wire members configured to abut inner surfaces 32 of the top section  
30 and absorb vibration or movement as the top section 30 is lowered onto the  
bottom section 20, such as using a helicopter. The energy absorbing members 60  
30 may be flexible and/or deformable.

**[0036]** In one embodiment, the top section 30 may be used as an intermediate  
section of an emergency restoration structure having more than two tower sections  
and, as such, the top section 30 may be provided with the top portion 50 of the  
alignment frame at the bottom end of the top section 30 and may further be provided  
35 with the bottom portion 40 of another alignment frame at the top end of the top  
section 30 for alignment with the top portion 50 of the another alignment frame which  
may be provided on another tower section of the emergency restoration structure to  
be lowered onto the top section 30. Further, while it is illustrated in the drawings and

described herein that the bottom portion 40 of the alignment frame has the alignment portions 45 and the hooks 48, in other embodiments, one or more components of the apparatus for helicopter erection and the alignment frame may be reversed between the bottom portion 40 and the top portion 50 of the alignment frame. Further, while it is illustrated in the drawings and described herein that each of the bottom portion 40 and the top portion 50 of the alignment frame has four same or similar alignment portions arranged (e.g., symmetrically arranged) around a perimeter of the respective bottom section 20 and top section 30, the present invention is not limited thereto. For example, in an alternate embodiment, each of the bottom portion 40 and the top portion 50 of the alignment frame may have a pair of same or similar alignment portions arranged at opposite sides of the respective bottom section 20 and top section 30.

**[0037]** With reference to FIG. 5, the bottom section 20 and the top section 30 are shown disassembled from each other. As illustrated, the bottom section 20 is provided with the bottom portion 40 of the alignment frame, and the top section 30 is provided with the top portion 50 of the alignment frame. Additionally, the energy absorbing members 60 are arranged at the top of the bottom section 20. With reference to FIG. 6, the top section 30 is shown raised above the bottom section 20 near to an assembled position. The bottom portion 40 of the alignment frame is configured to align the top portion 50 of the alignment frame, and the energy absorbing members 60 are configured to abut the inner surfaces 32 of the top section 30, as the top section 30 is lowered onto the bottom section 20, such as using a helicopter.

**[0038]** With reference to FIG. 7, a top of the bottom portion 40 of the alignment frame is shown in closer detail. As illustrated, the alignment portion 45 may have a central inclined face 452 and a pair of lateral inclined faces 454 on opposite sides of the central inclined face 452 to form a section of a pyramid. The inclined faces 452 and 454 of the alignment portion 45 are configured to abut and guide the cross bar 52 and the extending bars 53 of the top portion 50 of the alignment frame as the top section 30 is lowered onto the bottom section 20. As illustrated, the hook 46 may protrude upward through an opening 455 formed through the central inclined face 452 of the alignment portion 45 to capture the cross bar 52.

**[0039]** With reference to FIGS. 8 to 16, tasks of a method of helicopter erection of an emergency restoration structure according to an embodiment of the present invention are illustrated.

**[0040]** With reference to FIG. 8, a plan view and an elevation view are shown illustrating a task of setting first anchors and a foundation at ground level, and guying the foundation with a first guy wire. The first guy wire may be tightened with a



1 turnbuckle, for example, and anchored at a suitable distance from the foundation.  
As shown in FIG. 8, a pair of foundations may be set at opposite sides of one or  
more conductors to be supported by the emergency restoration structure. Further,  
while some suitable distances between the pair of foundations and between the  
5 foundations and the anchor locations are shown in FIG. 8, embodiments of the  
present invention are not limited to these distances.

**[0041]** With reference to FIG. 9, a plan view and an elevation view are shown  
illustrating a task of assembling a bottom section, or bottom tower section, of the  
emergency restoration structure on each of the pair of foundations. In one  
10 embodiment, a gimbal is assembled on the foundation, and the bottom section is  
assembled on the gimbal. The bottom section may be plumbed, such as using a  
turnbuckle, and, in one embodiment, may be plumbed within plus or minus one  
degree, for example. The bottom section may be guyed to the anchors using second  
guy wires. Further, the bottom section is provided with a bottom portion of an  
15 alignment frame for alignment of a top section or an intermediate section of the  
emergency restoration structure to be assembled on the bottom section. The  
alignment frame may be the alignment frame or apparatus described above with  
reference to FIGS. 1 to 7. In FIG. 9, the bottom section or column of the emergency  
restoration structure is shown having a height of 2.8 m; however, embodiments of  
20 the present invention are not limited thereto.

**[0042]** With reference to FIG. 10, a plan view and an elevation view are shown  
illustrating a task of setting second anchors at ground level, and providing a top  
section or intermediate section of the emergency restoration structure to be  
assembled on the bottom section. As shown in the plan view, the second anchors  
25 may be located at a greater distance from the respective foundations than the first  
anchors and, in one embodiment, may be permanent anchors. While some suitable  
distances between the foundations and the second anchor locations are shown in  
FIG. 10, embodiments of the present invention are not limited to these distances.  
The second anchors may be used for guying the top section or intermediate section  
30 of the emergency restoration structure with a guy wire after being assembled on the  
bottom section. As illustrated in the elevation view, the top section or intermediate  
section of the emergency restoration structure may be provided to be arranged on  
the bottom section via helicopter; however, embodiments of the present invention  
are not limited thereto. That is, in other embodiments of the present invention, the  
35 top section or intermediate section of the emergency restoration structure may be  
aligned with and arranged on the bottom section using a crane or other suitable  
device. Also, the top section or intermediate section of the emergency restoration

1 structure may be provided with third guy wires to be subsequently anchored at the second anchors.

5 **[0043]** With reference to FIG. 11, the top section or intermediate section of the emergency restoration structure arranged on the bottom section is released by the helicopter, and another top section or intermediate section of the emergency restoration structure may be provided (e.g., by helicopter), arranged on another one of the bottom sections, and released. The top section or intermediate section of the emergency restoration structure is provided with a top portion of an alignment frame for alignment with the bottom portion provided with the bottom section of the emergency restoration structure. In an embodiment, the top section 30 is lowered onto the bottom section 20 such that the bottom portion 40 of the alignment frame aligns the top portion 50 of the alignment frame, and the energy absorbing members 60 may abut inner surfaces of the top section 30 to facilitate alignment and absorb vibration or movement. Additionally, the inclined faces of the alignment portion 45 may abut and guide the cross bar 52 and the extending bars 53 of the top portion 50 of the alignment frame as the top section 30 is lowered onto the bottom section 20, and the hook 46 may protrude upward, such as through an opening formed through the central inclined face of the alignment portion 45, to capture the cross bar 52. As illustrated in FIG. 11, where the section arranged on the bottom section is an intermediate section of an emergency restoration structure, the intermediate section may further include a bottom portion of another alignment frame for alignment of a top section or another intermediate section of the emergency restoration structure to be assembled on the intermediate section. The another alignment frame may be the alignment frame or apparatus described above with reference to FIGS. 1 to 7.

20 **[0044]** With reference to FIG. 12, the intermediate section of the emergency restoration structure is guyed down using the third guy wires. Subsequent to the intermediate section being arranged on the bottom section (e.g., by helicopter) and released, a worker may climb the emergency restoration structure and fasten the intermediate section to the bottom section, and also release the third guy wires to be anchored.

30 **[0045]** With reference to FIGS. 13 and 14, the top section of the emergency restoration structure may be provided to be arranged on the intermediate section, such as via helicopter. The top section of the emergency restoration structure may be provided with fourth guy wires to be subsequently anchored at the second anchors, for example. The top section of the emergency restoration structure arranged on the intermediate section is released by the helicopter, and another top section of the emergency restoration structure may be provided (e.g., by helicopter), arranged on another one of the intermediate sections, and released. The top section

1 of the emergency restoration structure is provided with a top portion of an alignment frame for alignment with the bottom portion provided at the top of the intermediate section of the emergency restoration structure.

5 **[0046]** With reference to FIGS. 15 and 16, the top section of the emergency restoration structure is guyed down using the fourth guy wires. Subsequent to the top section being arranged on the intermediate section (e.g., by helicopter) and released, a worker may climb the emergency restoration structure and fasten the top section to the intermediate section, and also release the fourth guy wires to be anchored. While an emergency restoration structure having three tower sections is illustrated in the drawings, embodiments of the present invention are not limited thereto. That is, in other embodiments, the emergency restoration structure may have two tower sections or may have more than three tower sections.

10 **[0047]** Although not shown in the drawings, in one embodiment, after the intermediate section or top section is fastened to the bottom section, the top and bottom portions of the alignment frame may be removed from the intermediate section or top section and the bottom section. In another embodiment, the top and bottom portions of the alignment frame may be maintained on the intermediate section or top section and the bottom section, and the hook of the bottom portion may be unlatched from the top portion via a rope to disassemble the emergency restoration structure, such as using a helicopter.

20 **[0048]** While in one embodiment, the method of helicopter erection of an emergency restoration structure may include each of the tasks described above and shown in FIGS. 8 to 16, in other embodiments of the present invention, in a method of helicopter erection of an emergency restoration structure, one or more of the tasks described above and shown in FIGS. 8 to 16 may be absent and/or additional tasks may be performed. Further, in the method of helicopter erection of an emergency restoration structure according to one embodiment, the tasks may be performed in the order depicted in FIGS. 8 to 16. However, the present invention is not limited thereto and, in a method of dynamic real time transmission line monitoring according to one or more other embodiments of the present invention, the tasks described above and shown in FIGS. 8 to 16 may be performed in any other suitable sequence.

30 **[0049]** Although the drawings and accompanying description illustrate some exemplary embodiments of an apparatus for helicopter erection of an emergency restoration structure, and a method of helicopter erection of an emergency restoration structure using the same, it will be apparent that the novel aspects of the present invention may also be carried out by utilizing alternative structures, sizes, shapes, and/or materials in embodiments of the present invention. Also, in other

1       embodiments, components described above with respect to one embodiment may  
be included together with or interchanged with those of other embodiments.

5       **[0050]**     The preceding description has been presented with reference to certain  
embodiments of the invention. Persons skilled in the art and technology to which  
this invention pertains will appreciate that alterations and changes in the described  
structures and methods of operation can be practiced without meaningfully departing  
from the principles, spirit, and scope of this invention.

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**WHAT IS CLAIMED IS:**

1. An apparatus for helicopter erection of an emergency restoration structure, the apparatus comprising:

a first alignment frame portion attachable to a first section of an emergency restoration structure;

a second alignment frame portion attachable to a second section of the emergency restoration structure;

an alignment portion arranged on at least one of the first alignment frame portion and the second alignment frame portion; and

a hook configured to receive a portion of at least one of the first alignment frame portion and the second alignment frame portion.

2. The apparatus of claim 1, wherein the alignment portion comprises a plurality of inclined surfaces.

3. The apparatus of claim 2, wherein the hook extends through an opening of an inclined surface of the plurality of inclined surfaces.

4. The apparatus of claim 1, further comprising an energy absorbing member extending away from at least one of the first alignment frame portion or the second alignment frame portion and configured to abut an inner surface of at least one of the first section or the second section.

5. The apparatus of claim 4, wherein the energy absorbing member comprises at least one of a rod or a wire.

6. The apparatus of claim 1, further comprising a counterweight coupled to the hook, wherein the hook is pivotable about a pivot to receive the portion of the at least one of the first alignment frame portion or the second alignment frame portion, and the counterweight is configured to maintain the first alignment frame portion or the second alignment frame portion captured in a recess of the hook.

7. A method of erection of an emergency restoration structure, the emergency restoration structure including a first section, a second section, and a first alignment frame including a bottom portion coupled to the first section and a top portion coupled to the second section, the method comprising:

1                    lowering the second section onto the first section such that the second  
section is aligned with the first section by an alignment portion of the first alignment  
frame; and

5                    capturing a portion of the first alignment frame to a hook of the first  
alignment frame.

8.        The method claim 7, wherein the second section is lowered onto the  
first section using a helicopter.

10            9.        The method of claim 7, further comprising:  
              guying a foundation at ground level;  
              lowering the first section onto the foundation; and  
              guying the first section to an anchor.

15            10.       The method of claim 7, further comprising, after lowering the second  
section onto the first section:  
              fastening the second section to the first section; and  
              guying the second section to an anchor.

20            11.       The method of claim 10, further comprising, after fastening the second  
section to the first section, removing the first alignment frame from the first and  
second sections.

25            12.       The method of claim 10, further comprising, after fastening the second  
section to the first section:

              lowering a third section of the emergency restoration structure onto the  
second section such that the third section is aligned with the second section by an  
alignment portion of a second alignment frame of the emergency restoration  
structure; and

30            capturing a portion of the second alignment frame to a hook of the  
second alignment frame.

13.       An emergency restoration structure comprising:  
              a first section comprising a first end configured to be mounted to a  
35 foundation, and a second end opposite the first end;  
              a second section comprising a first end configured to be coupled to the  
second end of the first section, and a second end opposite the first end of the  
second section; and

1           a first alignment frame including a bottom portion configured to be  
coupled to the second end of the first section, and a top portion configured to be  
coupled to the first end of the second section, the first alignment frame comprising:  
                  an alignment portion arranged on at least one of the bottom  
5   portion and the top portion; and  
                  a hook configured to receive a portion of at least one of the  
bottom portion and the top portion.

10           14.    The emergency restoration structure of claim 13, wherein the alignment  
portion comprises a plurality of inclined surfaces.

15           15.    The emergency restoration structure of claim 13, wherein the first  
alignment frame further comprises an energy absorbing member extending away  
from at least one of the top portion or the bottom portion and configured to abut an  
15   inner surface of at least one of the first section or the second section.

            16.    The emergency restoration structure of claim 15, wherein the energy  
absorbing member comprises at least one of a rod or a wire.

20           17.    The emergency restoration structure of claim 13, further comprising:  
                  a third section comprising a first end configured to be coupled to the  
second end of the second section, and a second end opposite the first end of the  
third section; and

                  a second alignment frame including a bottom portion configured to be  
25   coupled to the second end of the second section, and a top portion configured to be  
coupled to the first end of the third section, the second alignment frame comprising:  
                  an alignment portion arranged on at least one of the bottom  
portion of the second alignment frame or the top portion of the second alignment  
frame; and

30                   a hook configured to receive a portion of at least one of the  
bottom portion of the second alignment frame or the top portion of the second  
alignment frame.

FIG. 1

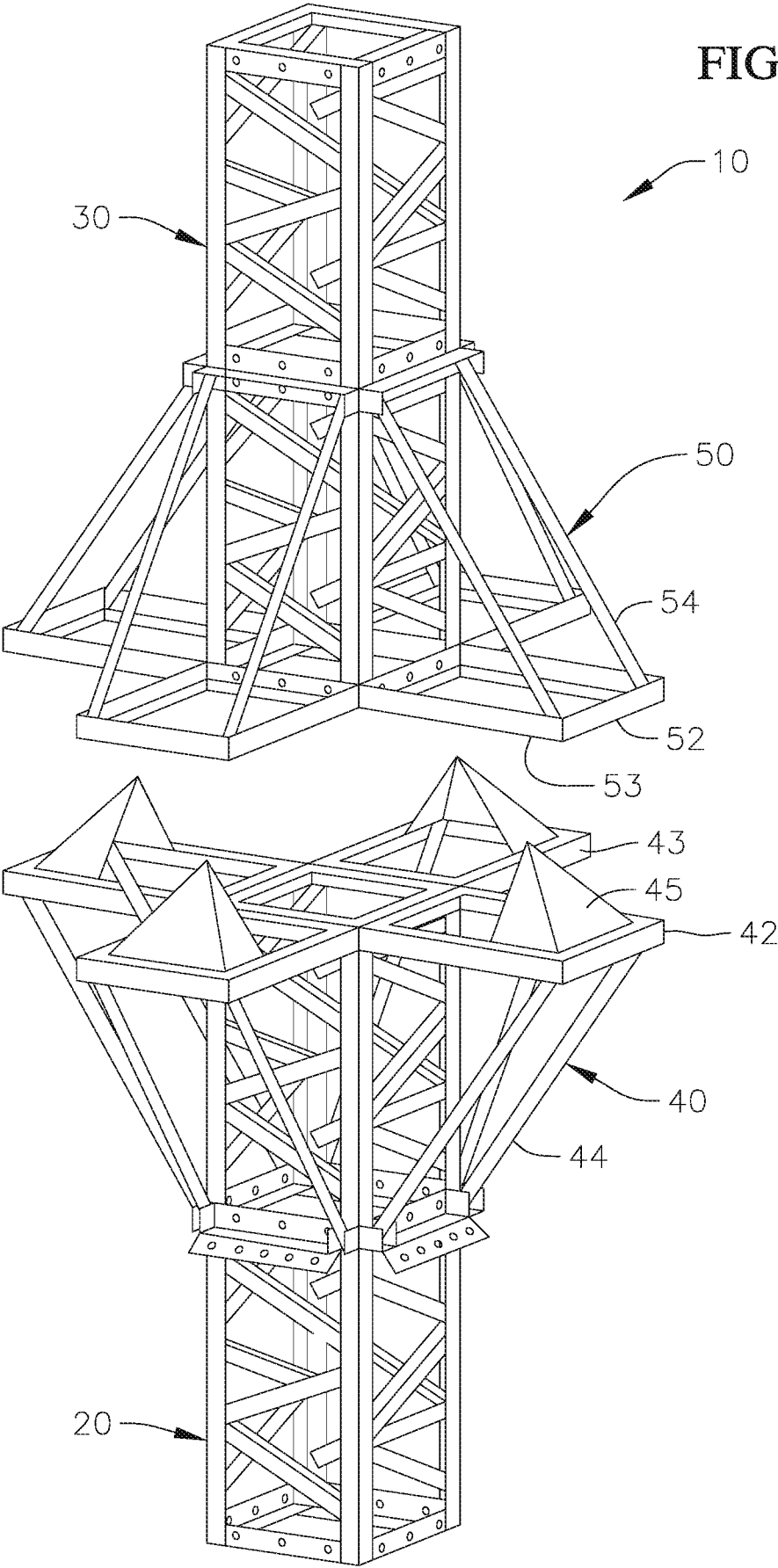




FIG. 2

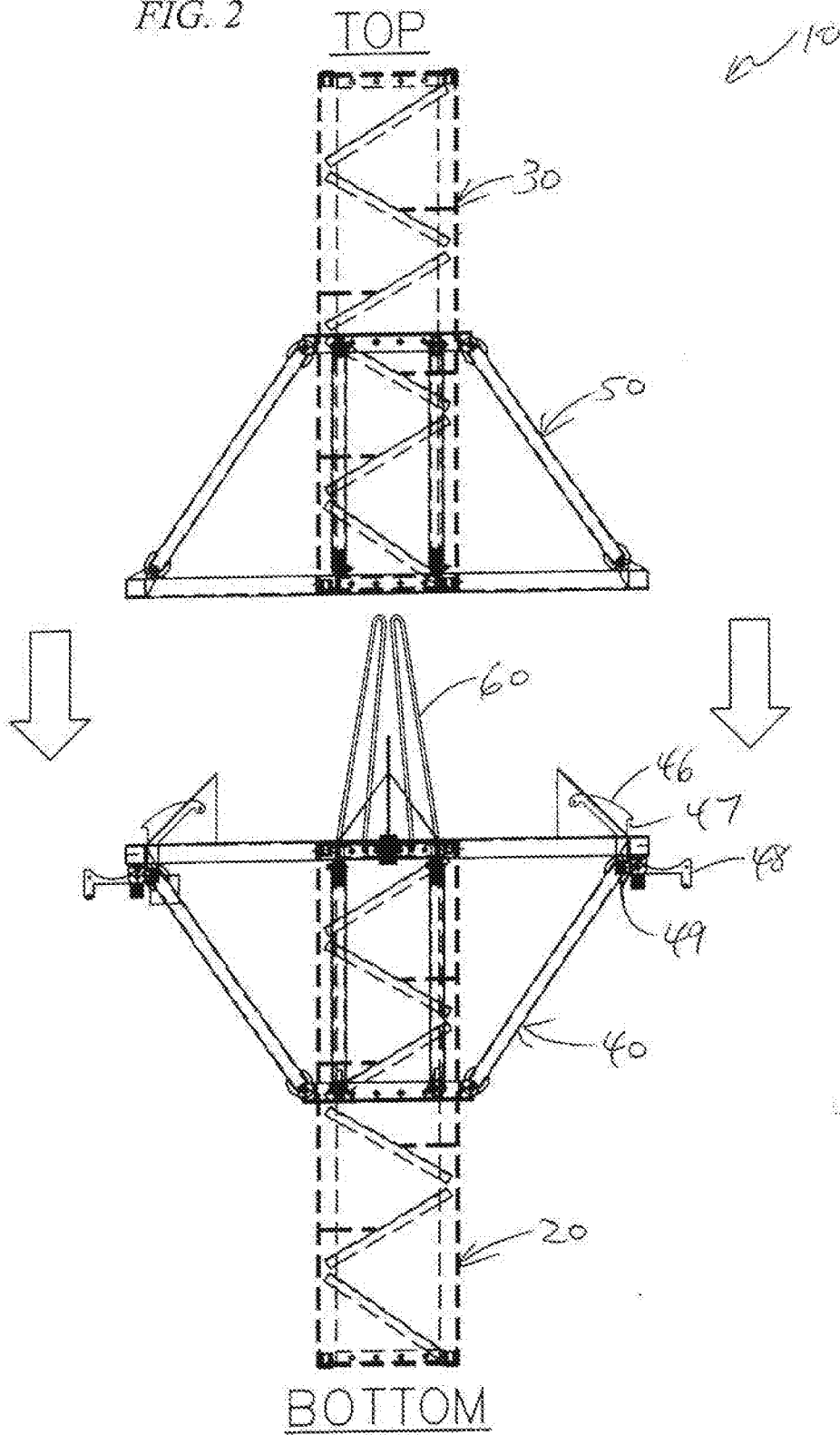


FIG. 3

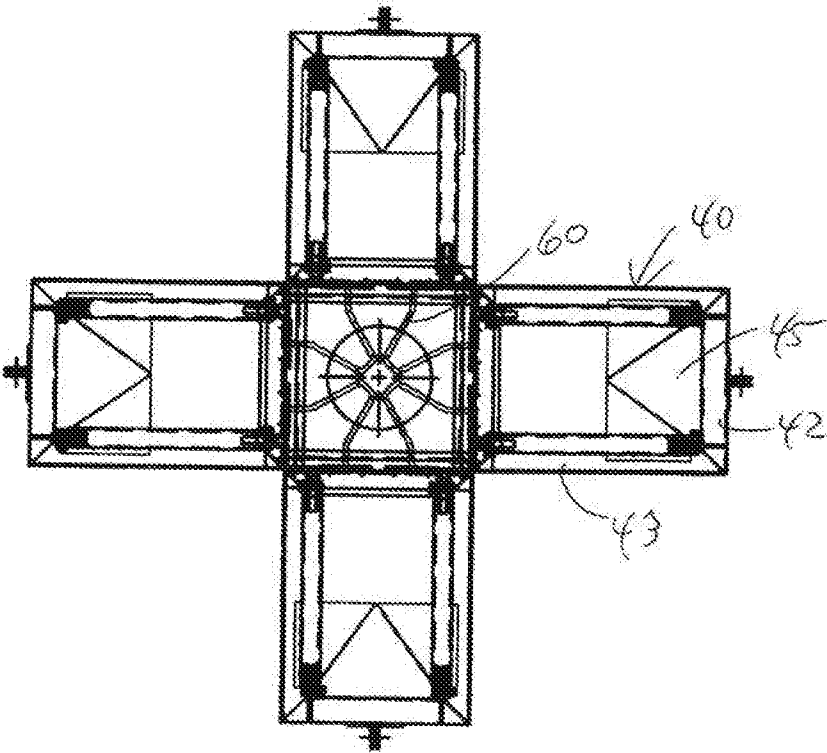


FIG. 4

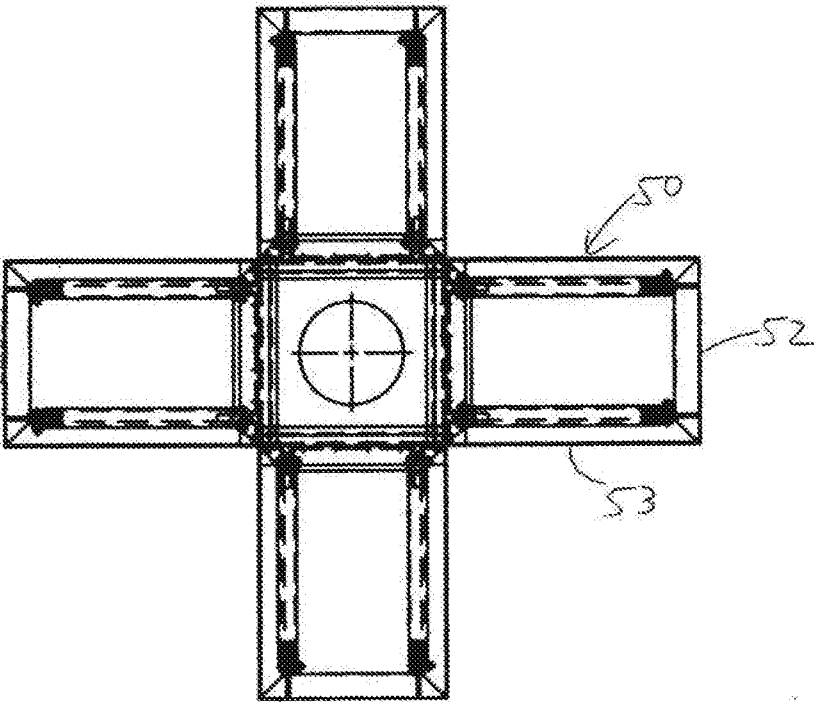


FIG. 5

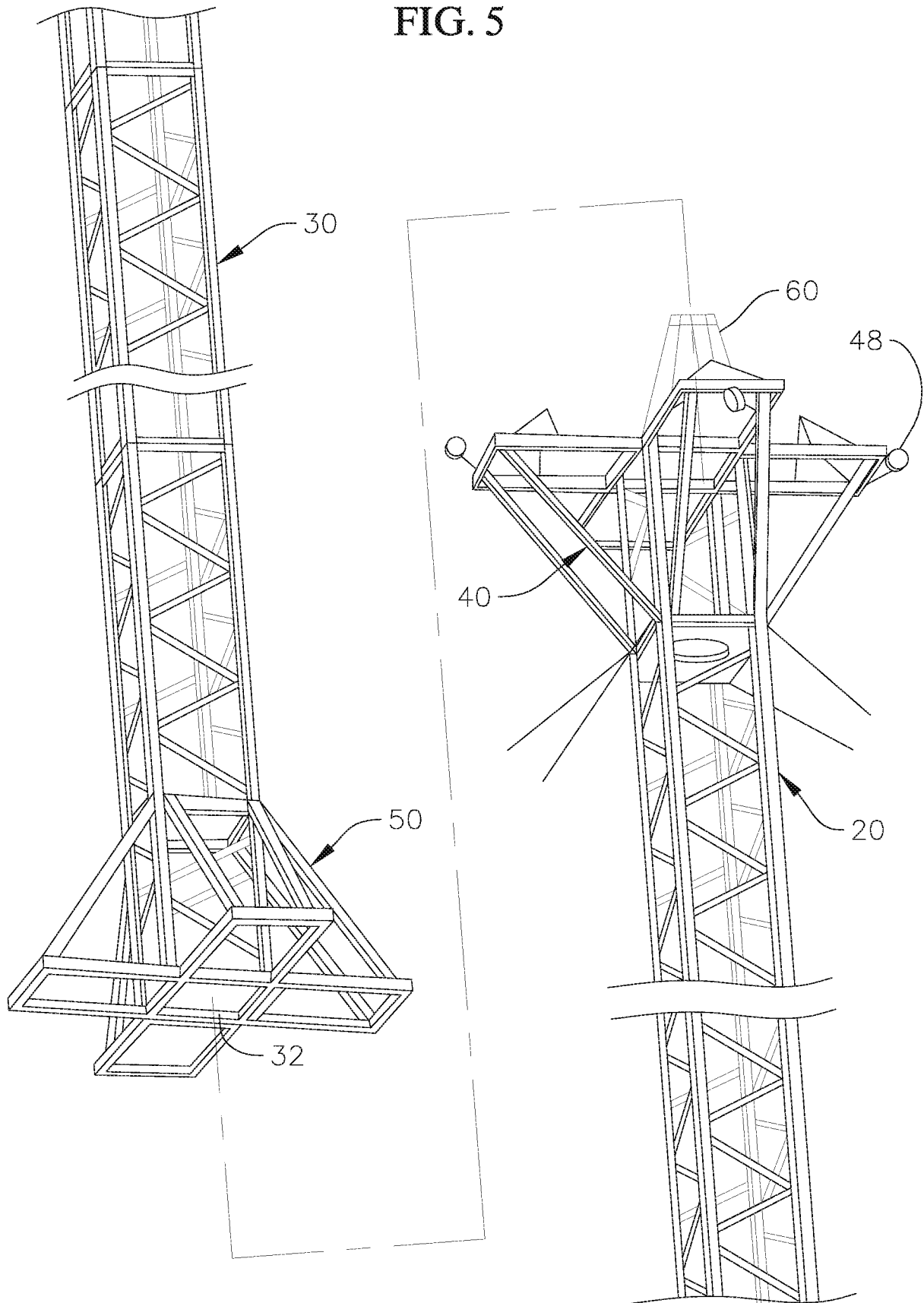


FIG. 6

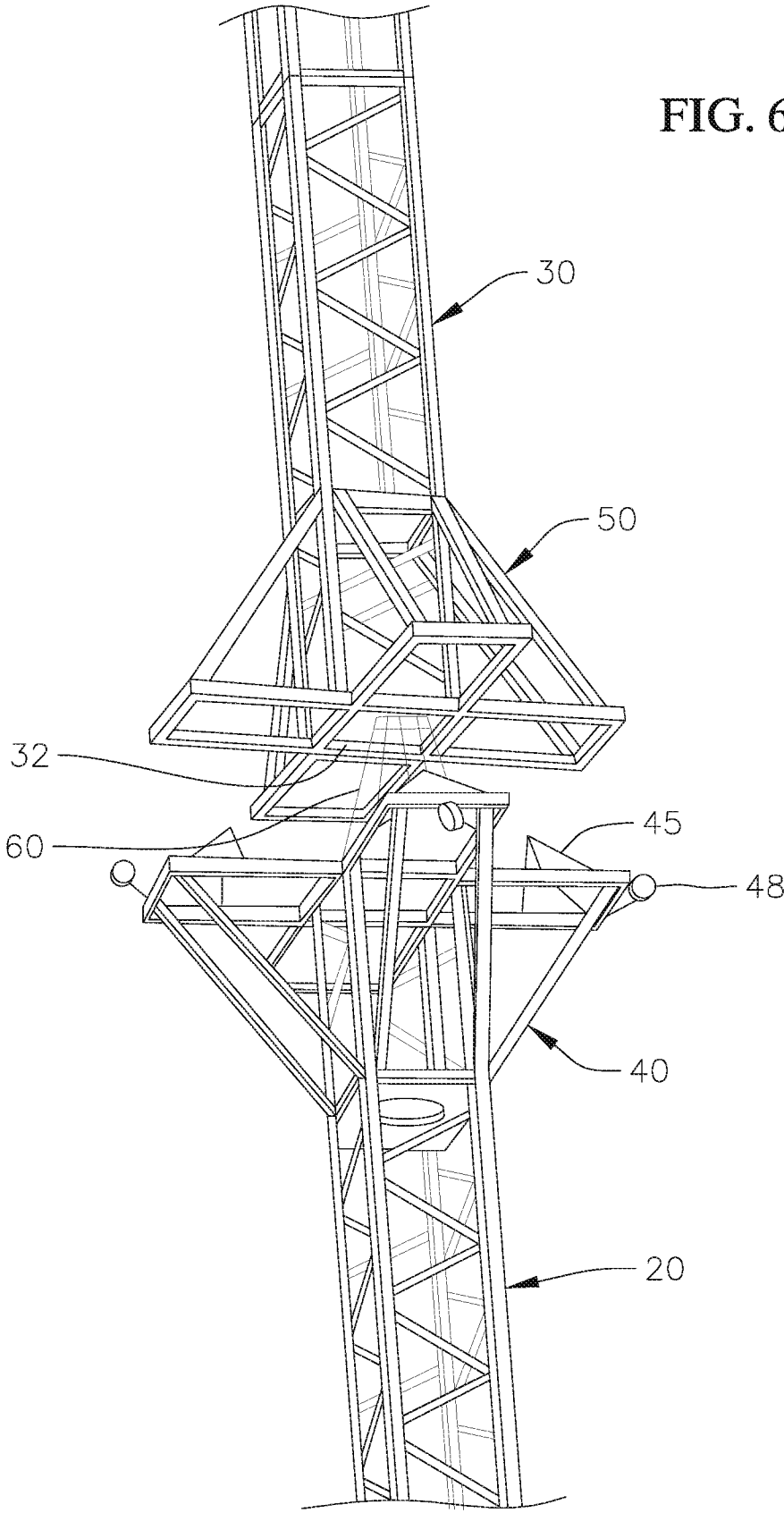


FIG. 7

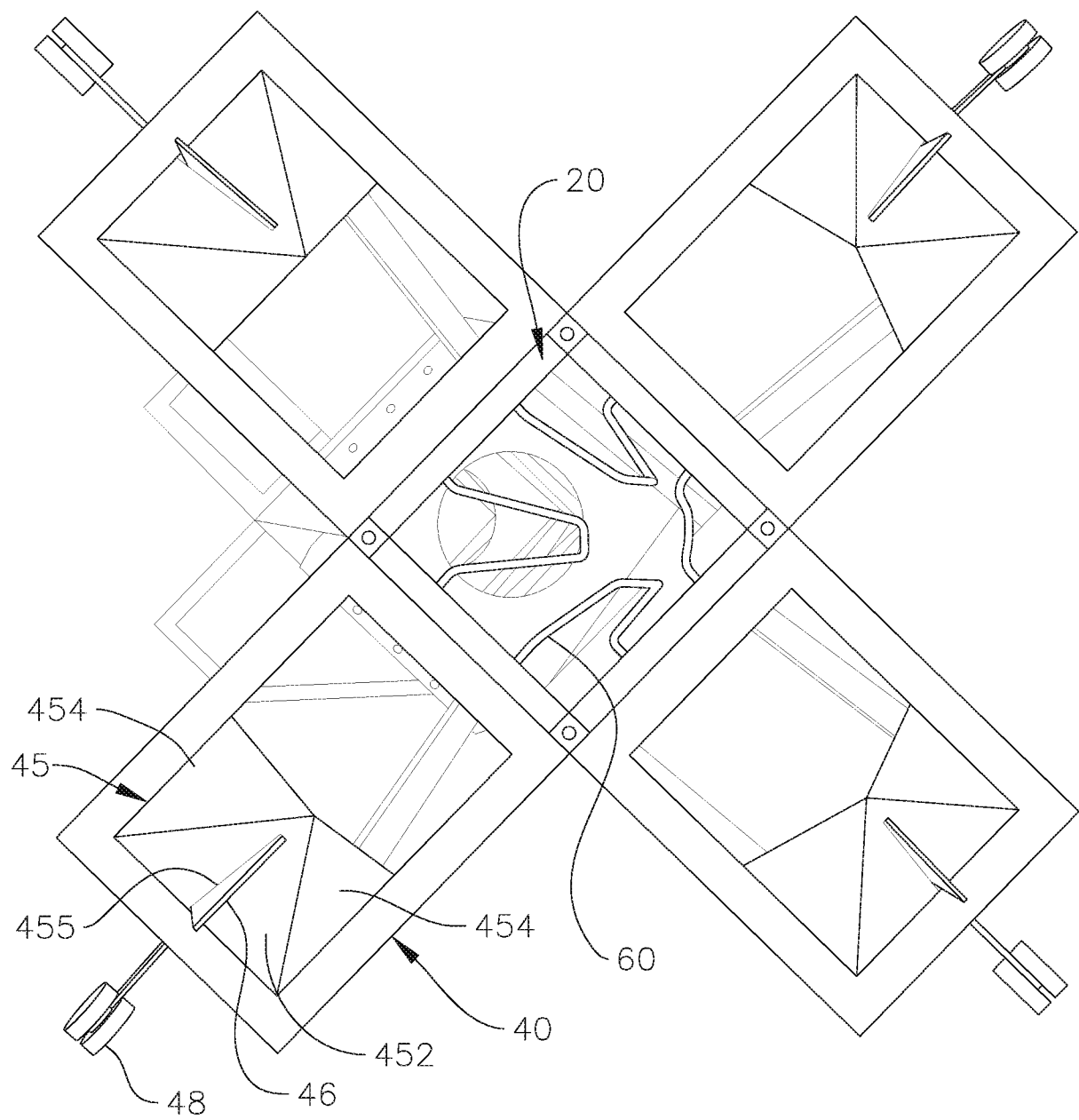
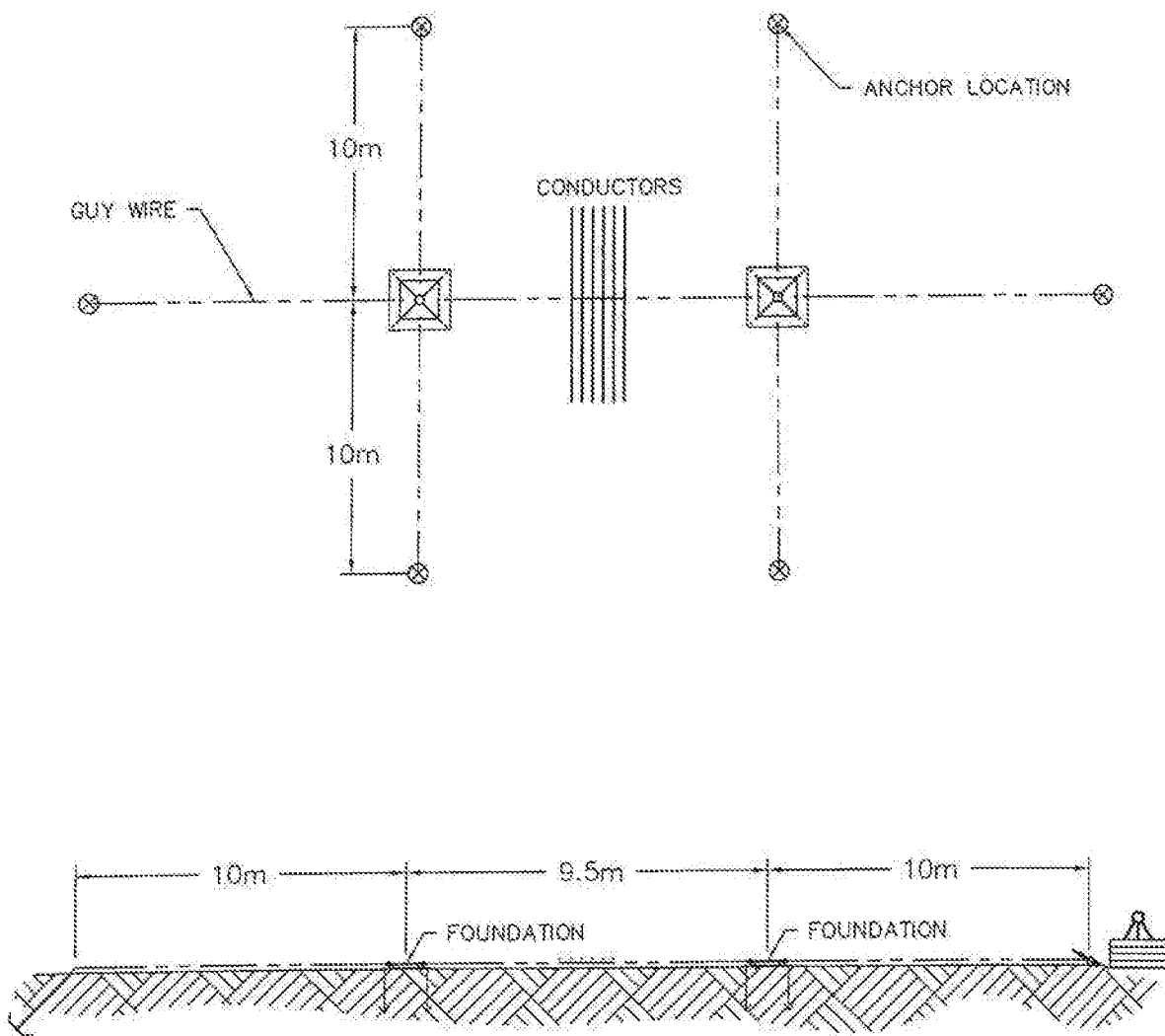
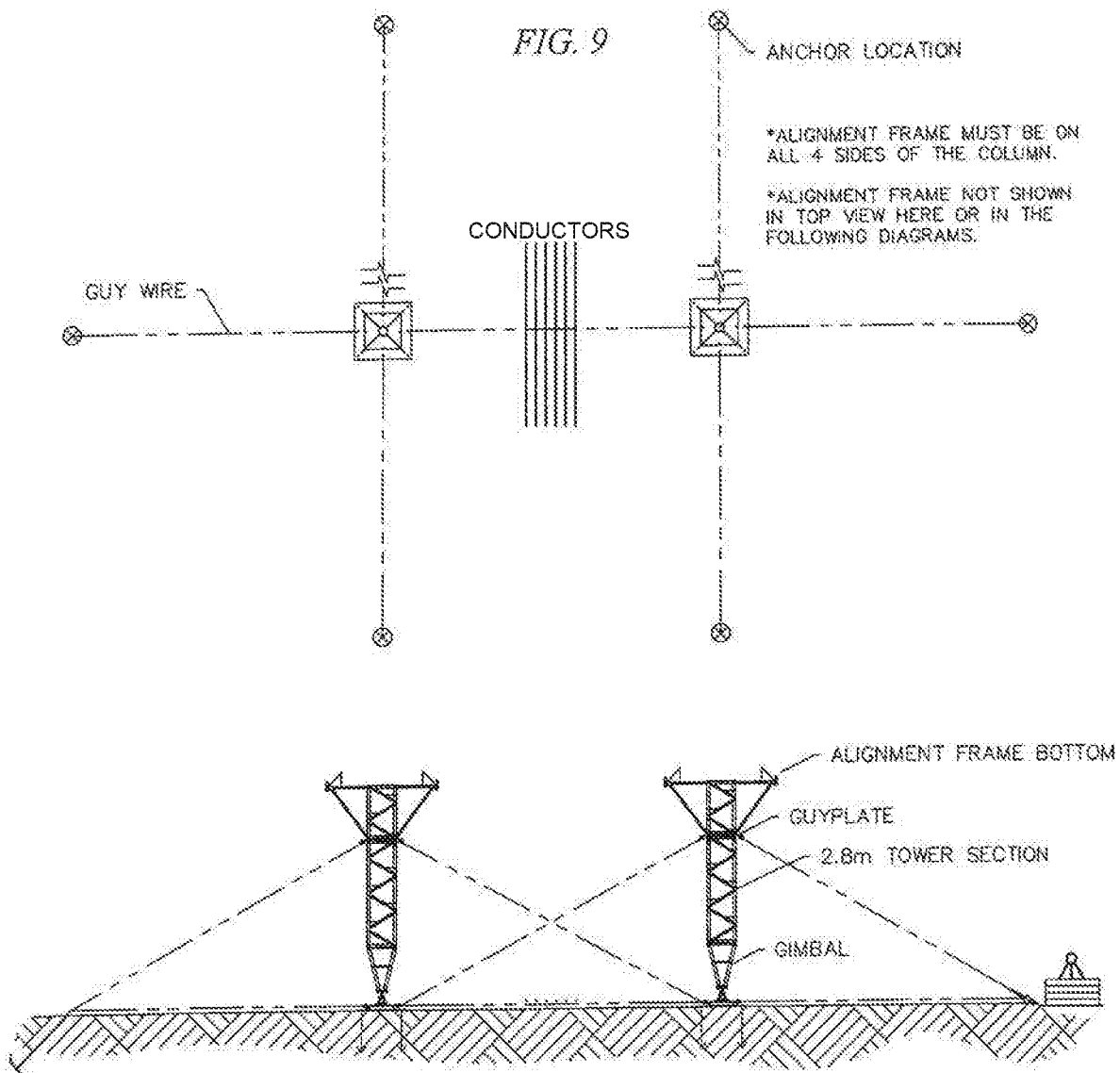


FIG. 8

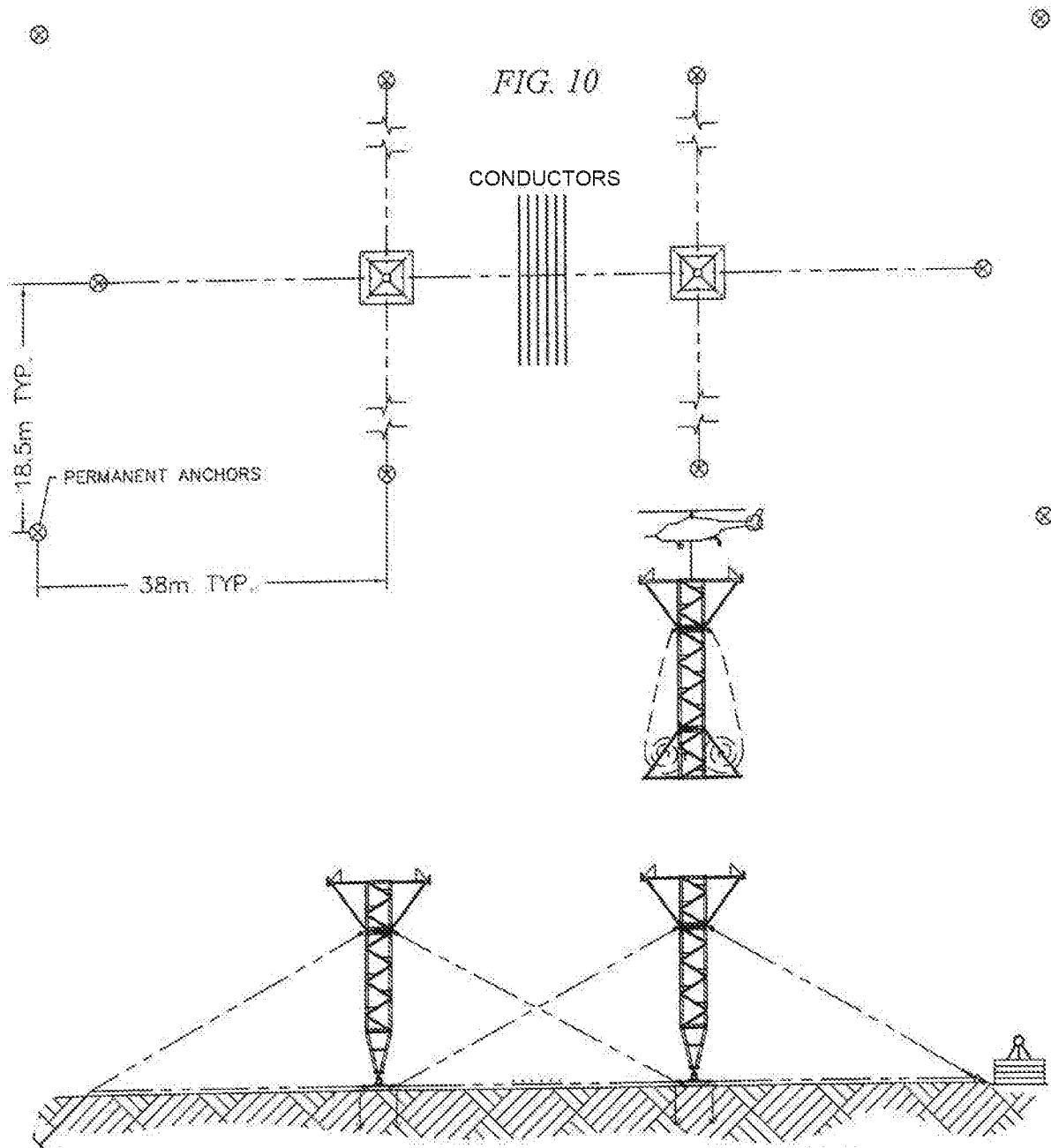


1. SET ANCHOR AND GUY THE FOUNDATIONS AT GROUND LEVEL.  
TIGHTEN ALL GUYS USING TURNBUCKLES

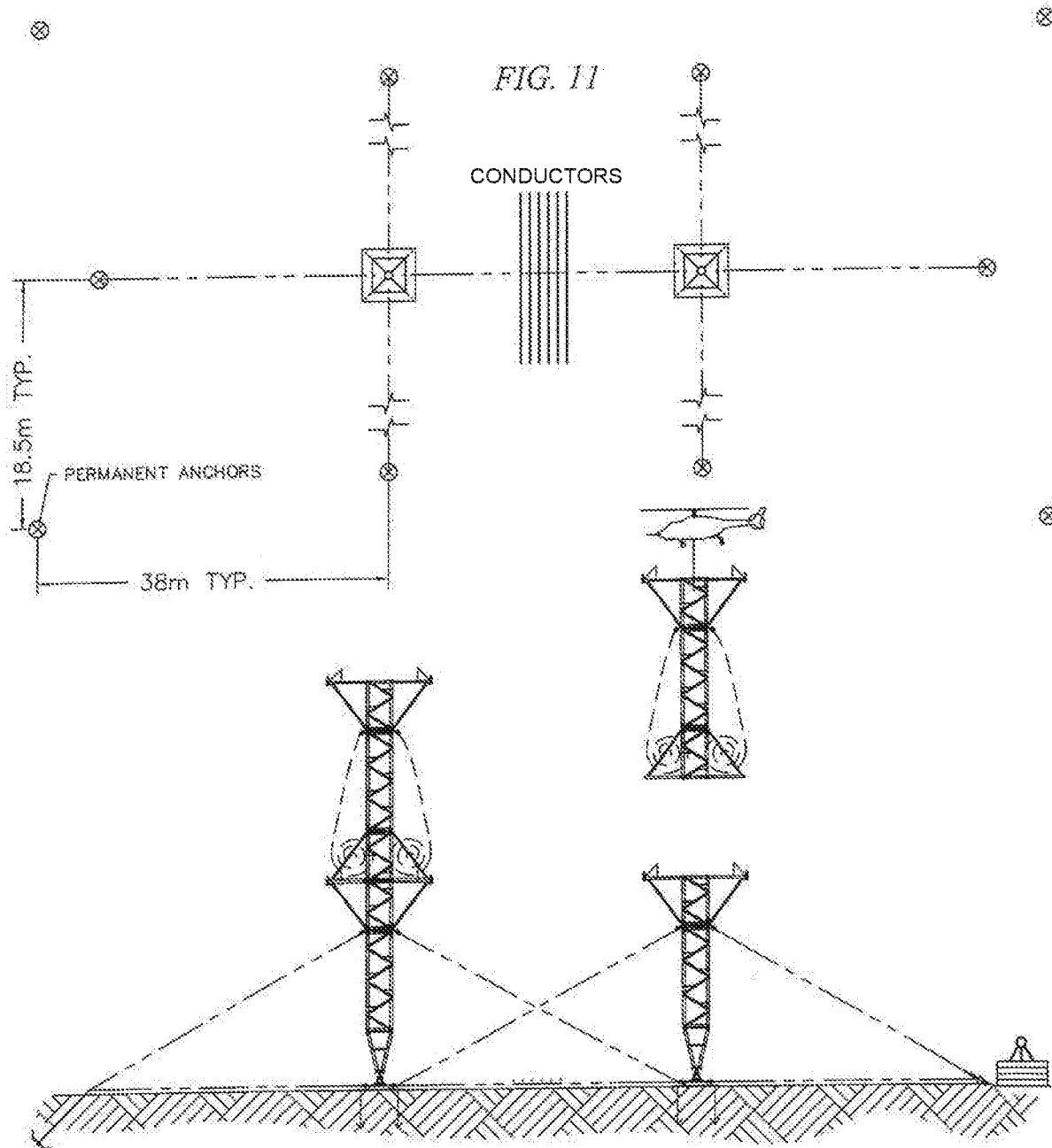


2. ASSEMBLE BOTTOM SECTIONS AND ALIGNMENT FRAME  
(i.e. GIMBAL, ONE 2.8m SECTION, GUYPLATE, AND  
ALIGNMENT FRAME BOTTOM)
3. PLUMB THE TWO COLUMNS USING TURNBUCKLES  
(PLUMB WITHIN  $\pm 1'$ )

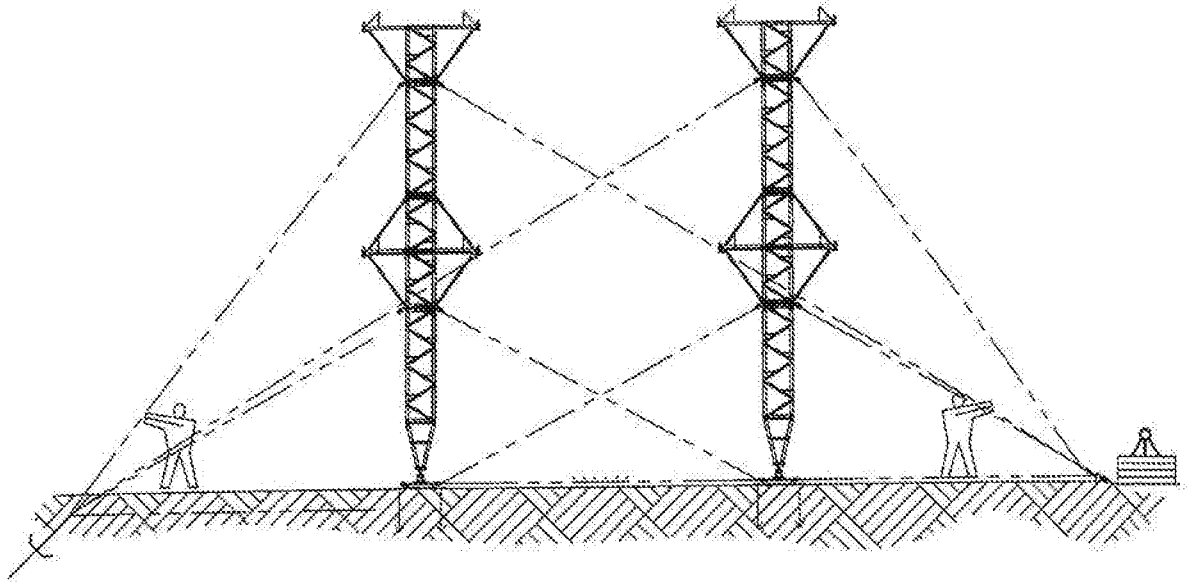
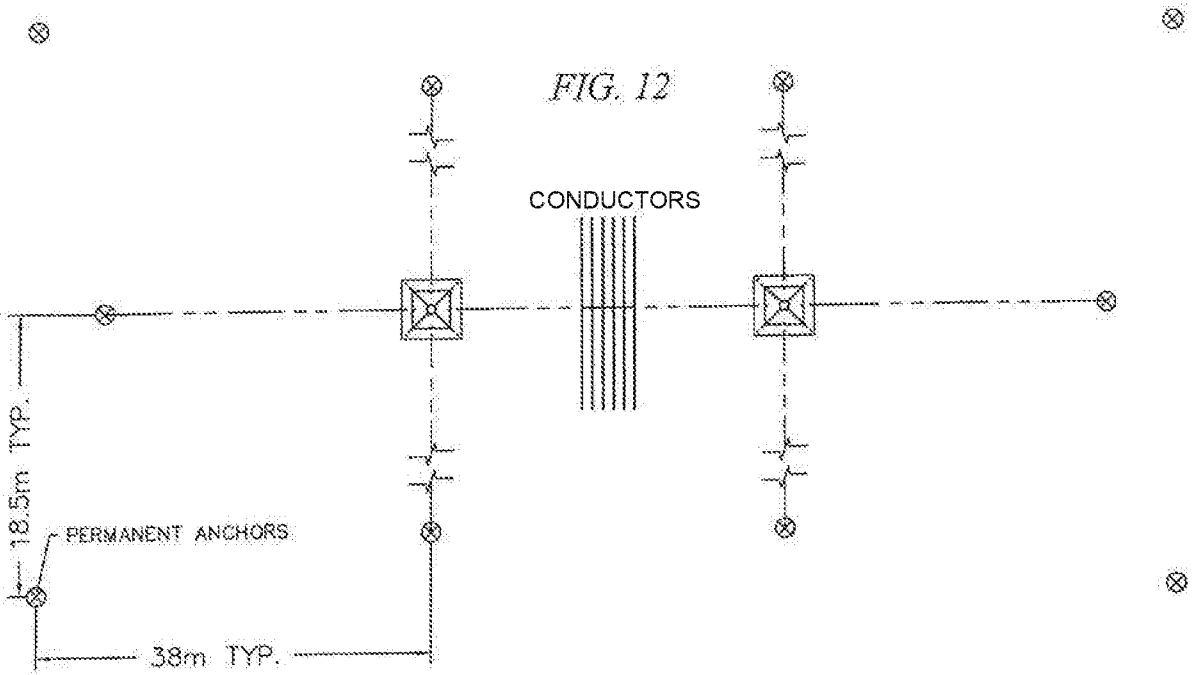




4. FLY IN TOP SECTIONS WITH ALIGNMENT FRAME TOP.
5. HELICOPTER RELEASES THE TOP SECTION.
6. PERMANENT GUY WIRES ARE HELD TO THE TOP TOWER ASSEMBLY.

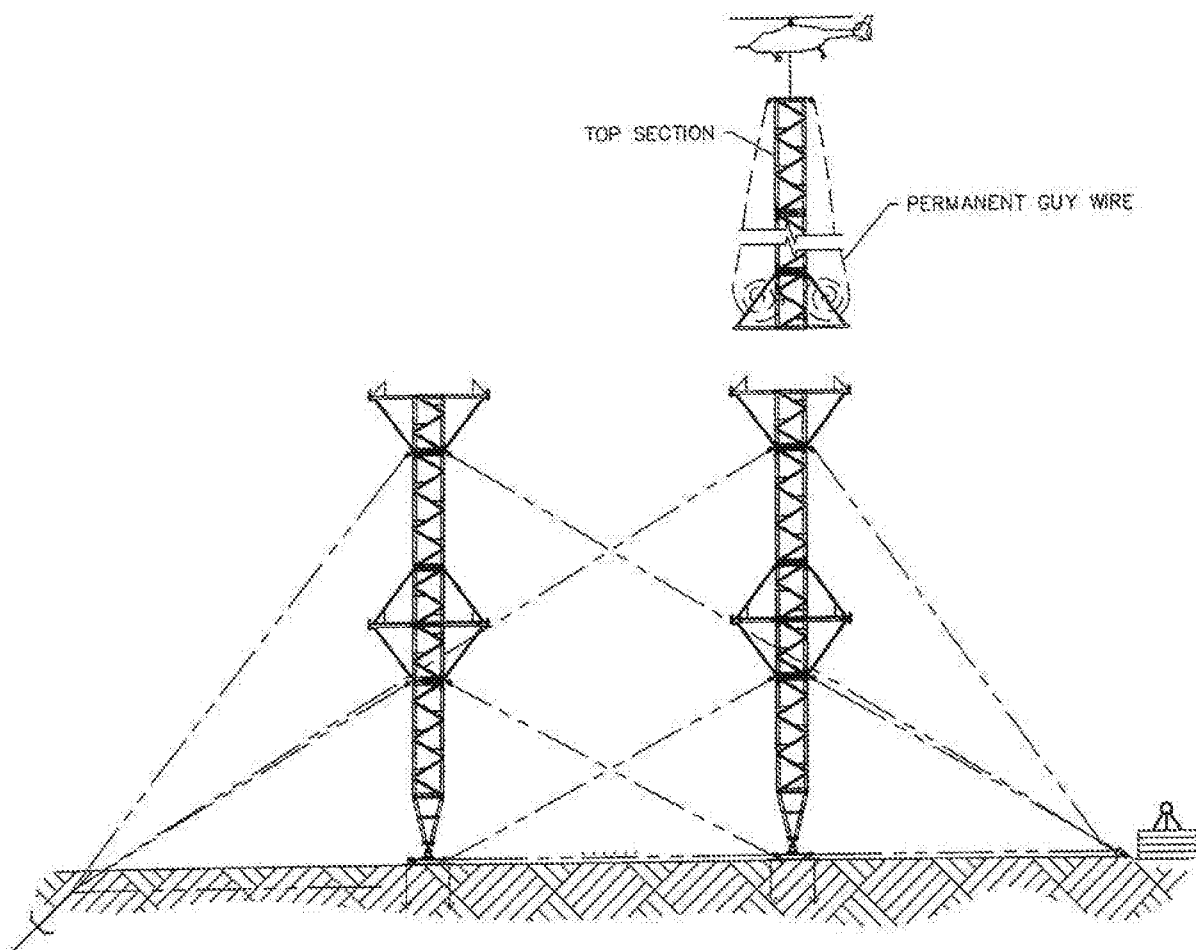


7. FLY IN SECOND TOP SECTIONS WITH ALIGNMENT FRAME TOP
8. HELICOPTER RELEASES THE TOP SECTION.



9. INTERMEDIATE SECTIONS ARE GUYED DOWN

FIG. 13



10. FLY IN ADDITIONAL TOP SECTIONS WITH.  
11. HELICOPTER RELEASES THE TOP SECTION.

FIG. 14

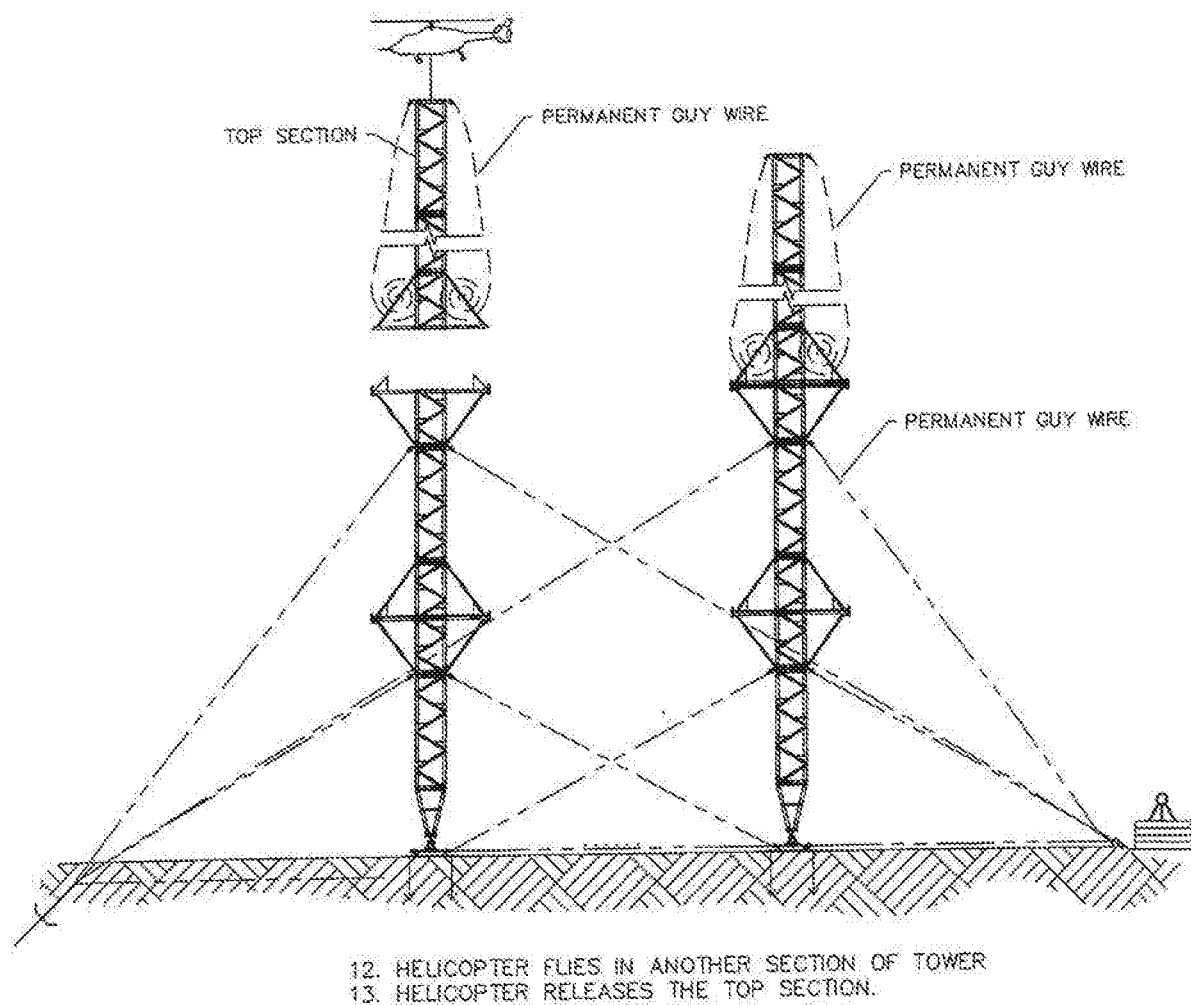


FIG. 15

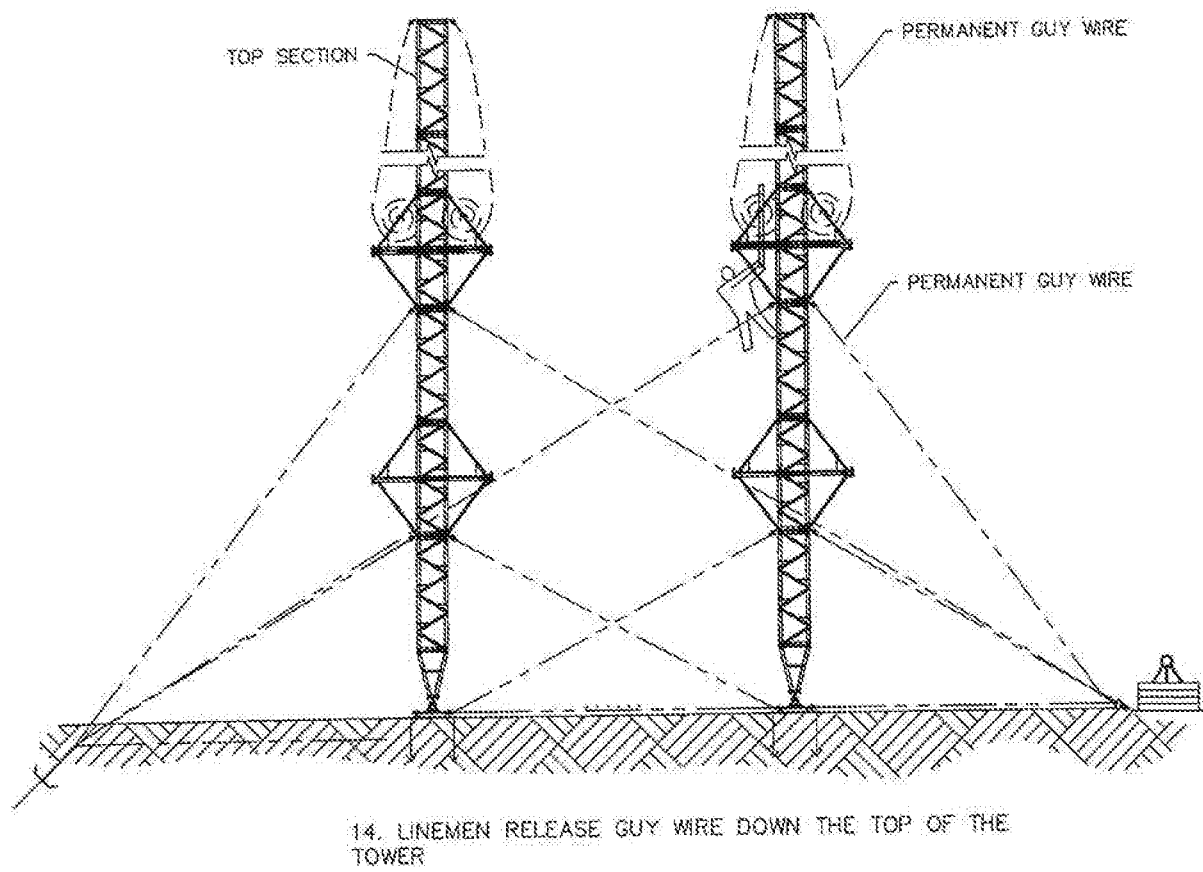
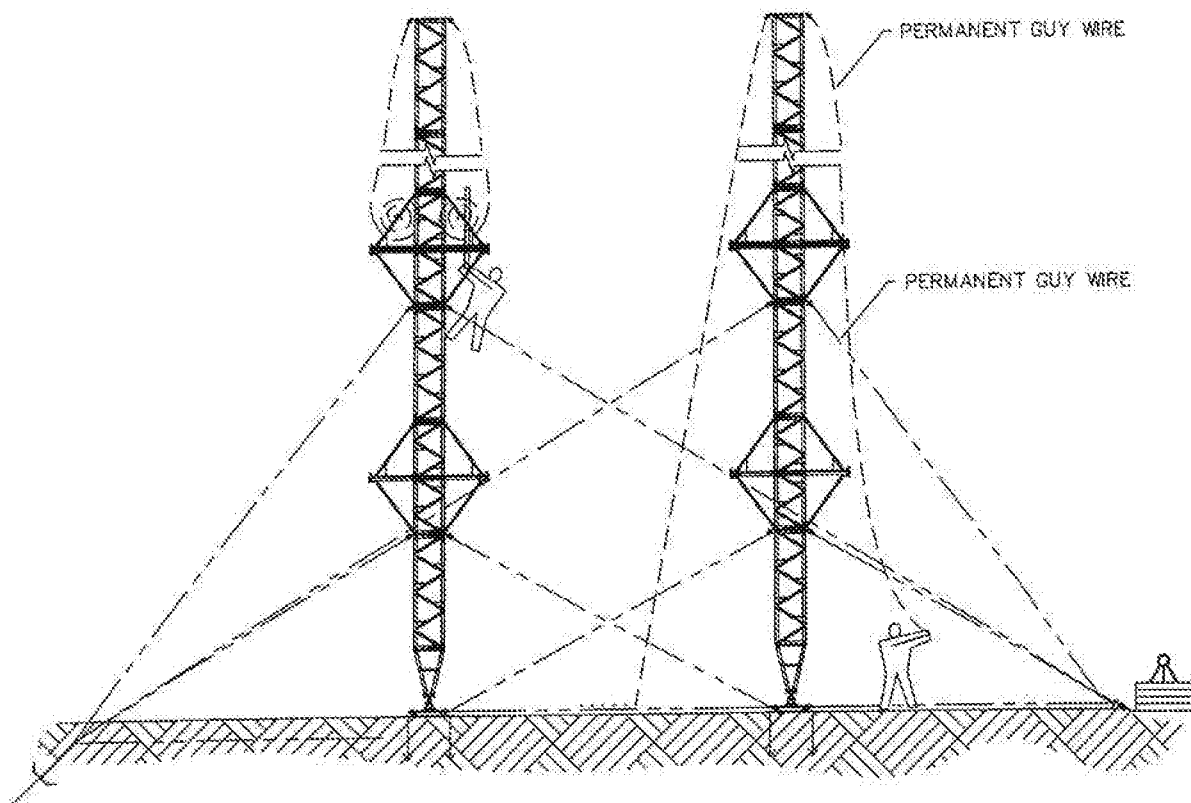


FIG. 16



15. LINEMEN ATTACH GUY WIRES TO PERMANENT ANCHORS.  
16. ASSEMBLY CONTINUES AS USUAL.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 16/57987

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - E04H 12/34, E04H 12/00, E04H 12/10, E04H 12/20 (2016.01)

CPC - E04H 12/342, E04H 12/34, E04H 12/00, E04H 12/10, E04H 12/20

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)

IPC(8): E04H 12/34, E04H 12/00, E04H 12/10, E04H 12/20 (2016.01)

CPC: E04H 12/342, E04H 12/34, E04H 12/00, E04H 12/10, E04H 12/20

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)

Google (Web, scholar, and patent); Patbase

Search terms: Helicopter, crane, structure, hook, clasp, catch, tower, truss, pylon, align\*, assembl\*, construct\*, erect\*, air, lift, mast, energy, absorb\*, frame, scaffold, power, transmission, electric\*, guy, rope, cable, latch, counterweight

## 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 8,375,650 B2 (GRATZER) 19 February 2013 (19.02.2013) Entire document, especially col 8, in 28-32, col 8, in 28-3, col 5, in 35-38, col 7, in 58-59, col 5, in 35-37, col 5, in 65-66 and figs. 5, 6a, 6b, 2 and 7.	1-2, 4-17 ----- 3
Y — A	US 4,356,498 A (POLLARD) 26 October 1982 (26.10.1982) Entire document, especially col 2, in 42-44, col 2, in 40-41 and figs. 1 and 4.	1-2, 4-17 ----- 3
Y	US 201 1/0283640 A1 (MILLER) 24 November 2011 (24.11.2011) Entire document, especially para [0098] and figs. 19 and 10.	4, 5, 15 and 16
Y	WO 2015/049520 A1 (BABCOCK NETWORKS LIMITED) 09 April 2015 (09.04.2015) Entire document, especially the abstract, para [0026] and fig. 5.	11



Further documents are listed in the continuation of Box C.



## \* Special categories of cited documents:

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"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"/V"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"/X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"/Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"/&amp;"

document member of the same patent family

Date of the actual completion of the international search

15 December 2016

Date of mailing of the international search report

09 JAN 2017

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