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(54) **CRANE**

(57) The present invention concerns a crane (1) comprising:
- a support tower (2) configured to rest on a rest surface (S) and extending along a height direction (Z-Z);
- an arm (3) extending away from the tower (2) along a main extension direction (X-X) between a first free end (31) and a second end (32) which is articulatedly connected to the tower (2);
- rotation members (4), interposed between the tower (2) and the arm (3), configured to allow the relative rotation of the arm (3) with respect to the tower (2) around the height direction (Z-Z);
- wind-action sensitive elements (5), arranged on the arm (3) between the first and second end (31, 32), configured to deflect air flows and generate on the arm (3) a torsional moment in the height direction (Z-Z) adapted to put the arm (3) in rotation with respect to the tower (2), said wind-action sensitive elements (5) comprising a deflector panel (50) switchable between an extended position in which it is configured to interact with the wind, and a retracted position in which it is insensitive to the action of the wind.

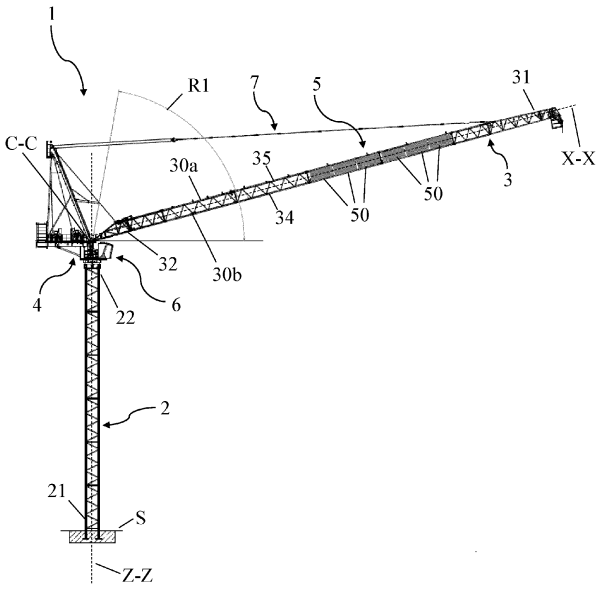

Fig. 1

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Description

Technical Field

[0001] The present invention relates to a crane, according to the preamble of claim 1.

[0002] The present invention finds useful use, albeit not exclusively, for lifting and moving loads, such as materials and/or goods, for example for the construction of buildings.

State of the art

[0003] Rope or piston cranes are known in the state of the art for lifting and moving loads. These cranes comprise a support tower, resting on a rest surface and extending in a height direction, to which an arm is articulatedly connected. In detail, the arm extends away from the upper top of the support tower between a free end and an end pivoted to the tower.

[0004] Such cranes also comprise rotation members, interposed between the tower and the arm, configured to allow the relative rotation of the arm with respect to the tower around the height direction. This relative rotation allows the arm of the crane to sweep a circular area representing the operating region of the crane within which the loads can be handled.

[0005] When the crane is not used for handling loads, whether it is a rope or hydraulic piston crane, it is useful to put it into a parking configuration, that is, by tilting the arm with respect to the rest surface more than in the condition in which the crane is operating. In this way, the footprint of the crane is reduced. Typically, in the condition in which the crane is operating the arm is at an inclination of 10-15° with respect to the rest surface, this inclination is brought to 65-80° in the parking configuration.

[0006] It is known that the aerodynamic action of the wind on the vertical structures is all the greater the farther away from the ground. Therefore, in the presence of strong winds, the arm of the crane, which is located at a height of several tens of metres, is subjected to high mechanical stresses that can cause it to break or be damaged.

[0007] It worth noting that the effect of the wind on the arm of the crane depends on the relative angle between the wind and the main extension direction of the arm (in aerodynamics "angle of incidence"). In particular, the mechanical stresses are all the greater the more the wind impacts orthogonally against the arm of the crane.

[0008] When the crane is in the parking configuration, it is therefore possible to reduce the mechanical stresses induced by the wind on the structure by changing the orientation of the arm, that is, by rotating it around the height direction.

[0009] However, this orientation operation cannot be done a priori, that is, at the time of setting the parking configuration, since the wind has a random nature and it is therefore not possible to predict its direction.

[0010] Cranes are known comprising one or more sails arranged on the arm which, when exposed to the action of the wind, generate an angular moment oriented along the height direction which tends to bring the arm into the configuration of least aerodynamic resistance to the action of the wind (angle of incidence of the wind on the arm null). These sails therefore allow to minimize the mechanical stresses on the structure of the crane when the crane is in the parking configuration.

[0011] Disadvantageously, these sails exert their effects even when the crane is in the operating configuration, negatively impacting the ease and precision of use. In fact, during the use of the crane, the random effect of the wind on the sails introduces unwanted and unpredictable angular moments on the arm that require the crane operator to make continuous compensation corrections.

SUMMARY OF THE INVENTION

[0012] In this context, the technical task underlying the present invention is to propose a crane that overcomes the drawbacks of the above-mentioned prior art.

[0013] In particular, an object of the present invention is to make available a crane capable of minimizing the mechanical stresses generated by the wind in the parking configuration without compromising the practicality of use.

[0014] In other words, an object of the present invention is to make available a crane having a practicality of use, in terms of precision of positioning the arm, comparable to that of the common cranes, and at the same time able to minimize the mechanical stresses induced by the wind when it is in the parking configuration.

Advantages of the invention

[0015] The crane subject-matter of the present invention solves the aforementioned technical problem as it comprises wind-action sensitive elements, arranged on the arm of the crane, configured to deflect the air flows and consequently to orient the arm of the crane along the direction of least aerodynamic resistance to the action of the wind (angle of incidence of the wind on the arm close to zero).

[0016] In particular, the wind-action sensitive elements comprise a deflector panel switchable between an extended position and a retracted position. It worth noting that in the extended configuration, unlike the retracted one, the wind acting on the panel generates a torsional moment on the arm that results in its orientation along the direction of least aerodynamic resistance to the action of the wind, thus minimizing the mechanical stresses generated by the wind.

[0017] Such wind-action sensitive means comprise wrapping elements connected to the panel and configured to wrap and unwrap the panel around a rotation axis so as to switch it between the extended position and the

retracted position. The panel, when it is in the retracted configuration, is wound around the rotation axis.

[0018] The wrapping elements are arranged at an upper rod-like element of the arm of the crane. This means that when the panel is in the retracted configuration it is not substantially exposed to the action of the wind since it is shielded by the upper rod-like element.

[0019] Therefore, advantageously, by placing the panel in the retracted position, it is possible to obtain a practicality of use, in terms of precision of positioning the arm, comparable to that of the common cranes. In fact, in the retracted position the panel, by not substantially opposing the motion of the wind as it is shielded by the upper rod-like element, does not induce any significant angular moment to the arm such as to compromise the dynamic behaviour and positioning precision thereof.

[0020] Furthermore, advantageously, in the parking configuration, by bringing the panel into the extended position it is possible to exploit the action of the wind to orient the arm along the direction of least aerodynamic resistance, thus minimising the mechanical stresses to which the arm is subjected.

[0021] Therefore, the present invention allows to make available a crane having a practicality of use, in terms of precision of positioning the arm, comparable to that of the common cranes, and at the same time able to minimize the mechanical stresses induced by the wind when it is in the parking configuration.

LIST OF FIGURES

[0022] Further features and advantages of the present invention will become more apparent from the following indicative, and hence non-limiting, description of a preferred, but not exclusive, embodiment of a crane as illustrated in the appended drawings, in which:

- Figure 1 shows a side view of a crane according to the present invention;
- Figure 2a shows a side view of a portion of a component of the crane of Figure 1 with the deflector panel of the wind-action sensitive means in the extended position;
- Figure 2b shows a side view of the component of Figure 2a with the deflector panel of the wind-action sensitive means in the retracted position;
- Figure 3 shows a perspective view of a component of the crane of Figure 1 with the deflector panel of the wind-action sensitive means in the retracted position;
- Figure 4 shows a perspective view of the component of Figure 3 with the deflector panel of the wind-action sensitive means in the extended position;
- Figure 5 shows a perspective view of a detail of the crane of Figure 1;
- Figure 6 shows a schematic top view of the crane of figure 1 in a configuration A in which the wind hits the arm transversely and a configuration B in which the arm is oriented along the direction of action of the wind.

DETAILED DESCRIPTION

[0023] With reference to the attached figures, the present invention relates to a crane marked with reference number 1.

[0024] It should be specified that in the context of the present invention, the term "crane" indicates a machine for lifting and moving loads, regardless of the type of implementation which, for example, can be with rope (rope crane) or hydraulic (piston crane).

[0025] The crane 1 comprises a support tower 2 configured to rest on a rest surface S. In detail, the tower 2 extends along a height direction Z-Z between a lower end 21 resting on the rest surface S and an upper end 22 opposite to the lower one 21.

[0026] Preferably, the tower 2 has a lattice structure with prismatic shape, for example, quadrangular or triangular.

[0027] In the embodiment shown in figure 1, the crane 1 comprises a control cabin 6 configured to house an operator and connected to the tower 2 at the upper end 22. In alternative embodiments, the crane 1 is controlled from the ground by means of special control means.

[0028] The crane 1 further comprises an arm 3 configured to carry out load lifting and handling operations. This arm 3 extends away from the tower 2 along a main extension direction X-X between a first free end 31 and a second end 32 which is articulatedly connected to the tower 2.

[0029] The second end 32 of the arm 3 is hinged to the tower 2 at the upper end 22 to rotate around a hinging axis C-C oriented orthogonally to the height direction Z-Z and to the main extension direction X-X of the arm 3.

[0030] With reference to the rotation of the arm 3 around the hinging axis C-C, marked in figure 1 as R1, the crane 1 is switchable between an operating configuration in which the arm 3 has an inclination of 10-15° with respect to the rest surface, and a parking configuration in which the arm is more inclined than in the condition of operating crane. Typically, in the parking configuration the arm 3 defines an angle comprised between 65° and 80° with the rest surface S.

[0031] It worth noting that, in the context of the present description, "operating condition" means that the arm 3 is arranged in such a way that the crane can perform its function of lifting and moving loads. Conversely, "parking condition" means a condition in which the crane is not operational and configured to have a smaller footprint on the rest surface S (projection of the footprint of the crane 1 on the rest surface S).

[0032] With reference to figure 1, the arm 3 comprises an upper rod-like element 30a and at least one lower rod-like element 30b which extend parallel to the main extension direction X-X of the arm 3. Referring to figure 1, the arm 3 comprises a lattice 30, with prismatic shape,

preferably quadrangular or triangular, and having a pair of side faces 33 extending along the height direction Z-Z between an upper edge 35 and a lower edge 34.

[0033] Preferably, the lattice 30 comprises the upper rod-like element 30a and the lower rod-like element 30b.

[0034] Furthermore, preferably, the upper rod-like element 30a and the lower rod-like element 30b respectively define the upper edge 35 and the lower edge 34.

[0035] The crane 1 further comprises rotation members 4 configured to allow the relative rotation of the arm 3 with respect to the tower 2 around the height direction Z-Z. This relative rotation allows the arm of the crane to sweep a circular air representing the operating region of the crane 1, i.e. the spatial region within which the crane is configured to carry out load handling.

[0036] The relative rotation of the arm 3 with respect to the tower 2 around the height direction Z-Z is schematically represented by the arrow marked as R2 in figure 6.

[0037] The rotation members 4 are interposed between the arm 3 and the tower 2.

[0038] According to one aspect, the rotation members 4 comprise a bearing (not shown in the figures), connected to the tower 2 and to the arm 3, configured to allow the relative rotation of the arm 3 with respect to the tower 2 around the height direction Z-Z.

[0039] The rotation members 4 will not be further described as they are known in the art of the machines for lifting and moving loads.

[0040] With reference to figure 1 and in particular to figures 3 and 4, the crane 1 comprises wind-action sensitive elements 5, i.e. elements configured to deflect the air flows V by opposing their motion.

[0041] In particular, with reference to figure 6, the wind-action sensitive means 5 are configured to interact with air flows V and generate on the arm 3 a torsional moment, oriented along the height direction Z-Z, adapted to put the arm 3 itself in rotation with respect to the tower 2.

[0042] The wind-action sensitive elements are arranged on the arm 3 between the first and second end 31, 32. In particular, the wind-action sensitive elements 5 are spaced from the tower 3 along the main extension direction X-X of the arm 3.

[0043] With reference to figure 2a and 4, the wind-action sensitive elements 5 comprise a deflector panel 50 exposable to the action of the wind so as to generate the aforementioned torsional moment responsible for the rotation of the arm.

[0044] According to a characteristic aspect of the present invention, the panel 50 is switchable between an extended position in which it is configured to interact with the air flows V of the wind, and a retracted position in which it is not sensitive to the action of the wind.

[0045] According to one aspect, in the extended configuration illustrated in Figures 2a and 4, the panel 50 extends both along a first direction D1-D1 parallel to the main extension direction X-X of the arm 3 and along a second direction D2-D2 orthogonal to the main extension direction X-X of the arm 3.

[0046] Therefore, in the extended configuration the panel 50 realizes a thrust surface on which the air flows of the wind strike generating a pressure profile. It is known that a pressure profile on a surface results in an aerodynamic force, which, in the case of the crane 1 subject-matter of the description, will discharge on the arm 3 causing it to rotate with respect to the tower 2.

[0047] It should be specified that the aerodynamic force can be decomposed into a first and a second component oriented respectively orthogonally and parallel to the main extension direction X-X of the arm 3. Only the first component of the aerodynamic force (orthogonal component) is responsible for the rotation of the arm 3 around the height direction Z-Z, since, unlike the second component (parallel component) it has a non-null force arm with respect to the height direction Z-Z.

[0048] It worth noting that the first component of the aerodynamic force, which is known to depend on the angle of incidence with which the flow impacts against the panel 50, will be maximum when the panel 50 is arranged orthogonally to the direction of the air flow V (figure 6 position A) and null when the panel 50 is oriented parallel to the direction of the air flow V (figure 6 position B).

[0049] Therefore, when the main extension direction X-X of the arm 3 is oriented transversely to the direction of the air flow V, an aerodynamic force will be generated on the panel 50 that will tend to orient the main extension direction X-X of the arm 3 along the direction of the air flow V.

[0050] In other words, with reference to figure 6, the crane 1 in position A will tend, as a result of the action of the wind, to spontaneously move into the configuration B through a rotation R2 around the height direction Z-Z.

[0051] Advantageously, when the crane 1 is in the parking configuration and the panel 50 in the extended position, the wind-action sensitive means 5 allow to orient the arm 3 parallel to the direction of the air flows V, thus minimizing the mechanical stresses induced in the structure of the crane 1 by the action of the wind.

[0052] Conversely, in the retracted position the panel 50 has a smaller footprint than in the extended position along the first or second direction D1-D1, D2-D2.

[0053] Preferably, with reference to figures 2b and 3, in the retracted position the panel 50 has a negligible extension along the first or second direction D1-D1, D2-D2 with respect to the extended position.

[0054] In particular, preferably, in the retracted position the panel 50 has an almost null extension along the first or second direction D 1-D 1, D2-D2.

[0055] It worth noting that in the retracted position the panel 50 has a rectilinear extension oriented along the first or second direction D1-D1, D2-D2, therefore it does not realize a thrust surface on which the air flows of the wind can strike to generate the aforementioned aerodynamic force.

[0056] The panel 50 in the retracted position is therefore not sensitive to the action of the wind, in particular

it does not generate the aforementioned torsional moment adapted to change the orientation of the arm 3 around the height direction.

[0057] Advantageously, the crane 1 subject-matter of the present invention, when used with the panel 50 in the retracted position, allows to obtain a practicality of use, in terms of precision of positioning the arm 3, comparable to that of the common cranes.

[0058] The wind-action sensitive means 5 comprise wrapping elements 51 configured to switch the panel 50 between the extended and retracted position by winding or unwinding (wrapping or unwrapping) it around a rotation axis R-R.

[0059] Preferably, the wind-action sensitive means 5 are directly connected to the panel 50 along a perimeter edge thereof.

[0060] In the retracted position the panel 50 is then wound on itself around the rotation axis R-R, conversely in the extended position the panel 50 is at least partially deployed.

[0061] In the embodiment shown in figure 5, the rotation axis R-R is oriented parallel to the main extension direction X-X of the arm 3, and hence to the first direction D1-D1. However, in alternative embodiments, the rotation axis R-R is arranged transversely to the main extension direction X-X of the arm 3, for example, oriented parallel to the second direction D2-D2.

[0062] According to one aspect, the wrapping elements 51 comprise a rod-like body (not depicted in the figures) extending along the rotation axis R-R and connected to the panel 50. In particular, the rod-like body is connected to the panel 50 along a perimeter edge thereof around which the aforementioned winding and unwinding operations take place.

[0063] According to a possible embodiment, the rod-like body is a shaft rotatable around the rotation axis R-R.

[0064] The wrapping elements 51, preferably, further comprise motorization means 52 configured to put in rotation the rod-like body around the rotation axis R-R and to switch the panel 50 between the extended and retracted position. Preferably, the motorization means comprise an electric motor kinematically connected with the rod-like body to put it in rotation around the rotation axis R-R.

[0065] In detail, the motorization means 52 are configured to put the rod-like body in rotation around the rotation axis R-R in a first rotation direction so as to switch the panel 50 from the retracted to the extended position, and in a second rotation direction, opposite to the first one, so as to switch the panel 50 from the extended to the retracted position.

[0066] According to one aspect, the crane 1 comprises an electronic control unit (not depicted in the figures) placed in signal communication with the motorization means 52 so as to switch the panel between the extended and retracted position.

[0067] Preferably, the electronic control unit is configured to place the panel 50 when the crane 1 is in the parking configuration, and in the retracted position when the crane is in the configuration of use.

[0068] With reference to Figures 1 and 2a, the wind-action sensitive means 5 comprise a plurality of panels 50 arranged in succession along the main extension direction X-X of the arm 3.

[0069] Preferably, the panels 50 of said plurality, when they are in the extended position, extend without interruption along the main extension direction X-X of the arm 3 for a section of a certain length L, designed in minimum number to ensure the correctness of the crane to the wind.

[0070] The panels 50 of said plurality, when they are in the extended position, therefore realize a single wall exposed to the action of the wind to orient the arm 3 of the crane 1 along the direction of least aerodynamic resistance to the action of the wind.

[0071] It worth noting that, for realization reasons, the panels 50 of said plurality may need to be spaced apart along the main extension direction X-X of the arm 3, for example due to an anchoring frame 53 described below. However, it should be specified that the spacing of the panels 50 is negligible with respect to their development in the main extension direction X-X of the arm 3, therefore it can be said that the panels 50, when they are in the extended position, extend seamlessly in accordance with what is stated above.

[0072] With reference to Figures 3-5, the wind-action sensitive elements 5 comprise a frame 53 constrained to the arm 3 and associated with the panel 50. In detail, the frame 53 comprises a framing element 53a, preferably of quadrangular shape, adapted to contour the panel 50 in the extended position.

[0073] Preferably, when the panel 50 is in the retracted position it is arranged at a section of the perimeter edge of the framing element 53a so as to leave the central portion free. Advantageously, this allows the effects of the wind on the wind-action sensitive elements to be minimised when the panel 50 is in the retracted position.

[0074] It should be specified that the frame 53 comprises anchoring means 55 configured to fix the panel 50 to the arm 3 of the crane 1.

[0075] Preferably, the framing element 53a of the frame extends between the upper rod-like element 30a and the lower rod-like element 30b of the arm 3.

[0076] According to one aspect, the frame 53 comprises at least one guide 54 configured to lead the panel 50 while switching between the extended position and the retracted position. This guide 54 extends parallel to a switching direction L-L of the panel 50 between the extended and retracted position. Preferably, said switching direction L-L is orthogonal to the direction identified by the rotation axis R-R around which the aforementioned winding and unwinding operations of the panel 50 take place.

[0077] In the embodiment of figure 3, the frame 53 comprises first guides 54a arranged on the framing element 53a of the frame 53, in particular on sides oriented transversely to the direction identified by the rotation axis R-

R. These first guides 54a are configured to guide peripheral portions of the panel 50 while switching between the extended and retracted position.

[0078] Furthermore, again in the embodiment of figure 3, the frame 53 comprises second guides 54b arranged internally to the framing element 53a and configured to guide central portions of the panel 50 while switching between the extended and retracted position.

[0079] With reference to the embodiment of figure 5, the frame 53 is fixed to one of the aforementioned side faces 33 of the lattice 30 of the arm 3.

[0080] In particular, preferably, the panel 50 in the extended position extends between the upper edge 35 and the lower edge 34 in one of the side faces 33 of the lattice 30. In other words, the panel 50, when it is in the extended position, lies in one of the side faces 33 of the lattice 30 which constitutes at least part of the arm 3.

[0081] Preferably, as shown in Figure 3, the framing element 53a extends mainly in a plane P which is arranged in one of the side faces 33 of the lattice 30.

[0082] In alternative embodiments, the plane P could be interposed between the side faces 33 of the lattice 30.

[0083] Clearly, in order to satisfy contingent and specific needs, a person skilled in the art may make numerous modifications and variants to the configurations described above. Such variations and modifications are all also contained within the scope of the invention, as defined by the following claims.

Claims

1. Crane (1) comprising:

- a support tower (2) configured to rest on a rest surface (S) and extending along a height direction (Z-Z);
- an arm (3) extending away from the tower (2) along a main extension direction (X-X) between a first free end (31) and a second end (32) which is articulatedly connected to the tower (2), the arm 3 comprising an upper rod-like element (30a) extending parallel to the main extension direction (X-X),
- rotation members (4), interposed between the tower (2) and the arm (3), configured to allow the relative rotation of the arm (3) with respect to the tower (2) around the height direction (Z-Z);
- wind-action sensitive elements (5) arranged on the arm (3) between the first and second end (31, 32), said wind-action sensitive elements (5) being configured to deflect air flows and generate on the arm (3) a torsional moment in the height direction (Z-Z) adapted to put the arm (3) in rotation with respect to the tower (2), said wind-action sensitive elements (5) comprising a deflector panel (50) switchable between an extended position in which it is configured to interact with the wind, and a retracted position in which it is insensitive to the action of the wind

characterized in that the wind-action sensitive means (5) comprise:

- wrapping elements (51) connected to the panel (50) and configured to wrap and unwrap the panel (50) around a rotation axis (R-R) so as to switch it between the extended position and the retracted position, in the retracted position the panel (50) being wound around the rotation axis (R-R), said wrapping elements (51) being arranged at the upper rod-like element (30a); and
- a frame (53) constrained to the arm (3) and associated with the panel (50), said frame (53) comprising a framing element (53a) adapted to contour the panel (50) in an extended position.

2. Crane (1) according to claim 1, wherein the rotation axis (R-R) is oriented parallel to the main extension direction (X-X) of the arm (3).

3. Crane (1) according to claim 1 or 2, wherein the wrapping elements (51) comprise:

- a rod-like body connected to a perimeter edge of the panel (50) and extending along the rotation axis (R-R);
- motorization means (52) configured to put in rotation the rod-like body around the rotation axis (R-R) so as to switch the panel (50) between the extended position and the retracted position.

4. Crane (1) according to any one of the preceding claims, wherein:

- the arm (3) comprises at least one lower rod-like element (30b) opposite to the upper rod-like element (30a),
- the framing element (53a) of the frame extends between the upper rod-like element (30a) and the lower rod-like element (30a).

5. Crane (1) according to any one of the preceding claims, wherein the frame (53) comprises at least one guide (54) configured to guide the panel (50) while switching between the extended position and the retracted position.

6. Crane (1) according to any one of the preceding claims, wherein the frame (53) comprises:

- first guides (54a) arranged on the framing element (53a) of the frame (53) configured to guide peripheral portions of the panel (50) while switching between the extended and retracted position,

- second guides (54b) arranged internally to the framing element (53a) and configured to guide respective central portions of the panel (50) while switching between the extended and retracted position.

7. Crane (1) according to any one of the preceding claims, wherein:

- in the extended position the panel (50) extends along a first direction (D1-D1) parallel to the main extension direction (X-X) of the arm (3), and a second direction (D2-D2) orthogonal to the main extension direction (X-X) of the arm (3);
- in the retracted position the panel (50) has a smaller footprint than in the extended position along said first direction (D1-D1) or second direction (D2-D2)

8. Crane (1) according to any one of the preceding claims, wherein in the retracted position the panel (50) has a negligible extension along the first or second direction (D1-D1, D2-D2) with respect to the extended position.

9. Crane (1) according to any one of the preceding claims, wherein the wind-action sensitive means (5) comprise a plurality of panels (50) arranged in succession along the main extension direction (X-X) of the arm (3).

10. Crane (1) according to claim 9, wherein said plurality of panels (50), when they are in the extended position, extend without interruption along the main extension direction (X-X) of the arm (3) for a section of the arm of a certain length (L).

11. Crane (1) according to any one of the preceding claims, wherein:

- the arm (3) comprises a prismatically shaped lattice (30) having a pair of side faces (33) extending along the height direction (Z-Z) between an upper edge (35) and a lower edge (34);
- the panel (50) in the extended position extends between the upper edge (35) and the lower edge (34) in one of said side faces (33) of the lattice (30).

12. Crane (1) according to claim 11, wherein the framing element (53a) extends mainly in a panel (P), is arranged in one of said side faces (33) of the lattice (30).

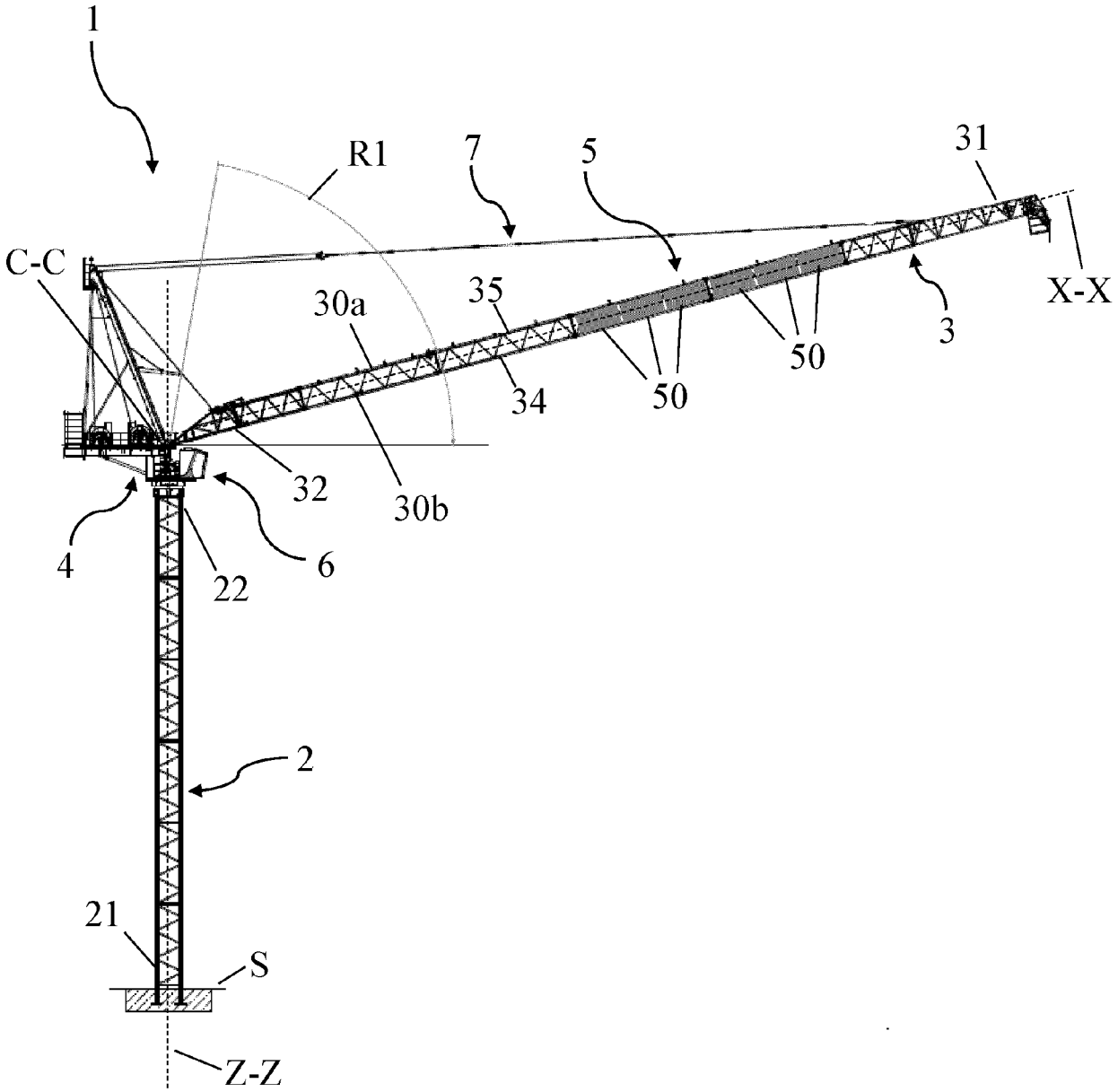

Fig. 1

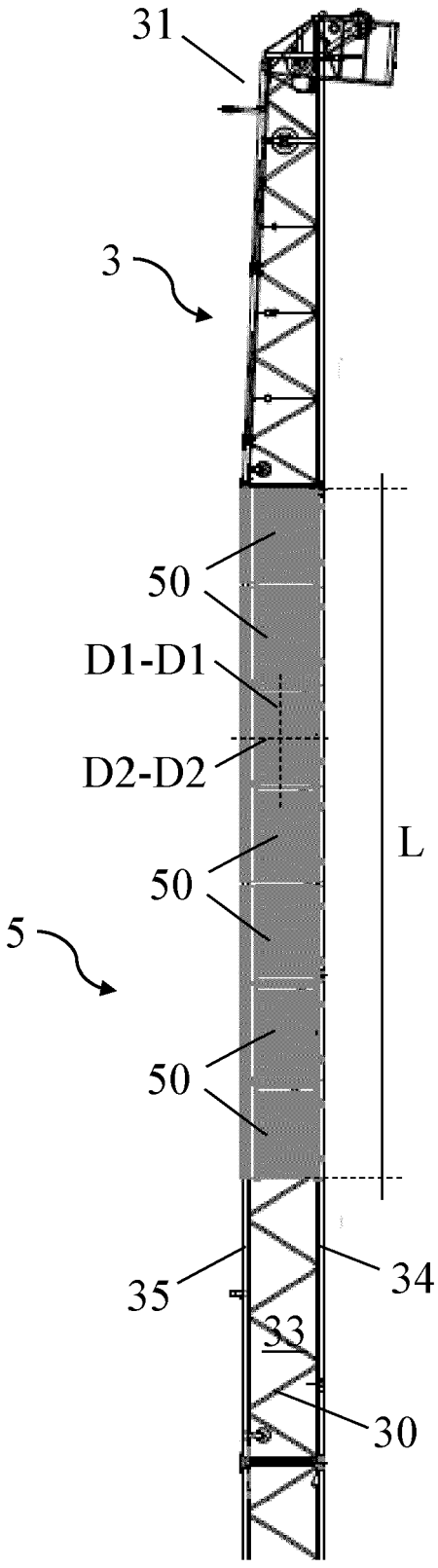

Fig. 2a

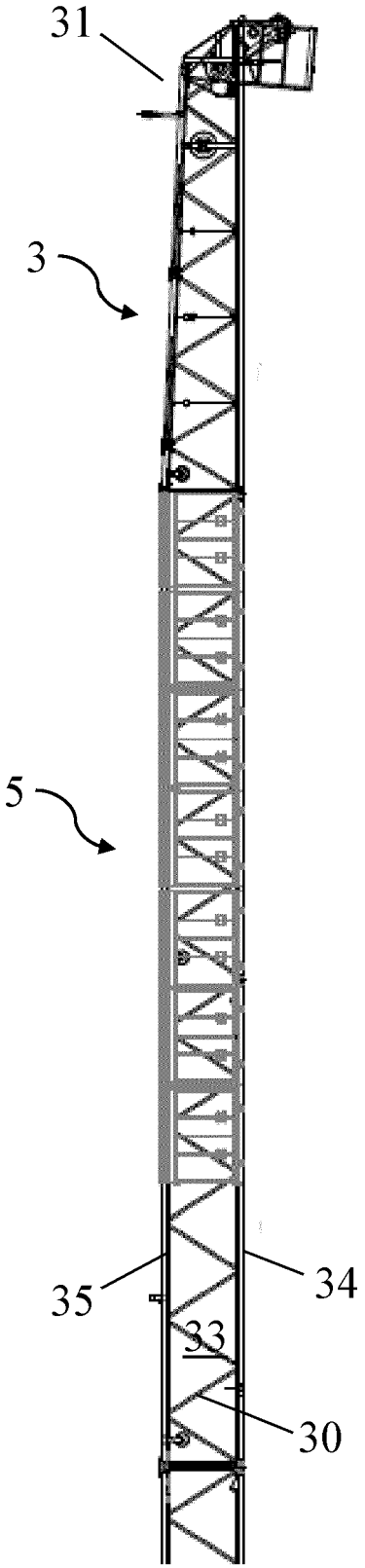

Fig. 2b

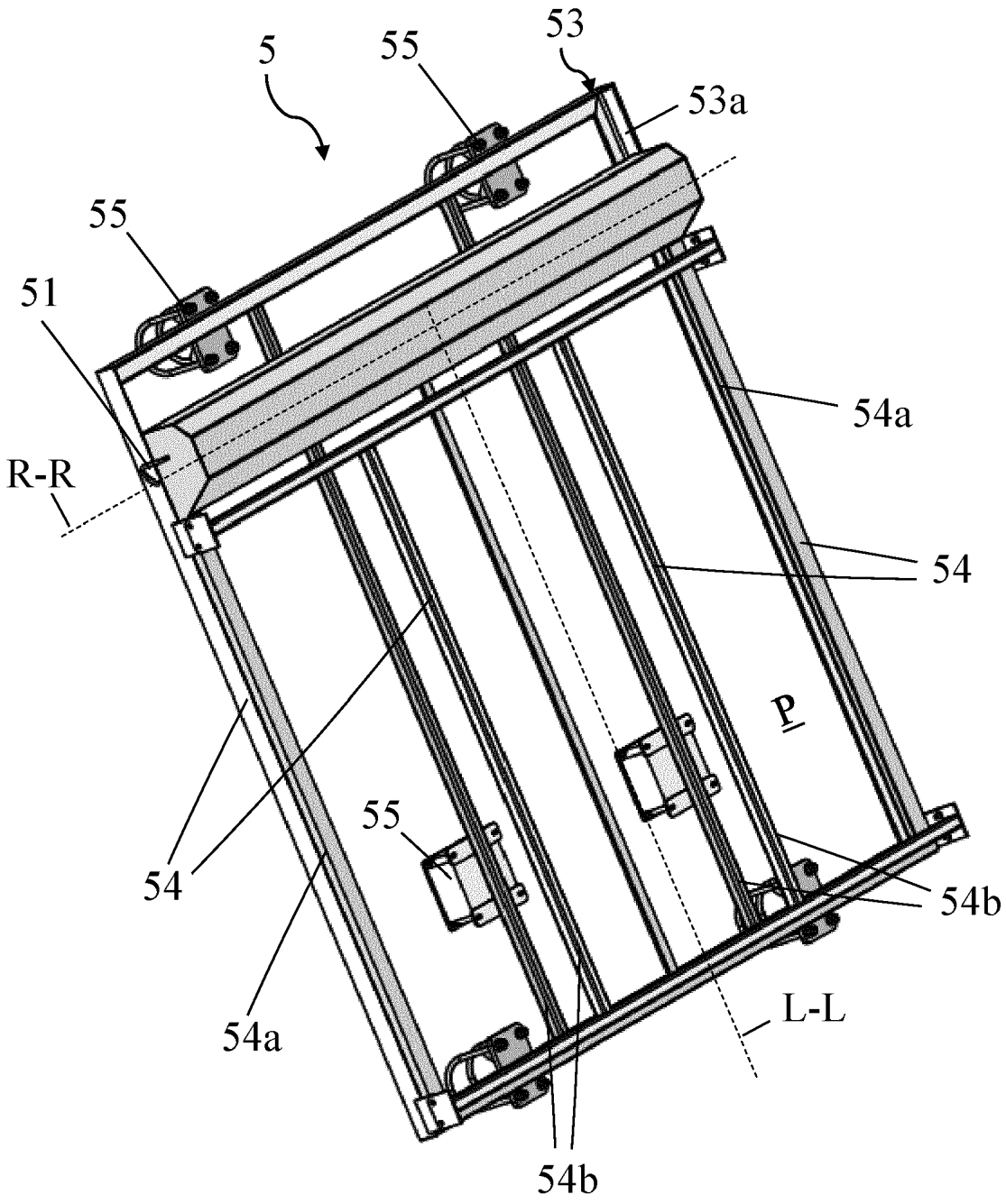

Fig. 3

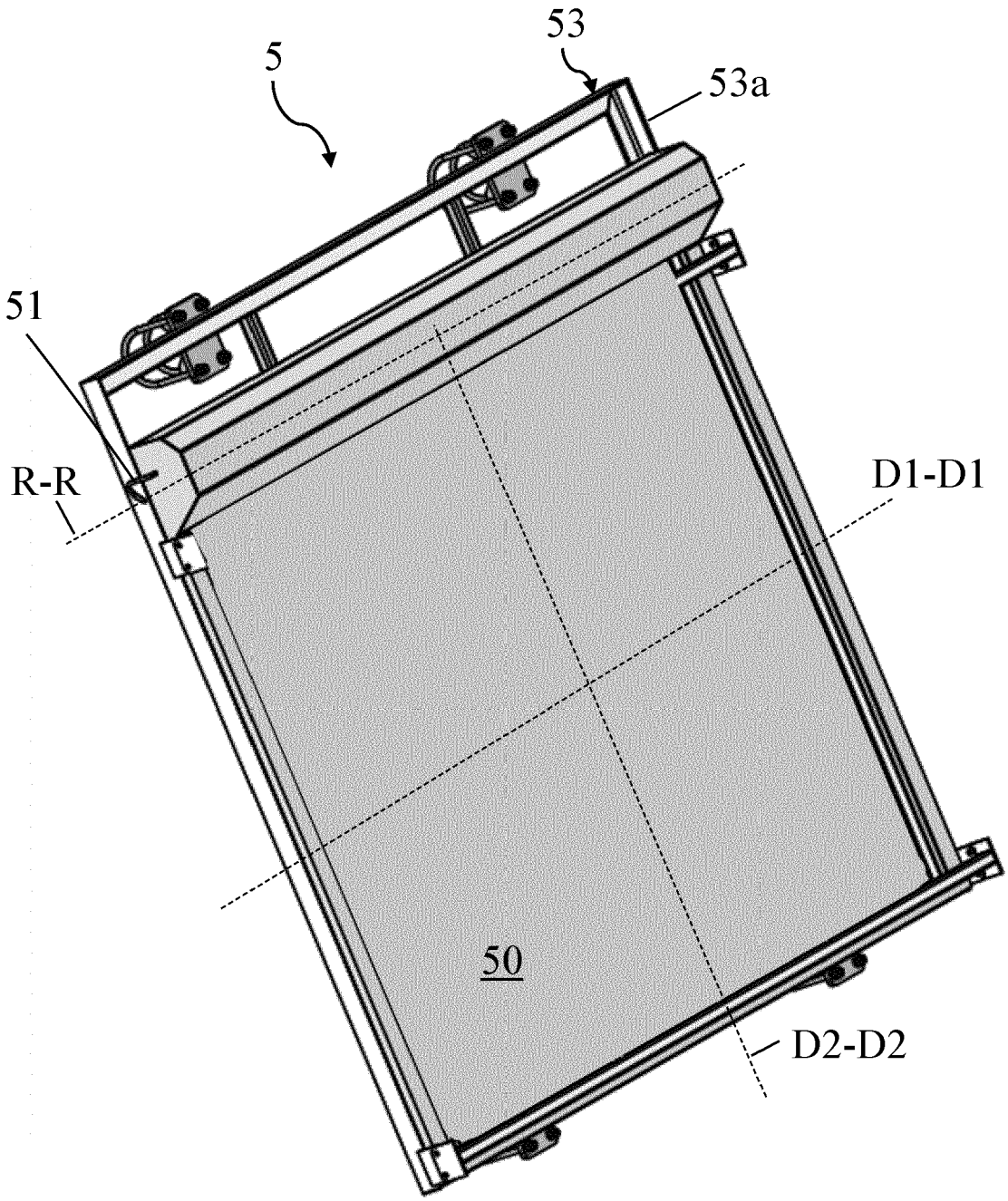

Fig. 4

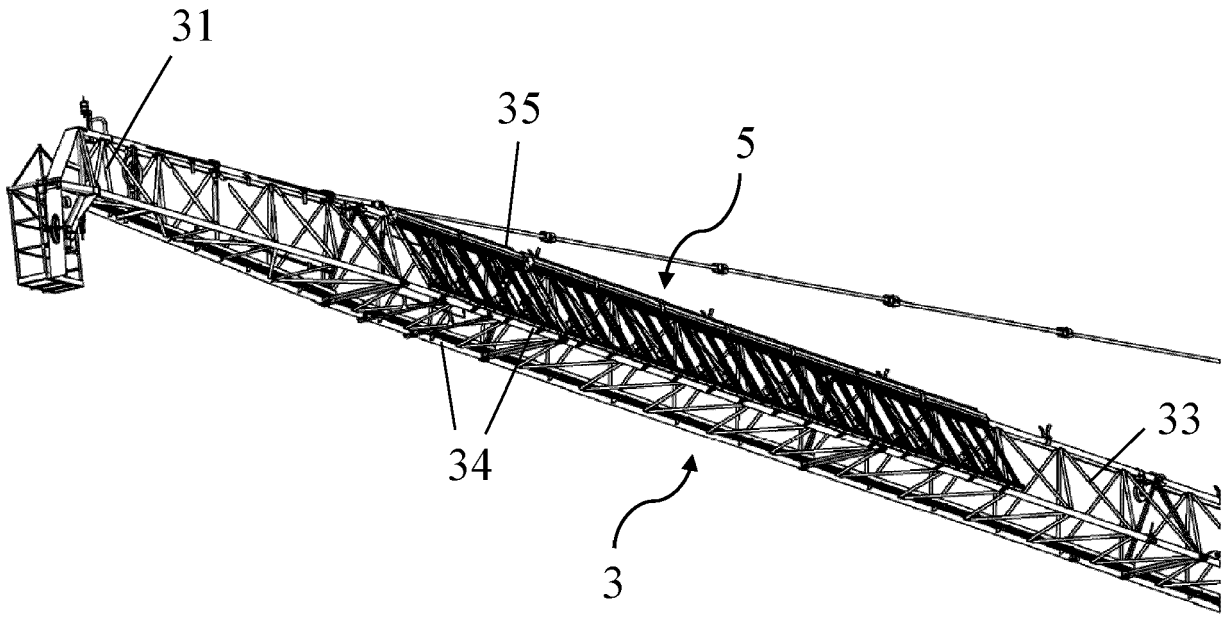

Fig. 5

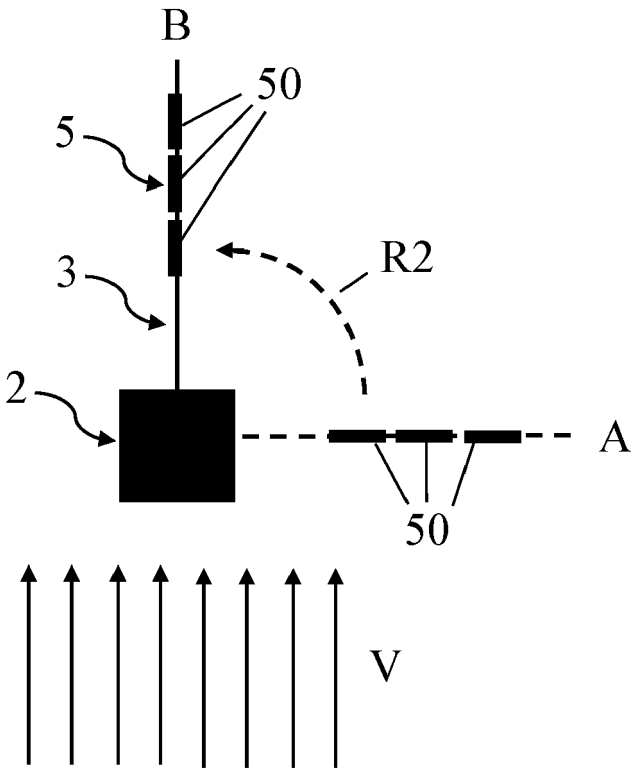

Fig. 6

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EUROPEAN SEARCH REPORT

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	1 March 2024	Serafeim, Athanasios

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