



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
19.09.2018 Bulletin 2018/38

(51) Int Cl.:
B66C 23/26 (2006.01)

(21) Application number: **18156339.6**

(22) Date of filing: **12.02.2018**

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

(72) Inventors:
• **NATELLA, Enrico**
42123 Reggio Emilia (IT)
• **NIZZOLINI, Lorenzo**
21052 Busto Arsizio (VA) (IT)

(74) Representative: **Corradini, Corrado et al**
Ing. C. Corradini & C. S.r.l.
Via Dante Alighieri 4
42121 Reggio Emilia (IT)

(30) Priority: **13.03.2017 IT 201700027378**

(71) Applicant: **Eng Cranes SRL**
40126 Bologna (IT)

(54) **TOWER CRANE**

(57) A tower crane (100) is described, comprising: a tower (105), a pivoting structure (125) installed at the top of the tower (105), a fifth wheel (130) adapted to allow the pivoting structure (125) to rotate around a vertical rotation axis (Y), a jib (145) associated with the pivoting structure (125) and adapted to protrude horizontally with

respect to the rotation axis (Y) and two counter jibs (165, 170) mutually overlapping, both of which are associated with the pivoting structure (125) and protrude horizontally with respect to the rotation axis (Y) on the opposite side with respect to the jib (145).

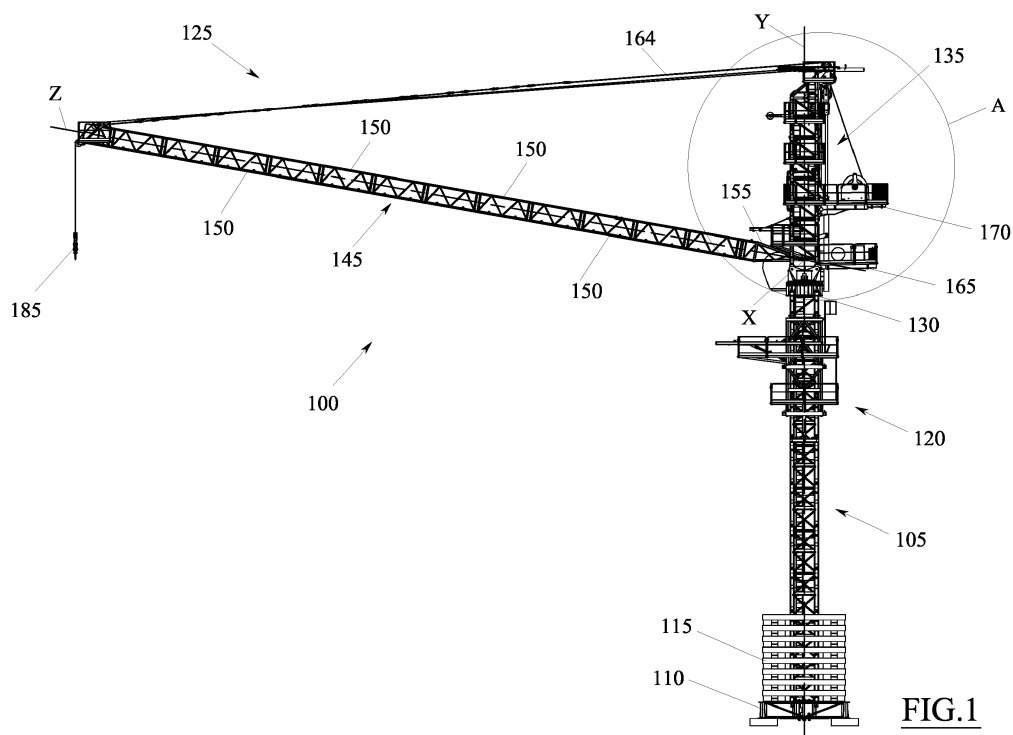


FIG.1

Description

Field of the invention

[0001] The present invention relates to a tower crane, such as a traditional tower crane or a luffing jib tower crane of the type commonly known by the name of luffer crane.

Background art

[0002] It is known that a tower crane is a widespread lifting device that is primarily used for the handling of loads within construction sites.

[0003] A tower crane generally comprises a vertical structure, conventionally called "tower", which is firmly anchored to the ground and at the top carries a pivoting structure which, due to the interposition of a special fifth wheel, is adapted to move with respect to the tower by rotating around a vertical rotation axis.

[0004] The pivoting structure generally comprises a long jib intended for load handling, usually called "rise", and a shorter counter jib, or "counter rise", which carries the ballasts necessary for the static balance of jibs and loads.

[0005] In conventional tower cranes, jib and counter jib are both fixed to the pivoting structure and protrude horizontally cantilevered from diametrically opposed parts with respect to the tower.

[0006] A requirement associated with the use of tower cranes is that the pivoting structure thereof can rotate by 360°, so that the jib and the counter jib are free to arrange in the direction of the wind when the crane is not used, such as after work.

[0007] It follows that the area swept by the jib and by the counter jib during a complete rotation of the pivoting structure must be completely free from obstacles.

[0008] Another requirement often associated with the use of conventional tower cranes is to not bring suspended loads over areas outside the construction site, especially above streets or other public areas.

[0009] For these reasons, the tower cranes cannot be used when the manoeuvring space is restricted, such as when the site is in a strongly urbanized context. In these contexts, luffing jib towers are preferably used, in which the jib designed to handle loads is constrained to the pivoting structure by means of a horizontal articulation axis and is associated with special driving means, which are adapted to rotate it around said articulation axis so as to vary the inclination thereof with respect to the ground.

[0010] In this way, the luffing jib can be rotated between a lowered position, in which it is substantially horizontal or slightly inclined, and a raised position in which the jib is very inclined with respect to the ground in order to significantly reduce the lateral bulk of the tower crane when not in use.

[0011] With this solution, luffing jib towers can be em-

ployed where more confined manoeuvring spaces are available compared to those required by traditional tower cranes.

[0012] Nevertheless, the manoeuvring spaces necessary for the use of luffing jib tower still remain relatively large, particularly because of the counter jib, the cantilever length of which still creates a significant lateral bulk.

[0013] In particular, the cantilever length of the counter jib is generally larger than 7-8 metres because of the need to accommodate not only the balancing weights but also many other functional devices, such as the load-lifting winch, the electrical panel and the hydraulic driving unit.

Description of the invention

[0014] An object of the present invention is to solve the above drawback of the prior art by providing a tower crane having a very small lateral bulk and which can therefore be used in extremely confined spaces.

[0015] Another object is to achieve the above object with a simple, rational and relatively cost-effective solution.

[0016] These and other objects are achieved with the features of the invention as described in the independent claim 1. The dependent claims describe preferred and/or particularly advantageous aspects of the invention.

[0017] In particular, an embodiment of the present invention provides a tower crane comprising:

- a tower,
- a pivoting structure installed at the top of the tower,
- a fifth wheel adapted to allow the pivoting structure to rotate around a vertical rotation axis,
- a jib associated with the pivoting structure and adapted to protrude horizontally with respect to the rotation axis, and
- two counter jibs mutually overlapping, both of which are associated with the pivoting structure and protrude horizontally with respect to the rotation axis on the opposite side with respect to the jib.

[0018] With this solution, the two counter jibs can have a significantly smaller length than the single counter jib of the prior art, thus effectively reducing the lateral bulk of the tower crane and thus the manoeuvring space needed for the use thereof.

[0019] For example, the two counter jibs may both have a horizontal extension of between 3 and 5 metres with respect to the rotation axis. Optionally, the upper counter jib may have a larger horizontal extension than the lower counter jib.

[0020] The presence of two counter jibs also has the advantage of providing a loading space globally comparable to or even larger than the single counter jib of the prior art, so as to still accommodate all functional devices that are conventionally installed on the counter jib.

[0021] For example, at least one device selected from

the group consisting of: a lifting winch, a hydraulic group and an electrical panel may be installed on one of the counter jibs; while the remaining devices of the group may be installed on the other counter jib.

[0022] Preferably, the winch may be installed on the upper counter jib while the hydraulic group and the electrical panel may be installed on the lower counter jib.

[0023] In this way, each device is placed in the most convenient position for its operation and use.

[0024] A respective group of ballasts may also be installed on each counter jib having the function to counterbalance the weight of the jib and the loads connected thereto.

[0025] Each of these ballasts may for example consist of a steel block, so as to have a specific weight greater than conventional reinforced concrete blocks, with the effect of providing the same counterweight with a smaller footprint. From a construction point of view, the pivoting structure may comprise a cage extending vertically and the two counter jibs may be individually shaped as a platform attached to and cantilevering horizontally from said cage.

[0026] With this solution, the two counter jibs provide a stable support for all the devices installed thereon and can also provide a platform for the operators. According to one aspect of the present invention, the jib adapted for load handling may be articulated to the pivoting structure according to a horizontal rotation axis.

[0027] With this solution, a luffing jib tower is substantially obtained in which the length of the jib does not affect the lateral bulk of the crane in non-use condition.

[0028] It is not excluded, however, that the solution with dual counter jib may also be adopted for traditional tower cranes, i.e. with fixed jib.

Brief description of the drawings

[0029] Further features and advantages of the invention will become apparent from the following description, provided by way of non-limiting example with the aid of the figures shown in the accompanying drawings.

Figure 1 is a lateral view of a tower crane according to an embodiment of the present invention, shown with the luffing jib in lowered position.

Figure 2 is the detail indicated with A in figure 1, shown in enlarged scale.

Figure 3 is the view indicated with B in figure 2.

Figure 4 is a lateral view of the tower crane in figure 1 shown with the luffing jib in raised position.

Figure 5 is detail C in figure 4, shown in enlarged scale.

Figures 6 to 9 are the view in figure 4 during subsequent steps of the procedure for removing the luffing jib.

Detailed description

[0030] The present invention relates to a tower crane 100 and more in particular, a tower crane with luffing jib of the type commonly known by the name of luffer crane.

[0031] Crane 100 comprises a vertical structure, usually referred to as "tower" and indicated as a whole with reference numeral 105, which may have the overall shape of a parallelepiped extending according to a vertical central axis starting from a lower end towards a top.

[0032] The lower end of tower 105 is firmly anchored to the ground, for example by means of a resting base 110 on which a ballast 110 is loaded having a stabilization function.

[0033] Tower 105 may consist of a lattice structure, typically a metal lattice, which may for example comprise four vertical uprights connected together by a plurality of horizontal and diagonal crosspieces, thus defining an empty inner space in which a ladder and any platforms may be accommodated.

[0034] From a construction point of view, tower 105 may be longitudinally divided into a plurality of prefabricated elements or segments having a predetermined height, such as between 2 and 12 metres, which are coaxially stacked on top of each other and fitted together by means of removable fasteners, for example by means of bolts, up to obtain a tower 105 having desired height. Tower 105 may be mounted and disassembled directly on site by means of a telescoping cage 120, whose operation is known per se and is therefore not described in detail.

[0035] Crane 100 further comprises a pivoting structure 125, which is installed at the top of tower 105 by the interposition of a fifth wheel 130 which allows said pivoting structure 125 to rotate about a vertical rotation axis Y.

[0036] The rotation axis Y of the pivoting structure 125 is preferably coincident with the central axis of tower 105, so as to improve the stability of crane 100.

[0037] The fifth wheel 130 generally comprises a fixed ring connected to tower 105 and a rotatable ring connected to the pivoting structure 125, which is rotatably coupled to the fixed ring through the interposition of rolling elements, such as one or more rows of balls.

[0038] The actuation in rotating of the pivoting structure 125 may be achieved by means of one or more motors, such as an electric or hydraulic motor, which is adapted to actuate in rotation the rotatable ring of the fifth wheel 130 with respect to the fixed ring. For example, the motor may be installed aboard the pivoting structure 125 and be adapted to actuate a pinion that meshes on a toothed crown coaxially anchored to the fixed ring of the fifth wheel 130.

[0039] The pivoting structure 125 comprises a cage 135, which can be shaped as a parallelepiped tower that extends with a vertical central axis starting from a lower end connected to the fifth wheel 130 towards an upper top end.

[0040] Cage 135 may consist of a lattice structure,

such as a metal lattice, and is internally hollow so as to define an empty inner channel which extends along the central axis of cage 135 up to the top.

[0041] Preferably, the central axis of cage 135 coincides with the rotation axis Y of the pivoting structure 125 and thus with the central axis of the underlying tower 105.

[0042] The pivoting structure 125 further comprises a luffing jib 145, which has a free end and an opposite end that is articulated at the base of cage 135 according to a horizontal articulation axis X.

[0043] The luffing jib 145 is generally shaped as an elongated body which extends mainly along a longitudinal axis Z substantially orthogonal to the articulation axis X.

[0044] The luffing jib 145 may consist of a lattice structure, typically a metal lattice, which may for example comprise four longitudinal members oriented parallel to the longitudinal axis Z and connected together by a plurality of horizontal and diagonal crosspieces.

[0045] From a construction point of view, the luffing jib 145 may be longitudinally divided into a plurality of prefabricated elements or segments 150 having a limited length, such as between 2.5 and 6 metres, which are coaxially arranged in a succession and fitted together by means of removable fasteners, for example by means of bolts, up to obtain a luffing jib 145 having the desired length.

[0046] In particular, the prefabricated elements 150 may be fitted one after the other starting from a connecting element 155, shaped as a pinnacle, which is directly connected to the pivoting structure 125 by means of a joint that defines the articulation axis X.

[0047] By rotating around the articulation axis X, the luffing jib 145 can vary its inclination with respect to the rotation axis Y of the pivoting structure 125 between a lowered position (see fig. 1) and a completely raised position (see fig. 4).

[0048] In the lowered position, the luffing jib 145 protrudes transversely, i.e. substantially cantilevering, with respect to the rotation axis Y of the pivoting structure 125, forming an angle close to 80° therewith and thus being nearly horizontal with respect to the ground.

[0049] In the completely raised position, the luffing jib 145 is perfectly vertical or nearly so.

[0050] Preferably, the articulation axis X of the luffing jib 145 is substantially coplanar to the central axis of cage 135, so that when the luffing jib 145 is in the raised (vertical) position, at least the lower portion of the luffing jib 145 is accommodated within the inner channel of cage 135.

[0051] In particular, the height of cage 135 is selected so as to accommodate at least the first two prefabricated elements 150, i.e. the first prefabricated element directly fitted on the connecting element 155 and the second prefabricated element 150 directly fitted on the first one.

[0052] Of course, in order to allow the luffing jib 145 to enter into the inner channel of cage 135, one of the sides of cage 135 parallel to the articulation axis X must be left

open (i.e. left devoid of horizontal and/or oblique crosspieces), or it must be opened before lifting the luffing jib 145.

[0053] As shown in figures 2 and 3, the oscillation of the luffing jib 145 around the articulation axis X may be obtained by means of a pair of hydraulically operated jacks 159 mounted aboard cage 135, preferably on the opposite side with respect to the luffing jib 145.

[0054] In particular, jacks 159 are oriented essentially vertically and comprise each a lower cylinder 160 from which a sliding stem 161 protrudes superiorly. Cylinders 160 are articulated to cage according to an articulation axis X' parallel to the articulation axis X of the luffing arm 145, while the free ends of the sliding stems 161 are fixed to a single movable crosspiece 162.

[0055] Preferably, the articulation axis X' of jacks 159 may be placed at a higher height than the articulation axis X of the luffing boom 145.

[0056] The movable crosspiece 162 is coupled with a system of pulleys 163 which are positioned at the top of cage 135 and whose ropes 164 are directly connected to the luffing jib 145, in particular to the free end thereof (see fig. 1). The pulley system 163 is configured so that a shortening of jacks 159 corresponds to a pull of ropes 164 downwards, and thus a lifting of the luffing jib 145 and vice versa, a lengthening of jacks 159 corresponds to a release of ropes 164 and thus a lowering of the luffing jib 145.

[0057] In particular, the pulley system 163 is configured so as to multiply the displacement of the movable crosspiece 162, i.e. so that a predetermined linear displacement of the movable crosspiece 162 corresponds to a greater sliding of ropes 164, for example a sliding equal to three times the linear movement of the movable crosspiece 162.

[0058] In this way, despite having a limited length, jacks 159 are effectively able to lift the luffing jib 145 up to reach a perfectly vertical position.

[0059] Although two jacks 159 have been described in this embodiment, it is not excluded that other embodiments use a single jack 159 or alternatively a number of jacks 159 higher than two.

[0060] As shown in figure 2, cage 135 is also associated with two mutually overlapping counter jibs, of which a lower counter jib 165 which can be placed substantially at the same height as the articulation axis X of the luffing jib 145, and an upper counter jib 170 placed at a higher height, for example substantially at the same height as the articulation axis X' of jacks 159.

[0061] Each of these counter jibs 165 and 170 is attached substantially cantilevering to cage 135 so as to protrude horizontally with respect to it, and thus with respect to the rotation axis Y of the pivoting structure 125, on the diametrically opposite side with respect to the luffing jib 145 when in the lowered position. In order to improve the stability of crane 100, the upper counter jib 170 may have a slightly greater horizontal extension than that of the lower counter jib 165.

[0062] In any case, the horizontal extension of both counter jibs 165 and 170 is preferably rather limited, such as between 3 and 5 metres.

[0063] It is noted herein that the term "horizontal extension" refers to the maximum cantilever dimension of the counter jibs with respect to the rotation axis Y, measured along a horizontal direction and coplanar to the longitudinal axis Z of the luffing jib 145.

[0064] From a construction point of view, each counter jib 165 and 170 can be shaped like a platform that is attached outside cage 135 and that defines a horizontal loading platform.

[0065] On both counter jibs 165 and 170, preferably in the vicinity of the free ends thereof, groups of ballasts 175 may be installed with the function of counterbalancing the weight of the luffing jib 145 and of the loads connected to it.

[0066] Each ballast 175 may consist of a steel block, which has a specific weight greater than conventional reinforced concrete blocks, thereby providing the same counterweight with a smaller footprint.

[0067] A lifting winch 180 may be installed on the upper counter jib 170, generally comprising a motor, such as an electric or hydraulic motor, and a drum adapted to be set in rotation by the motor, possibly through the interposition of a gearbox.

[0068] A rope is wrapped around the drum of the lifting winch 180 which, guided by suitable return wheels placed at the top of cage 135, is connected to a pulley 185 placed at the free end of the luffing jib 145 to fasten the loads.

[0069] A hydraulic group 190 may be installed on the lower counter jib 165, which comprises one or more hydraulic pumps which, driven by suitable electric motors, are adapted to deliver oil under pressure towards the various utilities installed on crane 100, including for example the motor (if hydraulic) of the lifting winch 180, jacks 159 that actuate the movement of the luffing jib 145 and the motor (if hydraulic) that drives the rotation of the entire pivoting structure 125.

[0070] The lower counter jib 165 may also accommodate an electrical panel 195 whose purpose is to power and optionally disconnect, in case of breakdown or maintenance, the electrical utilities of crane 100, including for example the motor (if electric) of the lifting winch 180 and the motor (if electric) which drives the rotation of the entire pivoting structure 125.

[0071] A peculiarity of crane 100 described above is that the luffing jib 145 can be disassembled piece by piece, without the need for external devices or machines.

[0072] To perform this disassembly, the luffing jib 145 is first brought into the raised position shown in figure 4 and 5, in which it is oriented vertically and in which the lower portion thereof is accommodated into the inner channel of cage 135.

[0073] At this point, jacks 159 may be detached from the pulley system 163 to be directly connected to the luffing jib 145 which is located in the raised position.

[0074] This connection (not shown in the figures) can

be achieved by means of the movable crosspiece 162, which can be released from the pulley system 163 to be subsequently anchored to corresponding abutment elements of the luffing jib 145.

[0075] In particular, the movable crosspiece 162 can be anchored to the second prefabricated element 150 of the luffing jib 145 (the second one starting from the connecting element 155, and thus from below), for example by engaging one of the horizontal beams thereof.

[0076] In this way, the first prefabricated element 150 of the luffing jib 145, which is contained within cage 135, can be released from the connecting element 155 (which is directly articulated to cage 135) and from the second prefabricated element 150 (to which the movable crosspiece 162 has been attached), for example by removing the mutual connection bolts.

[0077] At this point, jacks 159 may be actuated so as to slightly raise the second prefabricated element 150 and with it the entire upper portion of the luffing jib 145, which can then be anchored to cage 135.

[0078] In this way, the first prefabricated element 150 is completely free and can be pulled out sideways from cage 135 (see fig. 6), for example with the aid of special carriages provided with a movement in the horizontal direction. Once this first prefabricated element 150 is placed outside and next to cage 135, the same can be attached to pulley 185 that comes down from the end of the luffing jib 145, to be lowered to the ground with the lifting winch 180.

[0079] At this point, jacks 159 may be actuated so as to lower the remaining portion of the luffing jib 145, until the second prefabricated element 150 is brought substantially at the same height previously occupied by the first prefabricated element 150, such as resting on the connecting element 155 (see fig. 7). Once this position has been reached, the luffing jib 145 can be anchored to cage 135, so that the movable crosspiece 162 can be released from the second prefabricated element 150 and, after appropriate extension of jacks 159, be anchored to the fourth prefabricated element 150.

[0080] At this point, the second prefabricated element 150 can be released from the fourth prefabricated element 150 and extracted from cage 135 in the same way as described for the first prefabricated element 150 (see fig. 8).

[0081] The remaining part of the luffing jib 145 is then lowered as shown in figure 9 and the procedure is repeated up to the complete disassembly of the luffing jib 145.

[0082] The assembly of the luffing jib 145 can be carried out with the aid of jacks 159 by simply by reversing the steps described above.

[0083] To facilitate the disassembly/assembly operations, the pivoting structure 125 may be provided with some service platforms 210 attached externally with respect to cage 135 and placed at different heights, each of which is adapted to provide a support surface for the operators in charge of the above activities.

[0084] Crane 100 can finally be completed by a driver cab 215 which can be attached to, for example, the pivoting structure 125, for example at a height between the fifth wheel 130 and the lower counter jib 165.

[0085] While in the embodiment shown, jacks 159 are used both to vary the inclination of the luffing jib 145 and to disassemble it, it is not excluded that in other embodiments, these functions are assigned to different jacks.

[0086] Of course, a man skilled in the art may make several technical application changes to the crane 100 described above, without thereby departing from the scope of the invention as claimed hereinafter.

Claims

1. A tower crane (100) comprising:

- a tower (105),
- a pivoting structure (125) installed at the top of the tower (105),
- a fifth wheel (130) adapted to allow the pivoting structure (125) to rotate around a vertical rotation axis (Y),
- a jib (145) associated with the pivoting structure (125) and adapted to protrude horizontally with respect to the rotation axis (Y), and
- two counter jibs (165, 170) mutually overlapping, both of which are associated with the pivoting structure (125) and protrude horizontally with respect to the rotation axis (Y) on the opposite side with respect to the jib (145).

2. A tower crane (100) according to claim 1, wherein the two counter jibs (165, 170) both have a horizontal extension comprised between 3 and 5 metres from the rotation axis (Y).

3. A tower crane (100) according to any one of the preceding claims, wherein the counter jib (170) has an upper horizontal extension greater than the lower counter jib (165).

4. A tower crane (100) according to any one of the preceding claims, wherein at least one device selected from the group consisting of: a winch (180), a hydraulic group (190) and an electrical panel (195) is installed on one of the counter jibs (165, 170).

5. A tower crane (100) according to claim 4, wherein the winch (180) is installed on the upper counter jib (170).

6. A tower crane (100) according to claim 4 or 5, wherein the hydraulic group (190) is installed on the lower counter jib (165).

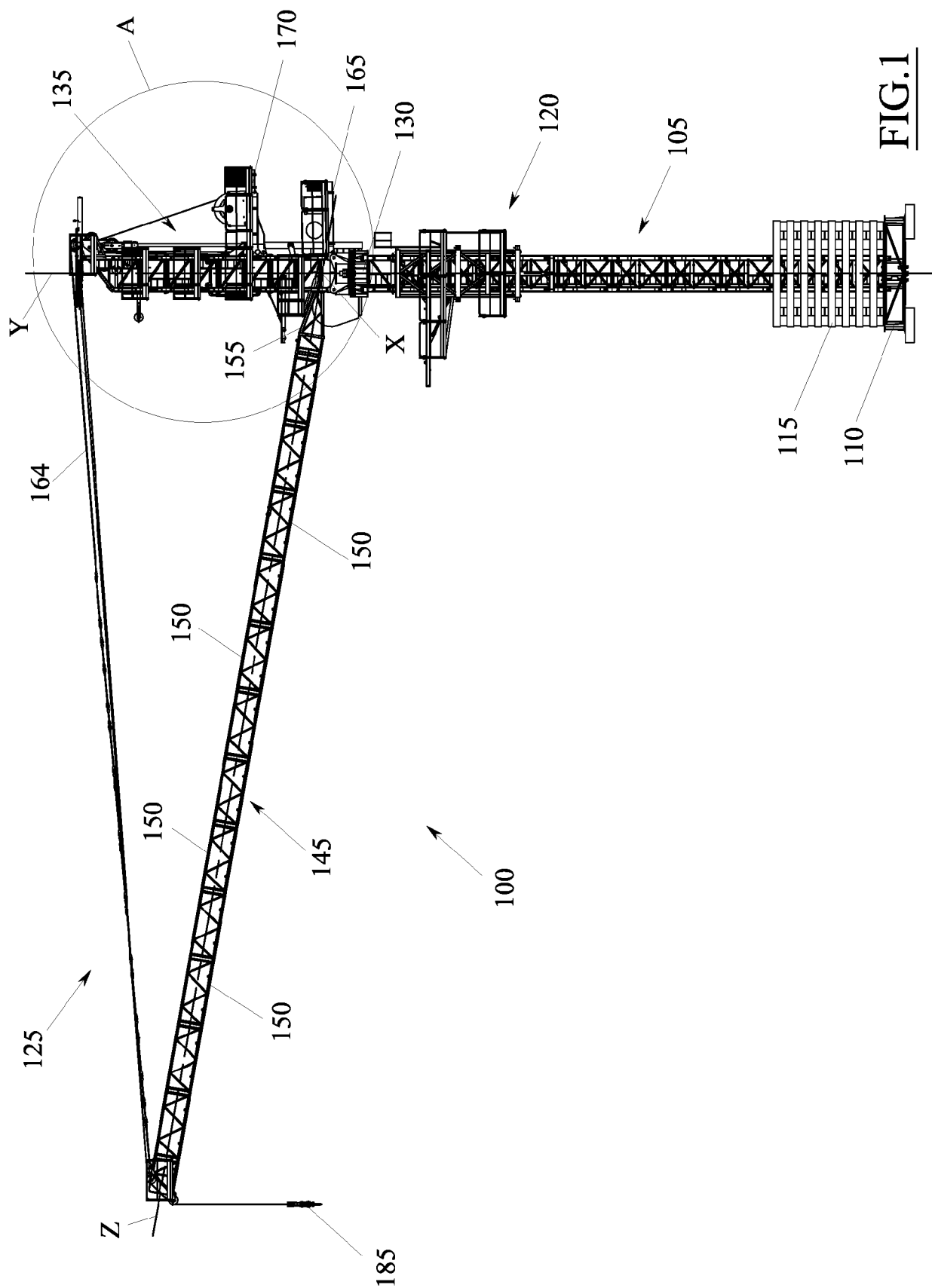
7. A tower crane (100) according to any one of claims

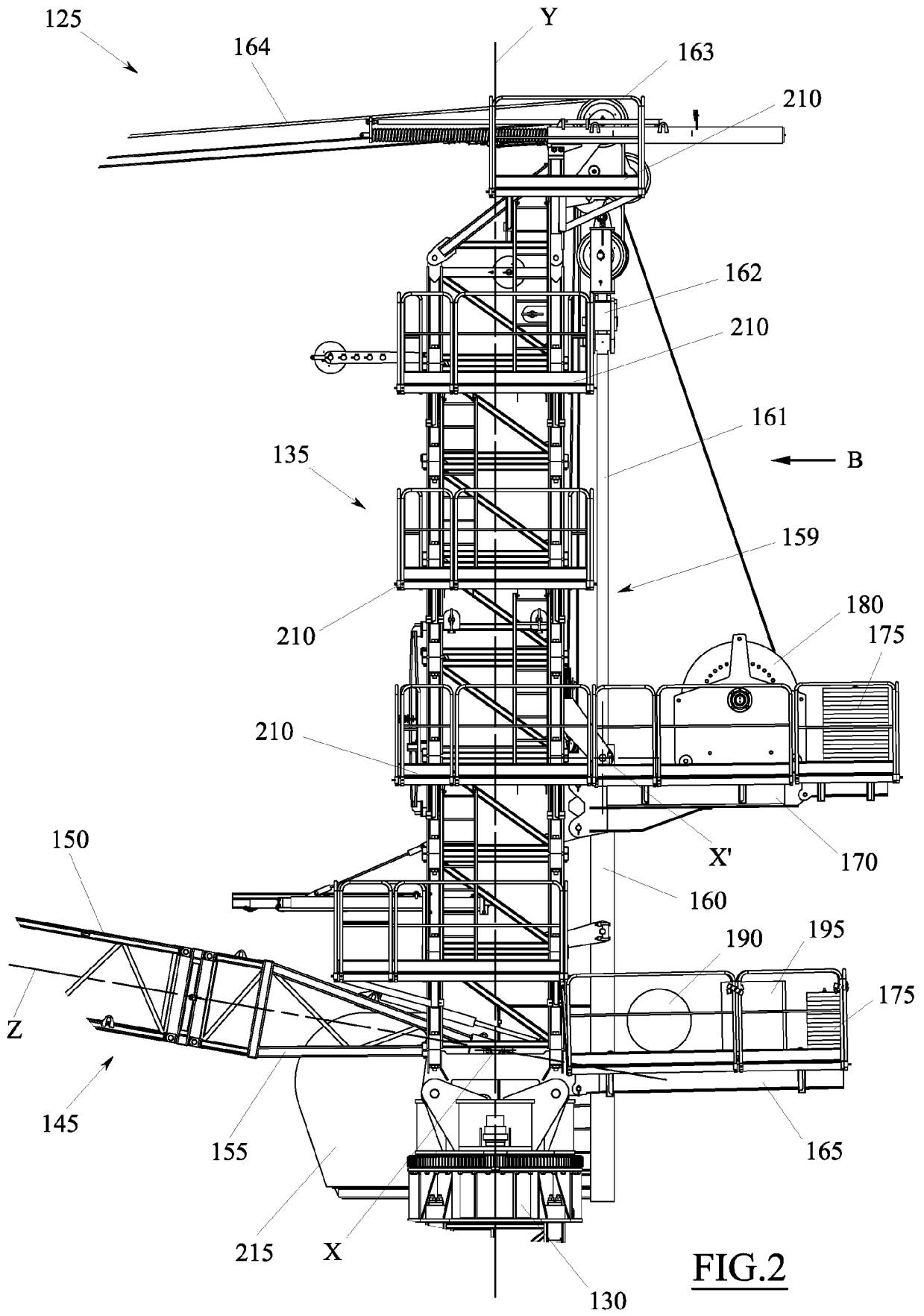
4 to 6, wherein the electrical panel (195) is installed on the lower counter jib (165).

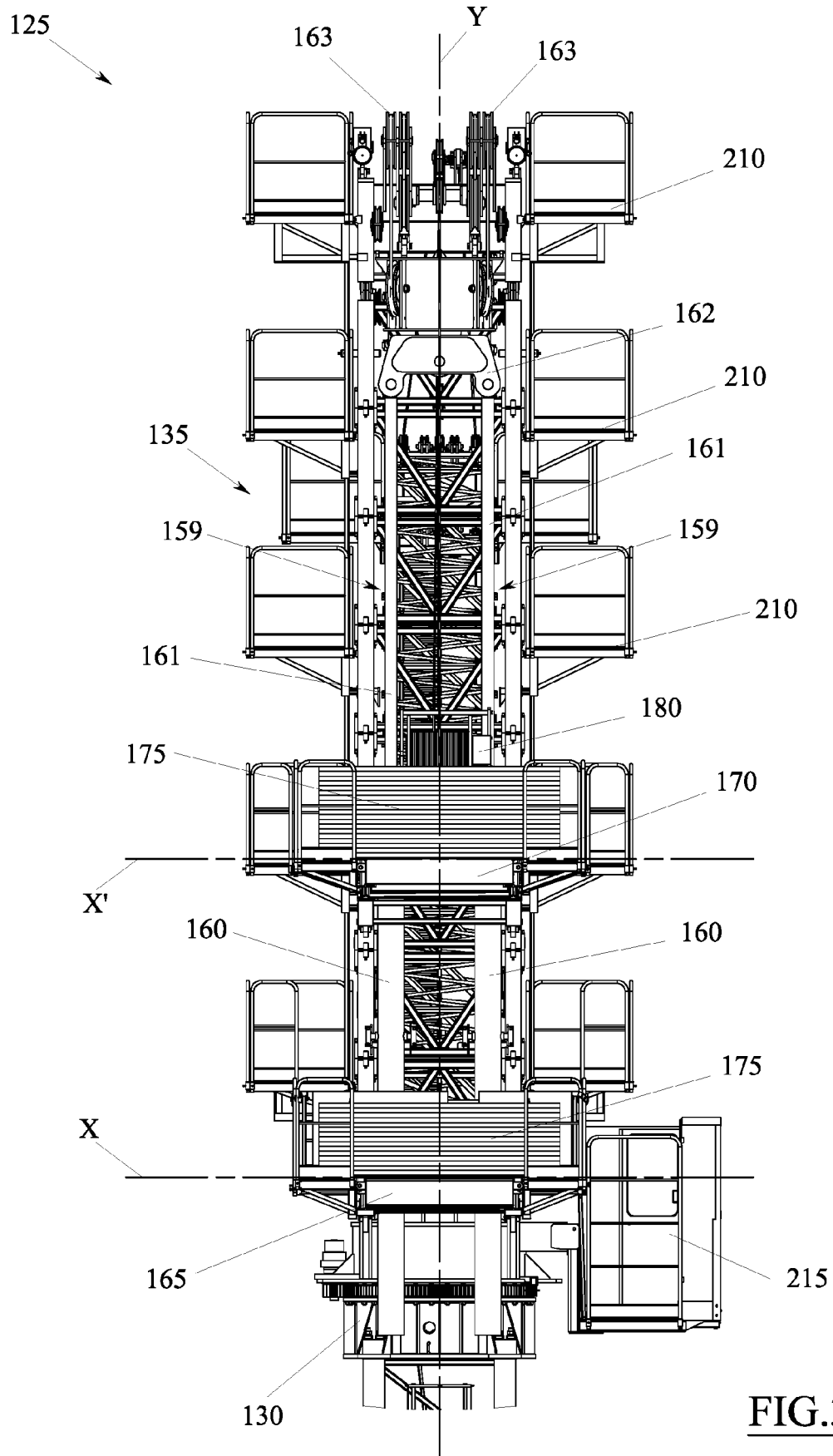
8. A tower crane (100) according to any one of the preceding claims, wherein a respective group of ballasts (175) is installed on each counter jib (165, 170).

9. A tower crane (100) according to any one of the preceding claims, wherein the pivoting structure (125) may comprise a cage (135) extending vertically and the two counter jibs (165, 170) are individually shaped as a platform attached to and cantilevering horizontally from said cage (135).

10. A tower crane (100) according to any one of the preceding claims, wherein the jib (145) is articulated to the pivoting structure (125) according to a horizontal rotation axis (X).







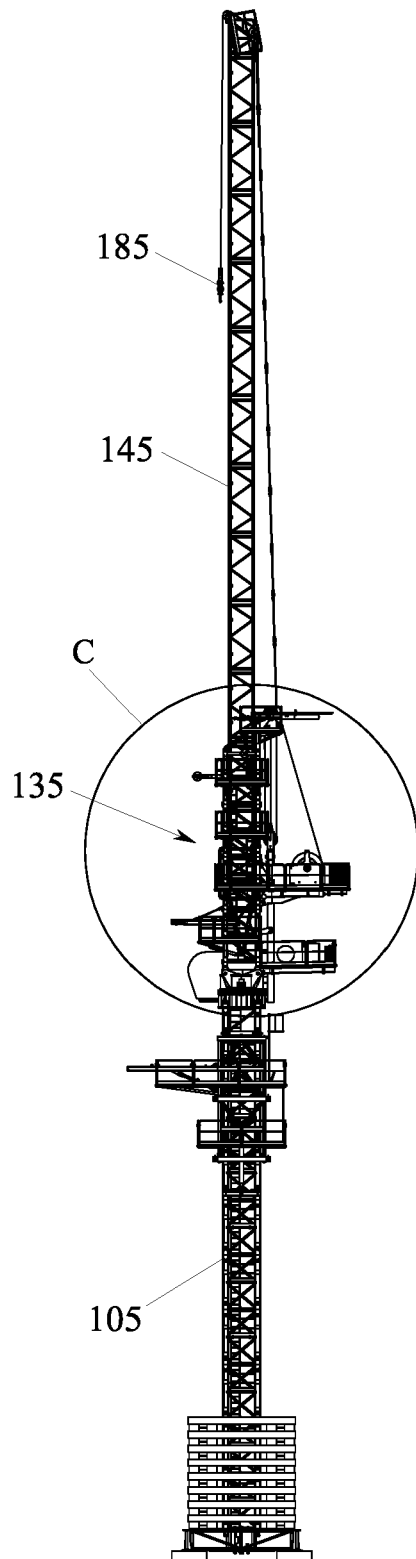


FIG.4

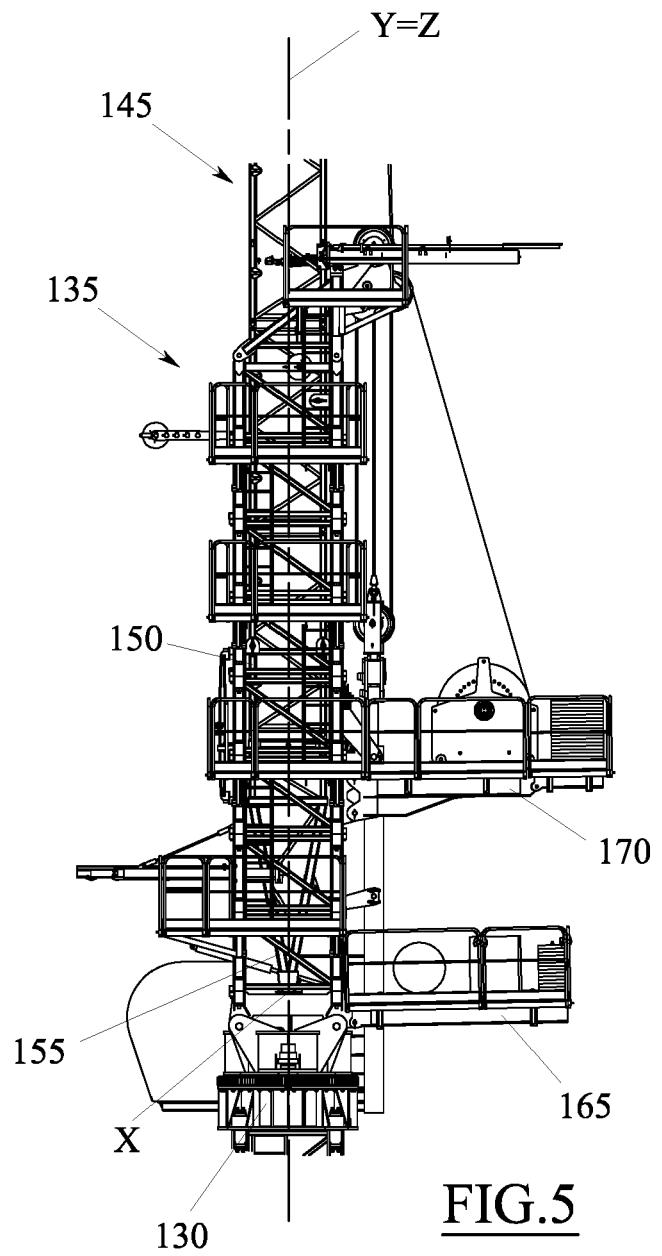


FIG.5

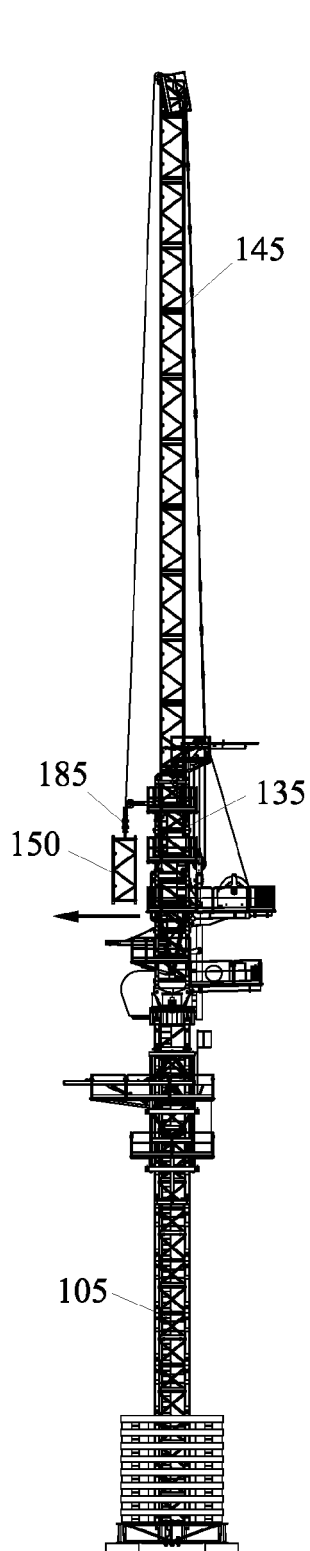


FIG. 6

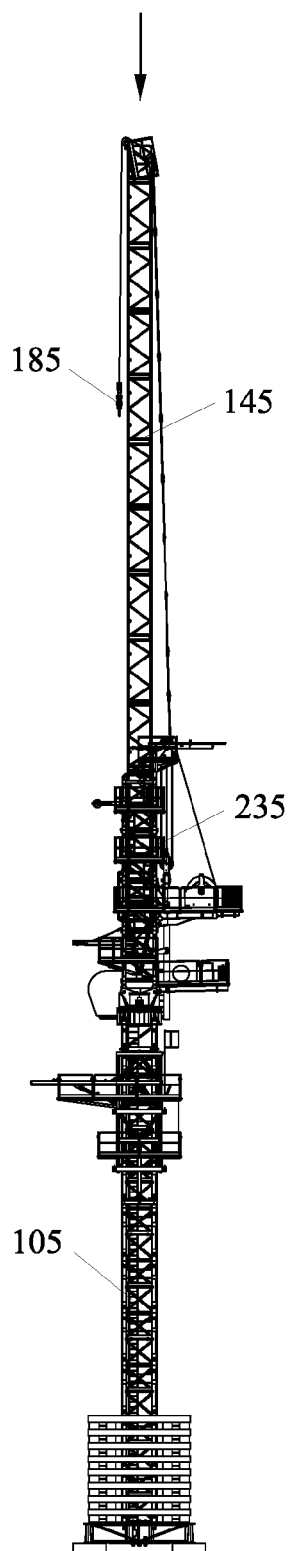


FIG. 7

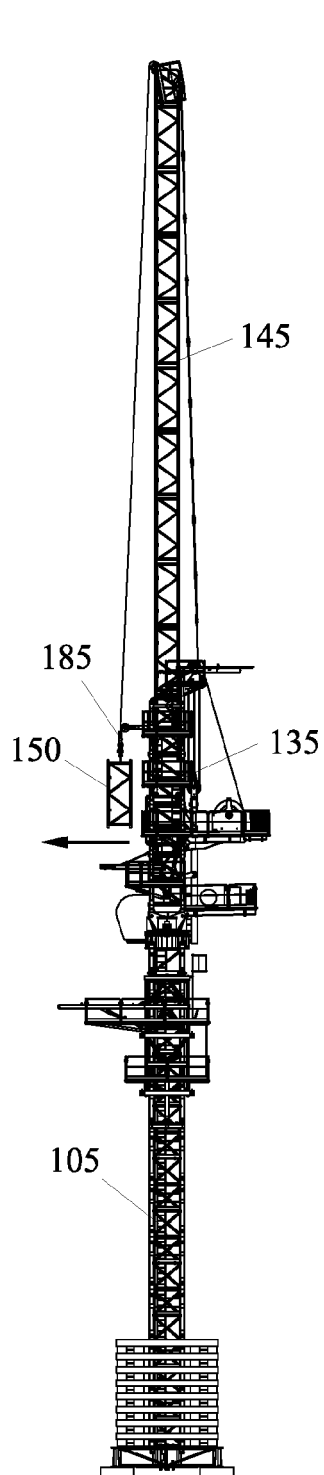


FIG. 8

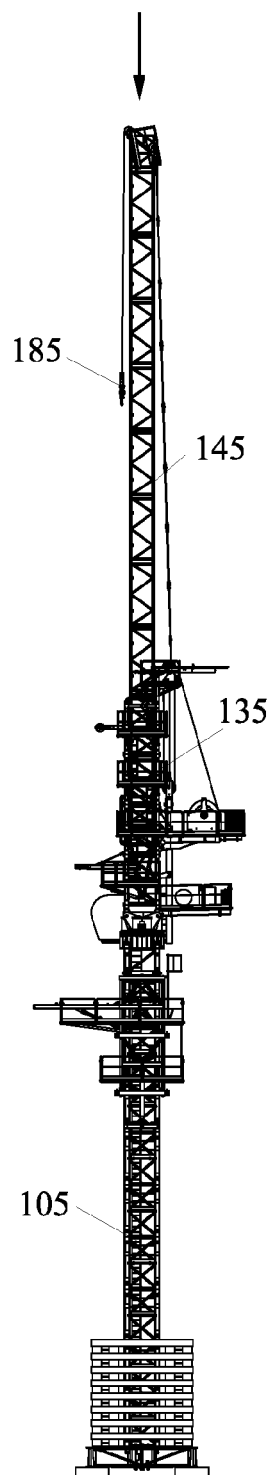


FIG. 9



EUROPEAN SEARCH REPORT

Application Number
EP 18 15 6339

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	JP 2008 150159 A (KOSHIHARA KK) 3 July 2008 (2008-07-03) * figures 1, 2, 7-10 * * see the revolving frame 11 with its winches 18 & 19 * * see the floor/bed 7a with its hydraulic drive unit 29 *	1-10	INV. B66C23/26
Y	DE 10 2015 016279 A1 (LIEBHERR-WERK EHINGEN GMBH [DE]) 23 June 2016 (2016-06-23) * figures 8b, 8c * * paragraph [0072] - paragraph [0074] *	1-10	
A	CN 205 616 473 U (LIN JIE) 5 October 2016 (2016-10-05) * figure 1 * * 6: rotating mechanism * * 13: so-called "lifting heavy" *	1	
A	CN 203 754 314 U (CHINA GEZHOUBA GROUP CO LTD) 6 August 2014 (2014-08-06) * see the upper counter-jib (with the counter-weight) * * see the lower part (with the power supply 5) *	1	TECHNICAL FIELDS SEARCHED (IPC) B66C E04G F03D
A	EP 2 962 978 A1 (DUNNE FURSEY [DE]) 6 January 2016 (2016-01-06) * figures 2-4 *	1	
A	CN 204 057 757 U (WUHU HEJIAN ROADS & BRIDGES MACHINERY CO LTD) 31 December 2014 (2014-12-31) * figure 1 *	1	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 28 June 2018	Examiner Guthmuller, Jacques
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)



EUROPEAN SEARCH REPORT

Application Number
EP 18 15 6339

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	CN 203 159 089 U (SHANDONG ELECTRIC POWER CONSTRUCTION NO 2 CO) 28 August 2013 (2013-08-28) * figures *	1	
A	JP S63 84094 U (-----) 2 June 1988 (1988-06-02) * figures *	1	
A	JP S63 315493 A (KUDAN KENCHIKU KENKYUSHO KK) 23 December 1988 (1988-12-23) * figure 1 *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 28 June 2018	Examiner Guthmuller, Jacques
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 15 6339

5

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

28-06-2018

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2008150159 A	03-07-2008	NONE	
DE 102015016279 A1	23-06-2016	NONE	
CN 205616473 U	05-10-2016	NONE	
CN 203754314 U	06-08-2014	NONE	
EP 2962978 A1	06-01-2016	EP 2962978 A1 WO 2016001212 A1	06-01-2016 07-01-2016
CN 204057757 U	31-12-2014	NONE	
CN 203159089 U	28-08-2013	NONE	
JP S6384094 U	02-06-1988	NONE	
JP S63315493 A	23-12-1988	NONE	

EPO FORM P0459

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