

(19)



(11)

EP 3 339 237 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
22.07.2020 Bulletin 2020/30

(51) Int Cl.:
B66C 23/68 (2006.01)

(21) Application number: **16205464.7**

(22) Date of filing: **20.12.2016**

(54) **HYDRAULIC CRANE**

HYDRAULIKKRAN

GRUE HYDRAULIQUE

(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**

(43) Date of publication of application:
27.06.2018 Bulletin 2018/26

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Description

FIELD OF THE INVENTION AND PRIOR ART

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

[0002] A hydraulic crane, for instance in the form of a lorry crane or forestry crane, often comprises a column, which is rotatable about a vertical axis of rotation, and a crane boom system, which is mounted to the column and which is intended to carry a load in a load suspension point at an outer end of the crane boom system, wherein the crane boom system comprises two or more liftable and lowerable crane booms which form a connection between the load suspension point and the column and which are articulately connected to each other.

[0003] In this description and the subsequent claims, the expression "liftable and lowerable crane boom" refers to a crane boom which can be pivoted in a vertical plane so as to thereby perform liftings and lowerings of a load carried by the crane. The expression "hydraulic cylinder for lifting and lowering the crane boom" here refers to the hydraulic cylinder which is associated with the liftable and lowerable crane boom and which carries out the pivoting thereof in a vertical plane.

[0004] The hydraulic crane according to the present invention is a so-called Z-type crane, where inner and outer booms of the crane are foldable into a compact Z-shaped parking position close to the column of the crane when the crane is to be transported or stored. A Z-type crane according to the preamble of claim 1 is previously known from EP 1 475 345 A1 and US 4 183 712 A. A further prior art document WO 2018/080403 A1, which is prior art according to Article 54(3) EPC, discloses the features of the preamble of claim 1 and additionally the further features of a link system comprising a first pair of link elements and a second pair of link elements arranged in parallel with each other on opposite sides of the first and second crane booms at said crane boom joint; that each pair of link elements comprises a first link element, which at one end is articulately connected to the first crane boom so as to be pivotable in relation to the first crane boom about an essentially horizontal third axis of rotation, and a second link element, which at one end is articulately connected to the second crane boom so as to be pivotable in relation to the second crane boom about an essentially horizontal fourth axis of rotation, wherein the first and second link elements in each pair are articulately connected to each other so as to be pivotable in relation to each other about an essentially horizontal fifth axis of rotation; that the second hydraulic cylinder at its outer end is articulately connected to the first pair of link elements; and that the link elements of the link system are configured to mechanically guide the cross bar element in an arcuate path about said crane boom joint when the second crane boom is pivoted in relation to the first crane boom, so as to make the cross bar element assume a position below the crane boom joint when the first and

second crane booms are in an extended working position and a position above the crane boom joint when the first and second crane booms are in the parking position.

5 SUMMARY OF THE INVENTION

[0005] The object of the present invention is to achieve a further development of a hydraulic crane of the above-mentioned type so as to provide a hydraulic crane that is improved in at least some aspect.

[0006] According to the invention, this object is achieved by means of a hydraulic crane having the features defined in claim 1.

[0007] The hydraulic crane of the present invention comprises:

- a column;
- a liftable and lowerable first crane boom, which is articulately connected to the column so as to be pivotable in relation to the column about an essentially horizontal first axis of rotation;
- a first hydraulic cylinder for lifting and lowering the first crane boom in relation to the column;
- a liftable and lowerable second crane boom, which is articulately connected to the first crane boom by a crane boom joint so as to be pivotable in relation to the first crane boom about an essentially horizontal second axis of rotation, wherein the first and second crane booms are foldable towards the column in order to assume a compact Z-shaped parking position together with the column; and
- a second hydraulic cylinder arranged on a first side of the first crane boom for lifting and lowering the second crane boom in relation to the first crane boom, the second hydraulic cylinder having an inner end facing the column and an opposite outer end, wherein the second hydraulic cylinder at its inner end is articulately connected to the first crane boom.

[0008] The hydraulic crane of the present invention is characterized in:

- that the hydraulic crane is provided with a link system comprising a first pair of link elements and a second pair of link elements arranged in parallel with each other on opposite sides of the first and second crane booms at said crane boom joint;
- that each pair of link elements comprises a first link element, which at one end is articulately connected to the first crane boom so as to be pivotable in relation to the first crane boom about an essentially horizontal third axis of rotation, and a second link element, which at one end is articulately connected to the second crane boom so as to be pivotable in relation to the second crane boom about an essentially horizontal fourth axis of rotation, wherein the first and second link elements in each pair are articulately connected to each other so as to be pivotable in re-

lation to each other about an essentially horizontal fifth axis of rotation;

- that the second hydraulic cylinder at its outer end is articulately connected to the first pair of link elements; and
- that the link system comprises a cross bar element, through which the first pair of link elements is connected to the second pair of link elements, wherein the link elements of the link system are configured to mechanically guide the cross bar element in an arcuate path about said crane boom joint when the second crane boom is pivoted in relation to the first crane boom, so as to make the cross bar element assume a position below the crane boom joint when the first and second crane booms are in an extended working position and a position above the crane boom joint when the first and second crane booms are in the parking position, wherein:

- the second link element (14a, 14b) in each pair of link elements has a prolonged part (16) which extends beyond the fifth axis of rotation (A5) and the cross bar element (15) extends between the outer end of the second link element (14a) of the first pair of link elements and the outer end of the second link element (14b) of the second pair of link elements, or
- the first link element (13a, 13b) in each pair of link elements has a prolonged part (17) which extends beyond the fifth axis of rotation (A5) and the cross bar element (15) extends between the outer end of the first link element (13a) of the first pair of link elements and the outer end of the first link element (13b) of the second pair of link elements.

[0009] The above-mentioned link system is used in order to effect an automatic modification of the point of application of the force exerted by the second hydraulic cylinder as the piston rod of the second hydraulic cylinder is extended, and the link system thereby influences the moment arm of the force exerted by the second hydraulic cylinder. The link elements of the link system are so arranged that the moment arm of the force acting on the crane boom joint between the first and second crane booms, i.e. the moment arm of the force exerted by the second hydraulic cylinder, is longer at the normal working positions of the first and second crane booms as compared to a corresponding Z-type crane lacking a link system at the joint between the first and second crane booms, which implies that the crane boom joint between the first and second crane booms of the crane according to the invention has a higher lifting capacity at these working positions as compared to a corresponding Z-type crane lacking a link system at the joint between the first and second crane booms. The cross bar element stabilizes the link system. Due to the fact that the link elements of the link system are configured to move the cross bar

element between a position below said crane boom joint when the first and second crane booms are in an extended working position and a position above the crane boom joint when the first and second crane booms are in the parking position, the cross bar element is prevented from restricting the angular range of the crane boom joint between the first and second crane booms.

[0010] Further advantageous features of the hydraulic crane according to the present invention will appear from the description following below and the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0011]** With reference to the appended drawings, a specific description of embodiments of the invention cited as examples follows below. In the drawings:

- Fig 1 is a lateral view of a hydraulic crane, not forming part of the present claimed invention as seen in an erected working position,
- Fig 2 is a detail enlargement of a section from the hydraulic crane of Fig 1,
- Figs 3 and 4 are perspective views from different directions of the hydraulic crane of Fig 1,
- Fig 5 is a lateral view of the hydraulic crane of Fig 1, as seen in another working position,
- Fig 6 is a lateral view of the hydraulic crane of Fig 1, as seen in a compact parking position,
- Fig 7 is a perspective view of the hydraulic crane of Fig 1, as seen in the parking position,
- Figs 8-10 are lateral views of the hydraulic crane of Fig 1, as seen in different intermediate positions between the working position illustrated in Fig 1 and the parking position illustrated in Fig 6,
- Fig 11 is a detail enlargement of a section from a hydraulic crane according to an embodiment of the invention,
- Fig 12 is a detail enlargement of a section from a hydraulic crane according to another embodiment of the invention, and
- Fig 13 is a lateral view of a hydraulic crane according to prior art.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0012] A hydraulic crane 1 not forming part of the present claimed invention is illustrated in Figs 1-10. The crane 1 is for instance a lorry crane or forestry crane. However, the crane according to the invention may also be a stationarily mounted crane, for instance at a timber-yard or in a factory.

[0013] The crane 1 is mounted on a frame 2, which for instance may be connected to the chassis of a lorry or a forestry vehicle. The frame 2 may be provided with adjustable support legs (not shown) for supporting the crane 1.

[0014] The crane 1 comprises:

- a crane base 3, which is fixed to the frame 2;
- a column 4, which is rotatably mounted to the crane base 3 so as to be rotatable in relation to the crane base about an essentially vertical axis of rotation A by means of an actuating device 5;
- a liftable and lowerable first crane boom 6, in the following denominated inner boom, which is articulately connected to the column 4 in such a manner that it is pivotable in relation to the column about an essentially horizontal axis of rotation A1, in the following denominated first axis of rotation;
- a first hydraulic cylinder 7 for lifting and lowering the inner boom 6 in relation to the column 4;
- a liftable and lowerable second crane boom 8, in the following denominated outer boom, which is articulately connected to the inner boom 6 by a crane boom joint 9 in such a manner that it is pivotable in relation to the inner boom about an essentially horizontal axis of rotation A2, in the following denominated second axis of rotation;
- a second hydraulic cylinder 10 for lifting and lowering the outer boom 8 in relation to the inner boom 6; and.
- a third hydraulic cylinder 11 (see Figs 3 and 4) for lifting and lowering the outer boom 8 in relation to the inner boom 6.

[0015] The second hydraulic cylinder 10 is arranged on a first side of the inner boom 6, and the third hydraulic cylinder 11 is arranged in parallel with the second hydraulic cylinder 10 on an opposite second side of the inner boom 6. Thus, the second and third hydraulic cylinders 10, 11 are arranged in parallel with each other on opposite sides of the inner boom 6 and they are configured to be operated synchronously in order to pivot the outer boom 8 in relation to the inner boom 6. As an alternative, the third hydraulic cylinder 11 could be omitted.

[0016] In the illustrated example, the first hydraulic cylinder 7 comprises a cylinder part 7a which is articulately connected to the column 4, and a piston which is received in the cylinder part 7a and displaceable in relation to it, wherein the piston is fixed to a piston rod 7b which is articulately connected to the inner boom 6.

[0017] Each one of the second and third hydraulic cylinders 10, 11 has an inner end facing the column 4 and an opposite outer end facing the outer boom 8. In the illustrated example, each one of the second and third hydraulic cylinders 10, 11 comprises a cylinder part 10a, 11a which is articulately connected to the inner boom 6, and a piston which is received in the cylinder part 10a, 11a and displaceable in relation to it, wherein the piston is fixed to a piston rod 10b, 11b which is articulately connected to the outer boom 8 through a link system 12.

[0018] In the illustrated embodiment, not forming part of the present claimed invention, the outer boom 8 is telescopically extensible to enable an adjustment of the extension length thereof. The outer boom 8 comprises a base section 8a, through which the outer boom 8 is articulately connected to the inner boom 6, and several telescopic crane boom sections 8b which are carried by the base section 8a and displaceable in the longitudinal direction of the base section by means of one or more hydraulic cylinders (not shown) for adjustment of the extension length of the outer boom 8. A load handling tool (not shown) is to be mounted to the outer end of the outer boom 8.

[0019] The above-mentioned link system 12 at the outer end of the second and third hydraulic cylinders 10, 11 comprises a first pair of link elements 13a, 14a and a second pair of link elements 13b, 14b arranged in parallel with each other on opposite sides of the inner and outer booms 6, 8 at the crane boom joint 9.

[0020] Each pair of link elements comprises a first link element 13a, 13b, which has an inner end and an opposite outer end. Each first link element 13a, 13b is at its inner end articulately connected to the inner boom 6 so as to be pivotable in relation to the inner boom 6 about an essentially horizontal axis of rotation A3, in the following denominated third axis of rotation. The first link elements 13a, 13b extend in parallel with each other on opposite sides of the inner boom 6 and they are of the same length. The first link element 13a included in the first pair of link elements is arranged on the same side of the inner boom 6 as the second hydraulic cylinder 10, whereas the first link element 13b included in the second pair of link elements is arranged on the same side of the inner boom 6 as the third hydraulic cylinder 11.

[0021] Each pair of link elements further comprises a second link element 14a, 14b, which has an inner end and an opposite outer end. Each second link 14a, 14b is at its inner end articulately connected to the outer boom 8 so as to be pivotable in relation to the outer boom 8 about an essentially horizontal axis of rotation A4, in the following denominated fourth axis of rotation. The second link elements 14a, 14b extend in parallel with each other on opposite sides of the outer boom 8 and they are of the same length.

[0022] The first and second link elements 13a, 14a of the first pair of link elements are articulately connected to each other so as to be pivotable in relation to each other about an essentially horizontal axis of rotation A5,

in the following denominated fifth axis of rotation. The first and second link elements 13b, 14b of the second pair of link elements are also articulately connected to each other so as to be pivotable in relation to each other about the fifth axis of rotation A5.

[0023] The link system 12 further comprises a cross bar element 15, through which the first pair of link elements 13a, 14a is connected to the second pair of link elements 13b, 14b. The cross bar element 15 is configured to support the link elements 13a, 14a of the first pair of link elements in relation to the link elements 13b, 14b of the second pair of link elements so as to thereby stabilize the link system 12.

[0024] The cross bar element 15 has the form of a pivot shaft, wherein at least one of the link elements 13a, 14a, 13b, 14b in each pair of link elements is pivotally mounted to the cross bar element 15.

[0025] In the embodiment not forming part of the present claimed invention illustrated in Figs 1-10, the cross bar element 15 extends linearly along the above-mentioned fifth axis of rotation A5, wherein the second and third hydraulic cylinders 10, 11 at their outer ends are articulately connected to the first pair of link elements 13a, 14a and the second pair of link elements 13b, 14b, respectively, through the cross bar element 15. In this case, the second and third hydraulic cylinders 10, 11 are at their outer ends fixed to the cross bar element 15 at opposite ends of the cross bar element, and both of the link elements 13a, 14a, 13b, 14b in each pair of link elements are at their outer ends pivotally mounted to the cross bar element 15.

[0026] In the embodiment of the present claimed invention illustrated in Fig 11, the second link element 14a, 14b in each pair of link elements has a prolonged part 16 which extends beyond the above-mentioned fifth axis of rotation A5, wherein the cross bar element 15 extends between the outer end of the second link element 14a of the first pair of link elements and the outer end of the second link element 14b of the second pair of link elements. In the illustrated example, the second and third hydraulic cylinders 10, 11 are at their outer ends fixed to the cross bar element 15 at opposite ends of the cross bar element. As an alternative, the second and third hydraulic cylinders 10, 11 may at their outer ends be articulately connected to the second link elements 14a, 14b at any position between the fifth axis of rotation A5 and the outer end of the second link elements.

[0027] In the embodiment of the present claimed invention illustrated in Fig 12, the first link element 13a, 13b in each pair of link elements has a prolonged part 17 which extends beyond the above-mentioned fifth axis of rotation A5, wherein the cross bar element 15 extends between the outer end of the first link element 13a of the first pair of link elements and the outer end of the first link element 13b of the second pair of link elements. In the illustrated example, the second and third hydraulic cylinders 10, 11 are at their outer ends fixed to the cross bar element 15 at opposite ends of the cross bar element.

As an alternative, the second and third hydraulic cylinders 10, 11 may at their outer ends be articulately connected to the first link elements 13a, 13b at any position between the fifth axis of rotation A5 and the outer end of the first link elements.

[0028] The links 13a, 14a, 13b, 14b of the link system 12 effect an automatic modification of the point of application of the lifting force exerted by the second and third hydraulic cylinders 10, 11 as the piston rods 10b, 11b of the second and third hydraulic cylinders are extended and retracted, and the link system 12 thereby influences the moment arm of the force exerted by these hydraulic cylinders 10, 11.

[0029] The hydraulic crane 1 is a Z-type crane, wherein the inner and outer booms 6, 8 are foldable into a compact Z-shaped parking position close to the column 4 when the crane is to be transported or stored, as illustrated in Figs 6 and 7. In the parking position, the inner boom 6 is folded downwards to a position close to the column 4, and the outer boom 8 is folded backwards and lies against the inner boom 6 on the upper side thereof. The inner and outer booms 6, 8 extend essentially in parallel with each other in the parking position.

[0030] The link elements 13a, 14a, 13b, 14b of the link system 12 are configured to mechanically guide the cross bar element 15 in an arcuate path about the crane boom joint 9 between the inner and outer booms 6, 8 when the outer boom 8 is pivoted in relation to the inner boom 6, so as to make the cross bar element 15 assume a position below the crane boom joint 9 when the inner and outer booms 6, 8 are in an extended working position, as illustrated in Figs 1-5, and a position above the crane boom joint 9 when the inner and outer booms 6, 8 are in the parking position, as illustrated in Figs 6 and 7. In the embodiment not forming part of the present claimed invention illustrated in Figs 1-10, the cross bar element 15 is moveable from the position illustrated in Fig 5 to the position illustrated in Fig 6, which implies that the cross bar element 15 is moveable over a very large angular range about the crane boom joint 9 between the inner and outer booms 6, 8.

[0031] In order to allow the link system 12 to operate as desired in the embodiment not forming part of the present claimed invention illustrated in Figs 1-10, the link system 12 should be so configured that it fulfils the following conditions:

$$\begin{aligned} &A < C, \\ &A < D, \text{ and} \\ &|D - C| < B < D + C, \end{aligned}$$

where A is the distance between the second axis of rotation A2 and the third axis of rotation A3, B is the distance between the third axis of rotation A3 and the fourth axis of rotation A4, C is the distance between the fourth axis of rotation A4 and the fifth axis of rotation A5, and D is the distance between the third axis of rotation A3 and the fifth axis of rotation A5.

[0032] Figs 8-10 illustrate one possible manner of moving the inner and outer booms 6, 8 from the working position illustrated in Fig 1 to the parking position illustrated in Figs 6 and 7. In a first step (see Fig 8), the piston rod 7b of the first hydraulic cylinder 7 is extended in order to lift the inner boom 6 as high as possible, and the piston rods 10b, 11b of the second and third hydraulic cylinders 10, 11 are extended to the end position illustrated in Fig 8. In this end position, the longitudinal axis of the second and third hydraulic cylinders 10, 11 cross the second axis of rotation A2, which implies that the moment arm of the force exerted by the second and third hydraulic cylinders 10, 11 is zero. However, the moment arm between the crane boom joint 9 and the centre of gravity of the outer boom 8 is rather long at this angular position of the outer boom 8, which implies that the outer boom 8 will fall downwards towards the upper side of the inner boom 6 under the effect of gravity. By this movement of the outer boom 8, the outer end of the piston rods 10b, 11b of the second and third hydraulic cylinders 10, 11 will move to the other side of the crane boom joint 9, while increasing the moment arm of the force exerted by the second and third hydraulic cylinders 10, 11, as illustrated in Fig 9. In the next step, the piston rod 7b of the first hydraulic cylinder 7 is retracted in order to fold the inner boom 6 downwards to a parking position close to the column 4, and the piston rods 10b, 11b of the second and third hydraulic cylinders 10, 11 are retracted in order to fold the outer boom 6 downwards to a parking position close to the upper side of the inner boom 6.

[0033] A prior art crane 100 with no link system at the crane boom joint 109 between the inner and outer booms 106, 108 is illustrated in Fig 13 in a position corresponding to the position illustrated in Fig 8. Except for the lack of the link system 12, the prior art crane 100 illustrated in Fig 13 has exactly the same design as the crane 1 according to the embodiment not forming part of the present claimed invention illustrated in Figs 1-10.

[0034] In the prior art crane 100, the outer end of the second hydraulic cylinder 110 is articulately connected to the outer boom 108 by a joint 120. As can be seen in Fig 13, the outer boom 108 of the prior art crane 100 is more vertically directed than the outer boom 8 of the crane 1 according to the present invention at the moment when the moment arm of the force exerted by the second hydraulic cylinder 110 is zero, which in its turn implies that the moment arm between the crane boom joint 109 and the centre of gravity of the outer boom 108 is much shorter in the prior art crane 100 than in the crane 1 according to the invention, at this stage during the movement of the inner and outer booms to the parking position. Thus, one of the positive effects of the link system 12 is that it will give the outer boom 8 an increased inclination in relation to the inner boom 6 at the moment when the moment arm of the force exerted by the second and third hydraulic cylinders 10, 11 is zero, which in its turn will facilitate the movement of the outer boom 8 to the parking position.

[0035] The invention is of course not in any way restricted to the embodiments described above. On the contrary, many possibilities to modifications thereof will be apparent to a person with ordinary skill in the art without departing from the scope of the invention which is defined in the appended claims.

Claims

1. A hydraulic crane comprising:

- a column (4);
- a liftable and lowerable first crane boom (6), which is articulately connected to the column (4) so as to be pivotable in relation to the column about an essentially horizontal first axis of rotation (A1);
- a first hydraulic cylinder (7) for lifting and lowering the first crane boom (6) in relation to the column (4);
- a liftable and lowerable second crane boom (8), which is articulately connected to the first crane boom (6) by a crane boom joint (9) so as to be pivotable in relation to the first crane boom about an essentially horizontal second axis of rotation (A2), wherein the first and second crane booms (6, 8) are foldable towards the column (4) in order to assume a compact Z-shaped parking position together with the column; and
- a second hydraulic cylinder (10) arranged on a first side of the first crane boom (6) for lifting and lowering the second crane boom (8) in relation to the first crane boom (6), the second hydraulic cylinder (10) having an inner end facing the column (4) and an opposite outer end, wherein the second hydraulic cylinder (10) at its inner end is articulately connected to the first crane boom (6);

characterized in:

- **that** the hydraulic crane (1) is provided with a link system (12) comprising a first pair of link elements (13a, 14a) and a second pair of link elements (13b, 14b) arranged in parallel with each other on opposite sides of the first and second crane booms (6, 8) at said crane boom joint (9);
- **that** each pair of link elements comprises a first link element (13a, 13b), which at one end is articulately connected to the first crane boom (6) so as to be pivotable in relation to the first crane boom (6) about an essentially horizontal third axis of rotation (A3), and a second link element (14a, 14b), which at one end is articulately connected to the second crane boom (8) so as to be pivotable in relation to the second crane

boom (8) about an essentially horizontal fourth axis of rotation (A4), wherein the first and second link elements (13a, 14a, 13b, 14b) in each pair are articulately connected to each other so as to be pivotable in relation to each other about an essentially horizontal fifth axis of rotation (A5);

- **that** the second hydraulic cylinder (10) at its outer end is articulately connected to the first pair of link elements (13a, 14a); and

- **that** the link system (12) comprises a cross bar element (15), through which the first pair of link elements (13a, 14a) is connected to the second pair of link elements (13b, 14b), wherein the link elements (13a, 14a, 13b, 14b) of the link system are configured to mechanically guide the cross bar element (15) in an arcuate path about said crane boom joint (9) when the second crane boom (8) is pivoted in relation to the first crane boom (6), so as to make the cross bar element (15) assume a position below the crane boom joint (9) when the first and second crane booms (6, 8) are in an extended working position and a position above the crane boom joint (9) when the first and second crane booms are in the parking position, wherein:

- the second link element (14a, 14b) in each pair of link elements has a prolonged part (16) which extends beyond the fifth axis of rotation (A5) and the cross bar element (15) extends between the outer end of the second link element (14a) of the first pair of link elements and the outer end of the second link element (14b) of the second pair of link elements, or
- the first link element (13a, 13b) in each pair of link elements has a prolonged part (17) which extends beyond the fifth axis of rotation (A5) and the cross bar element (15) extends between the outer end of the first link element (13a) of the first pair of link elements and the outer end of the first link element (13b) of the second pair of link elements.

2. A hydraulic crane according to claim 1, **characterized in:**

- **that** the hydraulic crane (1) comprises one more hydraulic cylinder (11), here denominated third hydraulic cylinder, for lifting and lowering the second crane boom (8) in relation to the first crane boom (6), wherein the third hydraulic cylinder (11) is arranged on a second side of the first crane boom (6) opposite and in parallel with the second hydraulic cylinder (10), the third hy-

draulic cylinder (11) having an inner end facing the column (4) and an opposite outer end; and
- **that** the third hydraulic cylinder (11) at its inner end is articulately connected to the first crane boom (6) and at its outer end is articulately connected to the second pair of link elements (13b, 14b).

3. A hydraulic crane according to claim 2, **characterized in that** the second and third hydraulic cylinders (10, 11) at their outer ends are articulately connected to the first pair of link elements (13a, 14a) and the second pair of link elements (13b, 14b), respectively, through the cross bar element (15), wherein the second and third hydraulic cylinders (10, 11) at their outer ends are fixed to the cross bar element (15) at opposite ends thereof.

4. A hydraulic crane according to any of claims 1-3, **characterized in that** the second and third hydraulic cylinders (10, 11) at their outer ends are articulately connected to the second link elements (14a, 14b) at a position between the fifth axis of rotation (A5) and the outer end of the second link elements.

5. A hydraulic crane according to any of claims 1-3, **characterized in that** the second and third hydraulic cylinders (10, 11) at their outer ends are articulately connected to the first link elements (13a, 13b) at a position between the fifth axis of rotation (A5) and the outer end of the first link elements.

6. A hydraulic crane according to any of claims 1-5, **characterized in that** the second crane boom (8) is telescopically extensible so as to enable an adjustment of the extension length thereof.

7. A hydraulic crane according to any of claims 1-6, **characterized in that** the hydraulic crane (1) is a lorry crane or forestry crane.

Patentansprüche

1. Hydraulischer Kran, umfassend:

- eine Säule (4);
- einen anhebbaren und absenkenden ersten Kranausleger (6), der gelenkig mit der Säule (4) verbunden ist, so dass er in Bezug auf die Säule um eine im Wesentlichen horizontale erste Drehachse (A1) schwenkbar ist;
- einen ersten Hydraulikzylinder (7) zum Anheben und Absenken des ersten Kranauslegers (6) in Bezug auf die Säule (4);
- einen anhebbaren und absenkenden zweiten Kranausleger (8), der gelenkig mit dem ersten Kranausleger (6) durch ein Kranauslegergelenk

(9) verbunden ist, so dass er in Bezug auf den ersten Kranausleger um eine im Wesentlichen horizontale zweite Drehachse (A2) schwenkbar ist, wobei der erste und zweite Kranausleger (6, 8) zu der Säule (4) hin klappbar sind, um so eine kompakte Z-förmige Parkposition zusammen mit der Säule anzunehmen; und

- einen zweiten Hydraulikzylinder (10), der auf einer ersten Seite des ersten Kranauslegers (6) zum Anheben und Absenken des zweiten Kranauslegers (8) in Bezug auf den ersten Kranausleger (6) angeordnet ist, wobei der zweite Hydraulikzylinder (10) ein inneres Ende, das zu der Säule (4) weist, sowie ein gegenüberliegendes äußeres Ende aufweist, wobei der zweite Hydraulikzylinder (10) an seinem inneren Ende gelenkig mit dem ersten Kranausleger (6) verbunden ist;

dadurch gekennzeichnet, dass:

- der Hydraulikkran (1) mit einem Kopplungssystem (12) versehen ist, das ein erstes Paar von Kopplungselementen (13a, 14a) und ein zweites Paar von Kopplungselementen (13b, 14b) umfasst, die parallel zueinander auf gegenüberliegenden Seiten des ersten und zweiten Kranauslegers (6, 8) an dem Kranauslegergelenk (9) angeordnet sind;

- jedes Paar von Kopplungselementen ein erstes Kopplungselement (13a, 13b), das an einem Ende gelenkig mit dem ersten Kranausleger (6) verbunden ist, so dass es in Bezug auf den ersten Kranausleger (6) um eine im Wesentlichen horizontale dritte Drehachse (A3) schwenkbar ist, und ein zweites Kopplungselement (14a, 14b) umfasst, das an einem Ende gelenkig mit dem zweiten Kranausleger (8) verbunden ist, so dass es in Bezug auf den zweiten Kranausleger (8) um eine im Wesentlichen horizontale vierte Drehachse (A4) schwenkbar ist, wobei das erste und das zweite Kopplungselement (13a, 14a, 13b, 14b) in jedem Paar gelenkig miteinander verbunden sind, so dass sie in Bezug zueinander um eine im Wesentlichen horizontale fünfte Drehachse (A5) schwenkbar sind;

- der zweite Hydraulikzylinder (10) an seinem äußeren Ende gelenkig mit dem ersten Paar von Kopplungselementen (13a, 14a) verbunden ist; und

- das Kopplungssystem (12) ein Querstangenelement (15) umfasst, durch das das erste Paar von Kopplungselementen (13a, 14a) mit dem zweiten Paar von Kopplungselementen (13b, 14b) verbunden ist, wobei die Kopplungselemente (13a, 14a, 13b, 14b) des Kopplungssystems so konfiguriert sind, dass sie das Querstangenelement (15) mechanisch in einem bo-

genförmigen Pfad um das Kranauslegergelenk (9) führen, wenn der zweite Kranausleger (8) in Bezug auf den ersten Kranausleger (6) geschwenkt ist, um so zu ermöglichen, dass das Querstangenelement (15) eine Position unterhalb des Kranauslegergelenks (9) annimmt, wenn der erste und zweite Kranausleger (6, 8) in einer ausgefahrenen Arbeitsposition sind, und eine Position oberhalb des Kranauslegergelenks (9) annimmt, wenn der erste und zweite Kranausleger in der Parkposition sind, wobei:

- das zweite Kopplungselement (14a, 14b) in jedem Paar von Kopplungselementen ein verlängertes Teil (16) aufweist, das sich über die fünfte Drehachse (A5) hinaus erstreckt, und sich das Querstangenelement (15) zwischen dem äußeren Ende des zweiten Kopplungselements (14a) des ersten Paares von Kopplungselementen und dem äußeren Ende des zweiten Kopplungselements (14b) des zweiten Paares von Kopplungselementen erstreckt, oder

- das erste Kopplungselement (13a, 13b) in jedem Paar von Kopplungselementen ein verlängertes Teil (17) aufweist, das sich über die fünfte Drehachse (A5) hinaus erstreckt, und sich das Querstangenelement (15) zwischen dem äußeren Ende des ersten Kopplungselements (13a) des ersten Paares von Kopplungselementen und dem äußeren Ende des ersten Kopplungselements (13b) des zweiten Paares von Kopplungselementen erstreckt.

2. Hydraulikkran nach Anspruch 1, **dadurch gekennzeichnet, dass**

- der Hydraulikkran (1) einen oder mehrere Hydraulikzylinder (11), hier mit drei Hydraulikzylindern bezeichnet, zum Anheben und Absenken des zweiten Kranauslegers (8) in Bezug auf den ersten Kranausleger (6) umfasst, wobei der dritte Hydraulikzylinder (11) auf einer zweiten Seite des ersten Kranauslegers (6) gegenüberliegend und parallel zu dem zweiten Hydraulikzylinder (10) angeordnet ist, wobei der dritte Hydraulikzylinder (11) ein inneres Ende, das zu der Säule (4) weist, und ein gegenüberliegendes äußeres Ende aufweist; und

- der dritte Hydraulikzylinder (11) an seinem inneren Ende gelenkig mit dem ersten Kranausleger (6) verbunden ist und an seinem äußeren Ende gelenkig mit dem zweiten Paar von Kopplungselementen (13b, 14b) verbunden ist.

3. Hydraulikkran nach Anspruch 2, **dadurch gekenn-**

zeichnet, dass der zweite und dritte Hydraulikzylinder (10, 11) an ihren äußeren Enden gelenkig mit dem ersten Paar von Kopplungselementen (13a, 14a) bzw. dem zweiten Paar von Kopplungselementen (13b, 14b) durch das Querstangenelement (15) verbunden sind, wobei der zweite und dritte Hydraulikzylinder (10, 11) an ihren äußeren Enden an dem Querstangenelement (15) an seinen gegenüberliegenden Enden befestigt sind.

4. Hydraulikkran nach einem der Ansprüche 1 - 3, **dadurch gekennzeichnet, dass** der zweite und dritte Hydraulikzylinder (10, 11) an ihren äußeren Enden gelenkig mit den zweiten Kopplungselementen (14a, 14b) an einer Position zwischen der fünften Drehachse (A5) und dem äußeren Ende der zweiten Kopplungselemente verbunden sind.
5. Hydraulikkran nach einem der Ansprüche 1 - 3, **dadurch gekennzeichnet, dass** der zweite und dritte Hydraulikzylinder (10, 11) an ihren äußeren Enden gelenkig mit den ersten Kopplungselementen (13a, 13b) an einer Position zwischen der fünften Drehachse (A5) und dem äußeren Ende des ersten Kopplungselemente verbunden sind.
6. Hydraulikkran nach einem der Ansprüche 1 - 5, **dadurch gekennzeichnet, dass** der zweite Kranausleger (8) teleskopisch ausfahrbar ist, um so eine Einstellung seiner Ausfahrlänge zu ermöglichen.
7. Hydraulikkran nach einem der Ansprüche 1 - 6, **dadurch gekennzeichnet, dass** der Hydraulikkran (1) ein Lastwagenkran oder ein Forstkran ist.

Revendications

1. Grue hydraulique comprenant :

- une colonne (4) ;
- une première flèche de grue (6) pouvant être levée et abaissée, qui s'articule sur la colonne (4) de manière à pouvoir pivoter par rapport à la colonne autour d'un premier axe de rotation (A1) essentiellement horizontal ;
- un premier vérin hydraulique (7) pour lever et abaisser la première flèche de grue (6) par rapport à la colonne (4) ;
- une seconde flèche de grue (8) pouvant être levée et abaissée, qui s'articule sur la première flèche de grue (6) par un raccord de flèche de grue (9) de manière à pouvoir pivoter par rapport à la première flèche de grue autour d'un deuxième axe de rotation (A2) essentiellement horizontal, dans laquelle les première et seconde flèches de grue (6, 8) peuvent se plier vers la colonne (4) afin d'adopter une position de sta-

tionnement compacte en forme de Z avec la colonne ; et

- un deuxième vérin hydraulique (10) agencé sur un premier côté de la première flèche de grue (6) pour lever et abaisser la seconde flèche de grue (8) par rapport à la première flèche de grue (6), le deuxième vérin hydraulique (10) comportant une extrémité intérieure faisant face à la colonne (4) et une extrémité extérieure opposée, dans laquelle le deuxième vérin hydraulique (10) au niveau de son extrémité intérieure s'articule sur la première flèche de grue (6) ;

caractérisée en :

- **ce que** la grue hydraulique (1) est pourvue d'un système de liaison (12) comprenant une première paire d'éléments de liaison (13a, 14a) et une seconde paire d'éléments de liaison (13b, 14b) agencées parallèlement entre elles sur des côtés opposés des première et seconde flèches de grue (6, 8) à niveau dudit raccord de flèche de grue (9) ;
- ce que chaque paire d'éléments de liaison comprend un premier élément de liaison (13a, 13b), qui au niveau d'une extrémité s'articule sur la première flèche de grue (6) de manière à pouvoir pivoter par rapport à la première flèche de grue (6) autour d'un troisième axe de rotation (A3) essentiellement horizontal, et un second élément de liaison (14a, 14b), qui au niveau d'une extrémité s'articule sur la seconde flèche de grue (8) de manière à pouvoir pivoter par rapport à la seconde flèche de grue (8) autour d'un quatrième axe de rotation (A4) essentiellement horizontal, dans laquelle les premiers et seconds éléments de liaison (13a, 14a, 13b, 14b) de chaque paire s'articulent l'un sur l'autre de manière à pouvoir pivoter l'un par rapport à l'autre autour d'un cinquième axe de rotation (A5) essentiellement horizontal ;
- ce que le deuxième vérin hydraulique (10) au niveau de son extrémité extérieure s'articule sur la première paire d'éléments de liaison (13a, 14a) ; et
- ce que le système de liaison (12) comprend un élément de barre transversale (15), par le biais duquel la première paire d'éléments de liaison (13a, 14a) est reliée à la seconde paire d'éléments de liaison (13b, 14b), dans lequel les éléments de liaison (13a, 14a, 13b, 14b) du système de liaison sont configurés pour guider mécaniquement l'élément de barre transversale (15) dans un chemin arqué autour dudit raccord de flèche de grue (9) lorsque la seconde flèche de grue (8) pivote par rapport à la première flèche de grue (6), de manière à amener l'élément de barre transversale (15) à adopter une posi-

tion sous le raccord de flèche de grue (9) lorsque les première et seconde flèches de grue (6, 8) sont dans une position de travail étendue et une position au-dessus du raccord de flèche de grue (9) lorsque les première et seconde flèches de grue sont dans la position de stationnement,

dans laquelle :

- le second élément de liaison (14a, 14b) de chaque paire d'éléments de liaison comporte une partie prolongée (16) qui s'étend au-delà du cinquième axe de rotation (A5) et l'élément de barre transversale (15) s'étend entre l'extrémité extérieure du second élément de liaison (14a) de la première paire d'éléments de liaison et l'extrémité extérieure du second élément de liaison (14b) de la seconde paire d'éléments de liaison, ou
- le premier élément de liaison (13a, 13b) de chaque paire d'éléments de liaison comporte une partie prolongée (17) qui s'étend au-delà du cinquième axe de rotation (A5) et l'élément de barre transversale (15) s'étend entre l'extrémité extérieure du premier élément de liaison (13a) de la première paire d'éléments de liaison et l'extrémité extérieure du premier élément de liaison (13b) de la seconde paire d'éléments de liaison.

2. Grue hydraulique selon la revendication 1, **caractérisée en :**

- **ce que** la grue hydraulique (1) comprend un vérin hydraulique (11) supplémentaire, appelé ici troisième vérin hydraulique, pour lever et abaisser la seconde flèche de grue (8) par rapport à la première flèche de grue (6), dans laquelle le troisième vérin hydraulique (11) est agencé sur un second côté de la première flèche de grue (6) à l'opposé du deuxième vérin hydraulique (10) et parallèlement à celui-ci, le troisième vérin hydraulique (11) comportant une extrémité intérieure faisant face à la colonne (4) et une extrémité extérieure opposée ; et
- ce que le troisième vérin hydraulique (11) au niveau de son extrémité intérieure s'articule sur la première flèche de grue (6) et au niveau de son extrémité extérieure s'articule sur la seconde paire d'éléments de liaison (13b, 14b).

3. Grue hydraulique selon la revendication 2, **caractérisée en ce que** les deuxième et troisième vérins hydrauliques (10, 11) au niveau de leurs extrémités extérieures s'articulent sur la première paire d'éléments de liaison (13a, 14a) et la seconde paire d'éléments de liaison (13b, 14b), respectivement, par le biais de l'élément de barre transversale (15), dans laquelle les deuxième et troisième vérins hydrauliques

(10, 11) au niveau de leurs extrémités extérieures sont fixés à l'élément de barre transversale (15) au niveau des extrémités opposées de celui-ci.

4. Grue hydraulique selon l'une quelconque des revendications 1 à 3, **caractérisée en ce que** les deuxième et troisième vérins hydrauliques (10, 11) au niveau de leurs extrémités extérieures s'articulent sur les seconds éléments de liaison (14a, 14b) dans une position entre le cinquième axe de rotation (A5) et l'extrémité extérieure des seconds éléments de liaison.
5. Grue hydraulique selon l'une quelconque des revendications 1 à 3, **caractérisée en ce que** les deuxième et troisième vérins hydrauliques (10, 11) au niveau de leurs extrémités extérieures s'articulent sur les premiers éléments de liaison (13a, 13b) dans une position entre le cinquième axe de rotation (A5) et l'extrémité extérieure des premiers éléments de liaison.
6. Grue hydraulique selon l'une quelconque des revendications 1 à 5, **caractérisée en ce que** la seconde flèche de grue (8) est télescopiquement extensible de manière à permettre un réglage de la longueur d'extension de celle-ci.
7. Grue hydraulique selon l'une quelconque des revendications 1 à 6, **caractérisée en ce que** la grue hydraulique (1) est une grue de camion ou une grue forestière.

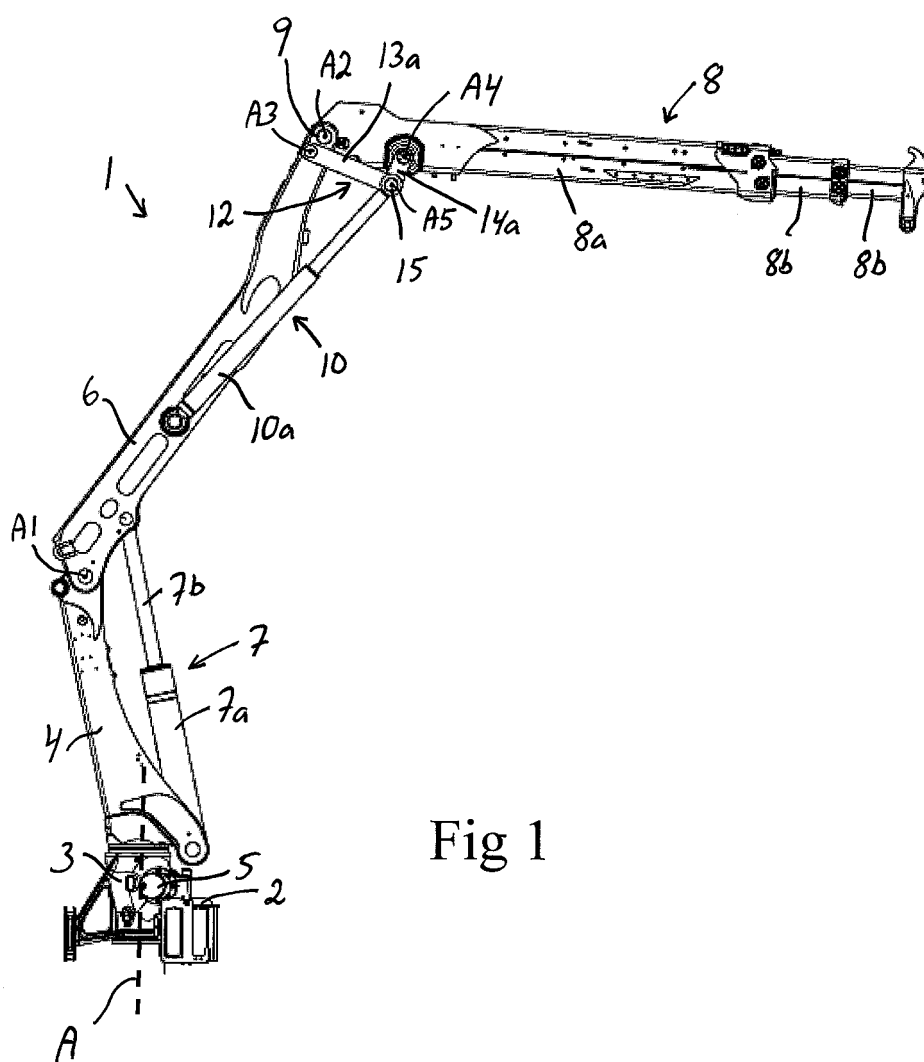


Fig 1

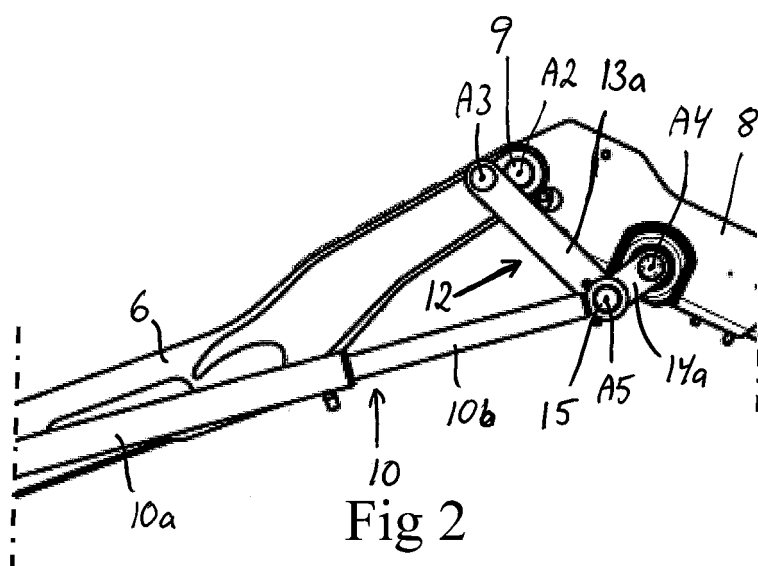


Fig 2

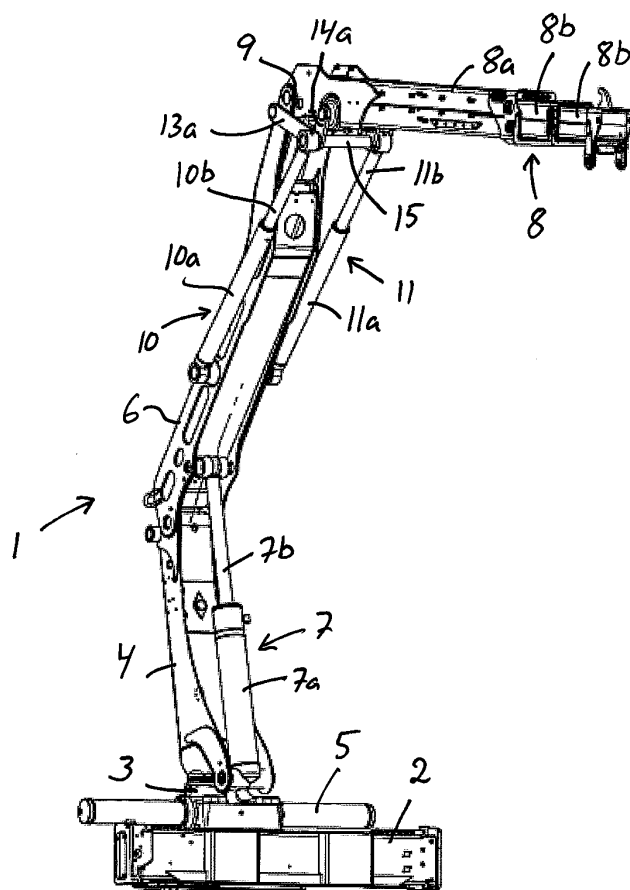


Fig 3

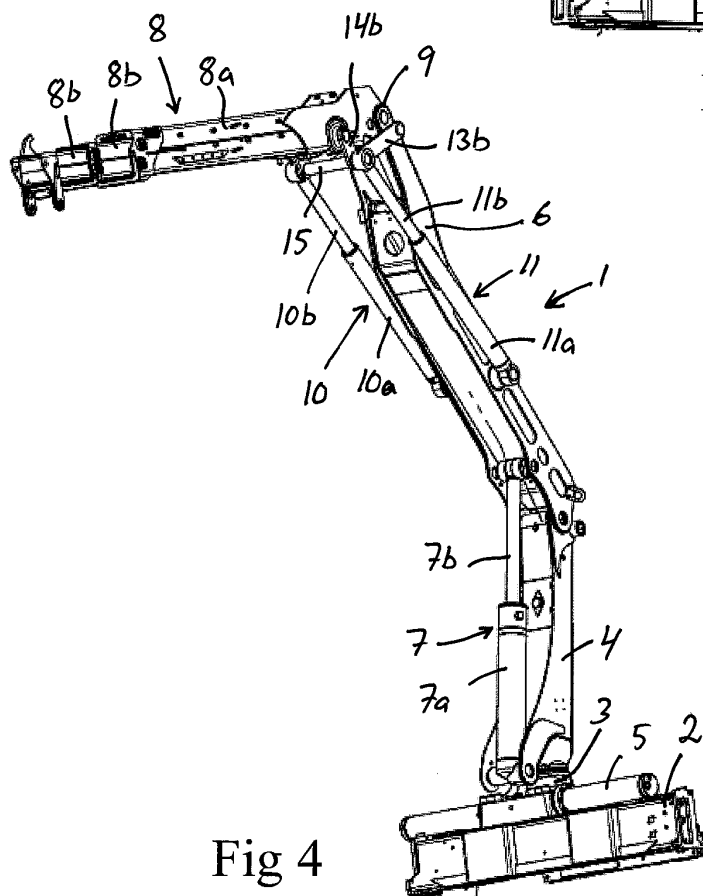


Fig 4

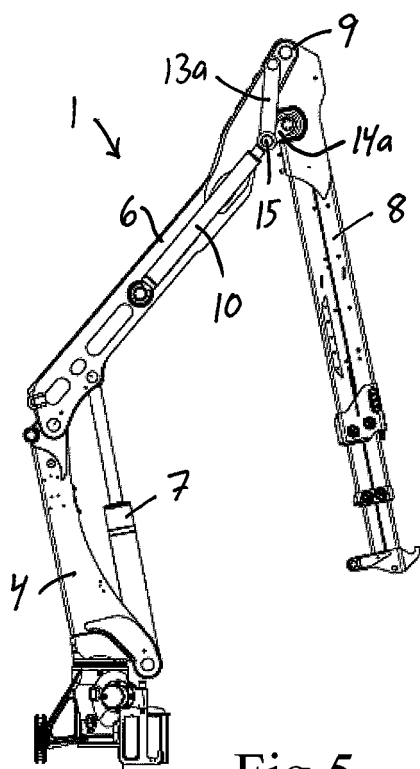


Fig 5

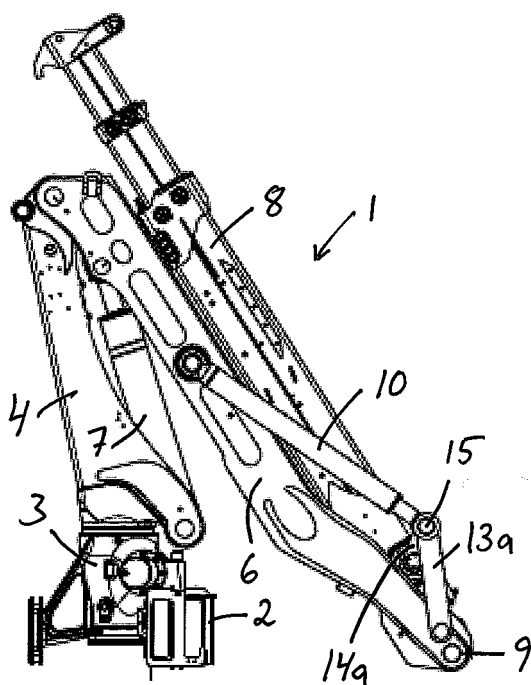


Fig 6

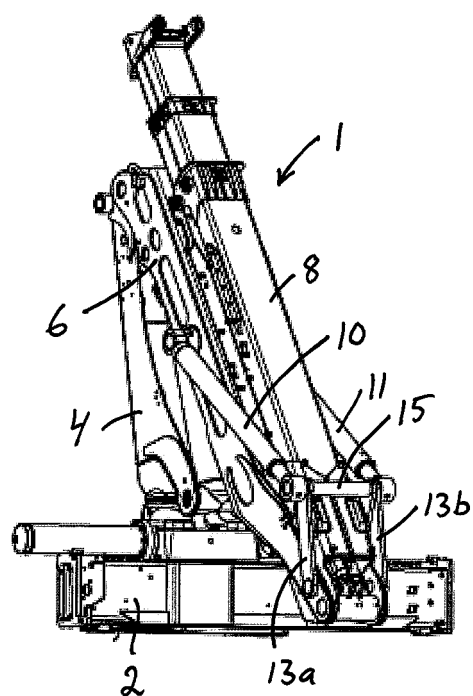


Fig 7

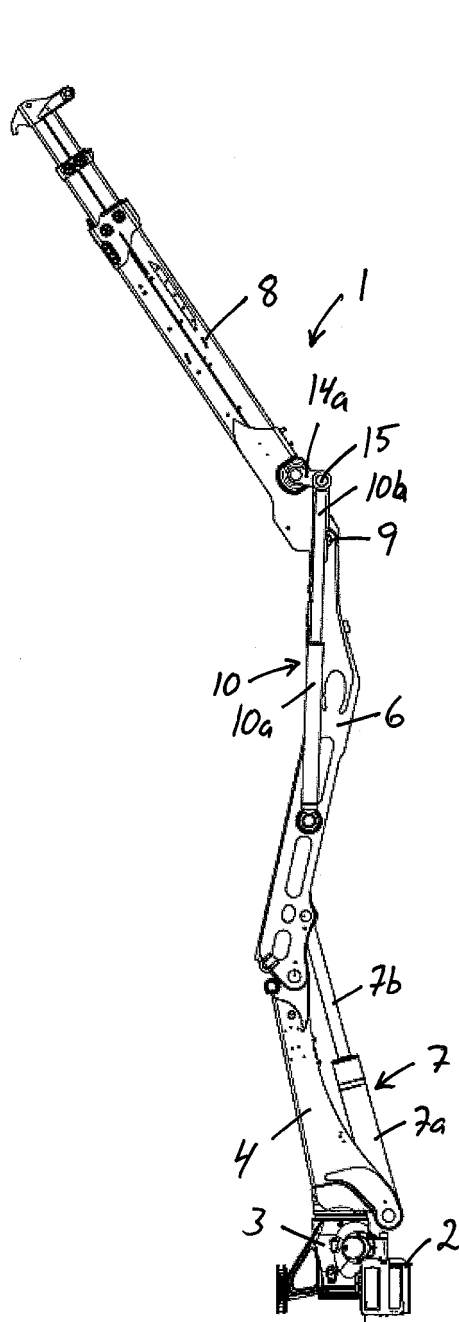


Fig 8

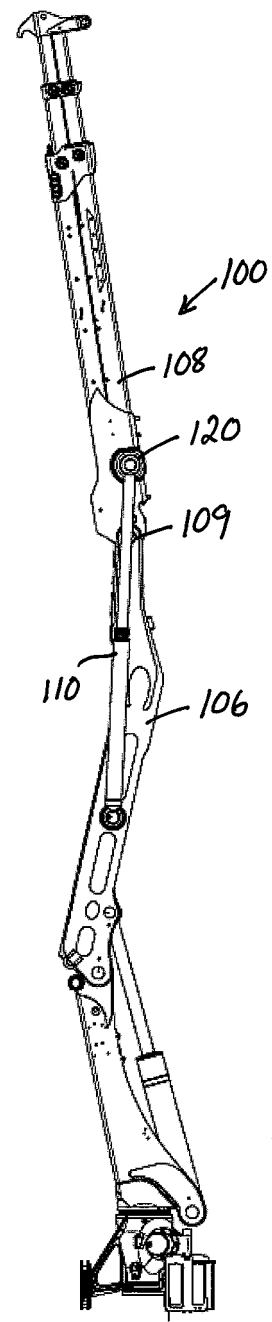


Fig 13

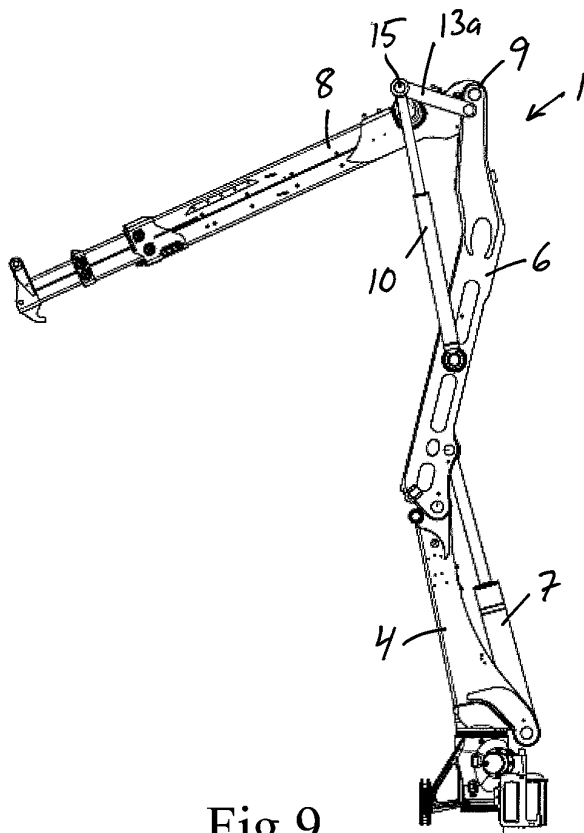


Fig 9

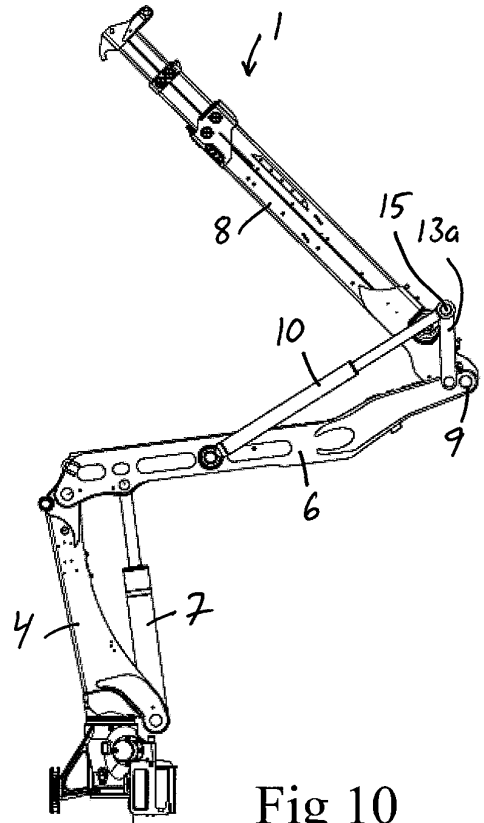


Fig 10

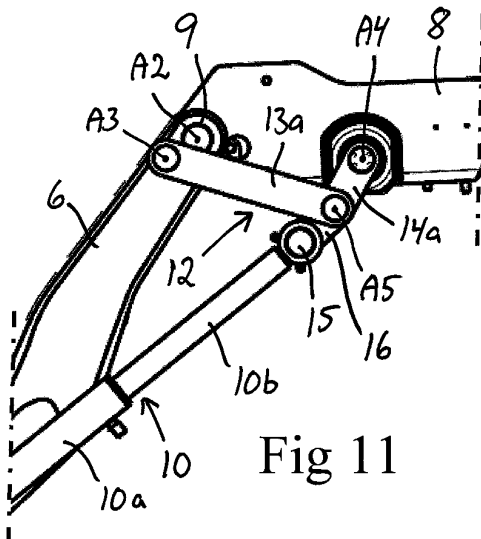


Fig 11

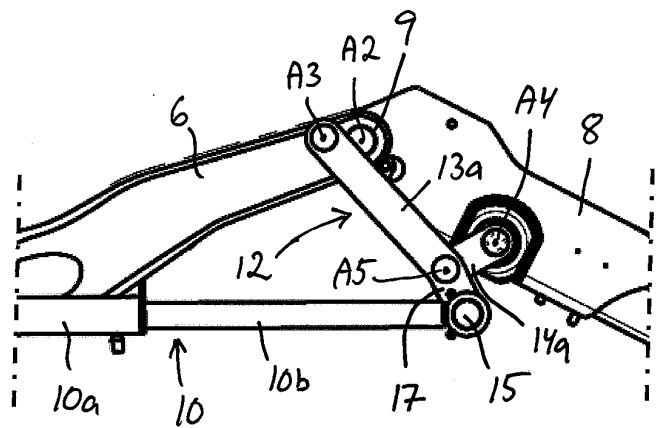


Fig 12

REFERENCES CITED IN THE DESCRIPTION

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