(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 656 723 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.05.2020 Bulletin 2020/22

(51) Int Cl.:
B66C 23/66 *(2006.01)* ***B66F 11/04*** *(2006.01)*

(21) Application number: **18207620.8**

(22) Date of filing: **21.11.2018**

(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:
KH MA MD TN

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(54) CONNECTING UNIT AND HYDRAULIC CRANE COMPRISING SUCH A CONNECTING UNIT

(57) A connecting unit (1) for detachable mounting to the tip of a crane boom in order to form a connection between the crane boom and an associated crane implement (4). The connecting unit comprises:
- an insertion part (10) to be inserted into a hollow crane boom section;
- a holding part (11), which is fixed to the insertion part and forms a support for the crane implement;
- one or more supporting elements (12a, 12b), each of which being moveable transversely to the longitudinal axis of the insertion part in order to allow the supporting element to be pushed outwards in relation to the longitudinal axis of the insertion part and against an inner surface of said crane boom section and thereby take up a play between the insertion part and the crane boom section; and
- an actuating device for moving the supporting elements transversely to the longitudinal axis of the insertion part.

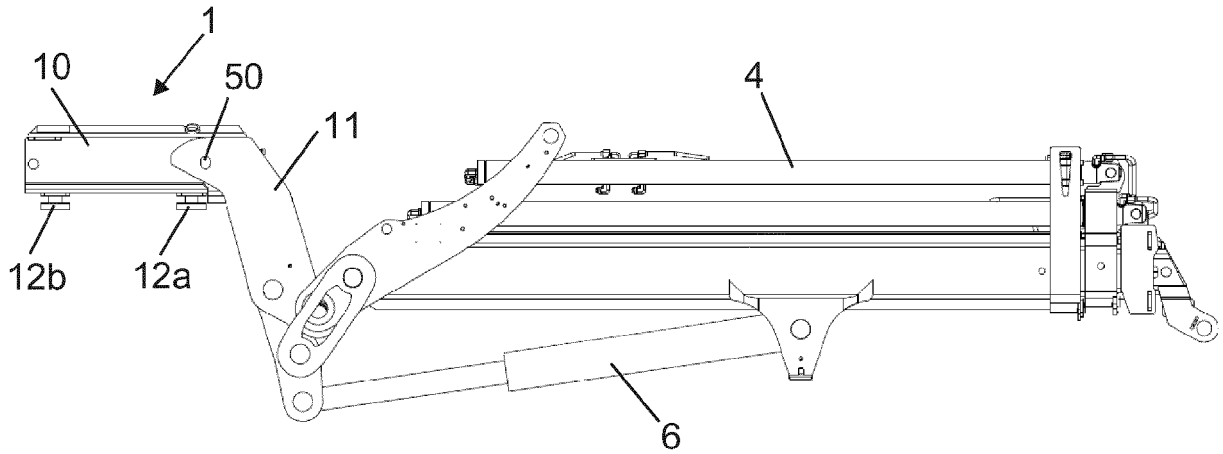

Fig 1

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Description

FIELD OF THE INVENTION AND PRIOR ART

[0001] The present invention relates to a connecting unit according to the preamble of claim 1, which is configured for detachable mounting to the tip of a crane boom in order to form a connection between the crane boom and an associated crane implement. The invention also relates to a hydraulic crane comprising such a connecting unit.

[0002] An ordinary loader crane is provided with a crane boom system which normally comprises a first crane boom in the form of a so-called inner boom, which is articulately connected to a rotatable column of the crane, and a second crane boom in the form of a so-called outer boom, which is telescopically extensible and articulately connected to the inner boom. The outer boom comprises a hollow base section, through which the outer boom is articulately connected to the inner boom, and one or more telescopic crane boom sections, which are hollow and carried by the base section. The telescopic crane boom sections are displaceable in the longitudinal direction of the base section by means of hydraulic cylinders for adjustment of the extension length of the outer boom. In order to extend the reach of the crane, i.e. the possible range for the lifting operations, an additional crane boom may be temporarily and detachably mounted to the outer end of the outer boom by means of a connecting unit with an insertion part that is received inside the foremost telescopic crane boom section of the outer boom. A detachable mounting of an additional crane boom to an outer boom of a hydraulic loader crane by means of such a connecting unit is for instance disclosed in DE 202008015659 U1. Also other types of crane implements, such as for instance an aerial working platform, may be detachably mounted to a hollow crane boom section of a crane boom by means of a connecting unit with an insertion part of the above-mentioned type.

[0003] In order to allow an insertion part of a connecting unit of the above-mentioned type to be inserted into a hollow crane boom section in an easy manner, there has to be a rather large play between the outer surface of the insertion part and the inner surface of the crane boom section. This play might be excessively large due to large tolerances in the manufacturing of the crane boom section and in the manufacturing of the insertion part of the connecting unit, or when a connecting unit that is not specifically adapted to the crane boom section in question is used. The play between the insertion part and the associated crane boom section may cause undesired and troublesome movements between the connecting unit and the crane boom section during movement of the crane boom system.

[0004] A known way to reduce the play between a hollow crane boom section and an insertion part of a connecting unit of the above-mentioned type is based on the insertion of a suitable number of plate-like metallic elements in the form of so-called shims in the gap between the crane boom section and the insertion part. The shims are detachably secured to the outer surface of the insertion part at the rear end and/or front end thereof, for instance by means of screws, before the insertion part is inserted into the crane boom section. For a larger gap, several shims have to be assembled into a pile of shims. Several attempts with different number of shims are often required before the insertion part has been properly fitted to the crane boom section, which implies that this procedure is rather laborious and time consuming.

SUMMARY OF THE INVENTION

[0005] The object of the present invention is to provide a new and favourable solution to the above-mentioned problem.

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

[0007] The connecting unit of the present invention comprises:

- an insertion part adapted to be inserted into a hollow crane boom section at the tip of a crane boom;
- a holding part, which is fixed to the insertion part and configured to form a support for a crane implement;
- one or more supporting elements, each of which being moveably mounted to the insertion part so as to be moveable transversely to the longitudinal axis of the insertion part in order to allow the supporting element to be pushed outwards in relation to the longitudinal axis of the insertion part and against an inner surface of said crane boom section and thereby take up a play between the insertion part and the crane boom section; and
- an actuating device for moving said one or more supporting elements transversely to the longitudinal axis of the insertion part.

[0008] Thus, the play between the insertion part and the crane boom section is taken up by the supporting elements in a quick and easy manner by adjustment of the position of the supporting elements in relation to the insertion part under the effect of the actuating device after the insertion of the insertion part into the hollow crane boom section. Hereby, the insertion part can be made to fit almost perfectly to the crane boom section after the insertion of the insertion part into the crane boom section, even when there is a large gap between the insertion part and the crane boom section. Consequently, a connecting unit with an insertion part of a given size may be mounted to crane boom sections of various sizes. Furthermore, no laborious and time consuming handling of shims or the similar is required.

[0009] According to an embodiment of the invention, the actuating device comprises:

- a rotatable actuating rod, which extends through an inner space of the insertion part and which is arranged to be rotatable by an operator when the connecting unit is mounted to the tip of the crane boom with the insertion part received in said crane boom section; and
- a link system arranged in the inner space of the insertion part, the link system being configured to transfer a rotary motion of the actuating rod into a translational motion of the supporting elements, wherein the link system is configured to exert a pushing force on each supporting element when the actuating rod is rotated in a first rotary direction and to exert a pulling force on each supporting element when the actuating rod is rotated in an opposite rotary direction.

Hereby, the position of the supporting elements may easily be adjusted by an operator without requiring any supply of electric power or pressurized fluid to the actuating device.

[0010] Another embodiment of the invention is characterized in:

- that the connecting unit comprises two such supporting elements arranged at a distance from each other as seen in the longitudinal direction of the insertion part;
- that the link system comprises a first link mechanism configured to act on a first one of said supporting elements, wherein the first link mechanism is in engagement with the actuating rod through a first connection member, which is provided with an internal thread that is in engagement with an external thread on the actuating rod so that a rotation of the actuating rod will result in a relative movement between the first connection member and the actuating rod in the axial direction of the actuating rod; and
- that the link system comprises a second link mechanism configured to act on a second one of said supporting elements, wherein the actuating rod is rotatably connected to the second link mechanism through a second connection member, the actuating rod being axially fixed to the second connection member so that the second connection member and the actuating rod are prevented from moving in relation to each other in the axial direction of the actuating rod in connection with a rotation of the actuating rod.

[0011] With this arrangement of the link system, the supporting elements are individually moveable outwards in relation to the longitudinal axis of the insertion part by means of one and the same actuating rod, wherein each supporting element is free to continue its movement towards the inner surface of the crane boom section under the effect of the rotating actuating rod and the associated link mechanism when the other supporting element has already reached an end position in contact with the inner surface of the crane boom section and has stopped moving.

[0012] According to another embodiment of the invention, the supporting elements are arranged at an underside or upper side of the insertion part and configured to be moveable upwards and downwards in relation to the insertion part, wherein each supporting element has a V-shaped or convex contact surface configured for engagement with a V-shaped internal wall surface of said crane boom section. With such a positioning and design of the supporting elements, the supporting elements will be capable of preventing the insertion part from moving upwards and downwards and also in lateral direction in relation to the crane boom section when they are pressed against the V-shaped internal wall surface at the lower or upper edge of the crane boom section.

[0013] Another embodiment of the invention is characterized in:

- that the connecting unit comprises a first supporting element arranged on a first side of the actuating rod and a second supporting element arranged opposite the first supporting element on an opposite second side of the actuating rod;
- that the link system comprises a first base part, which is provided with an internal thread that is in engagement with an external thread on the actuating rod so that a rotation of the actuating rod will result in a movement of the first base part in the axial direction of the actuating rod;
- that the link system comprises a second base part, which is fixed to the insertion part and prevented from moving in relation to the insertion part in the longitudinal direction thereof;
- that the link system comprises a first set of links, through which the first supporting element is connected to the first and second base parts, and a second set of links, through which the second supporting element is connected to the first and second base parts; and - that the actuating rod is axially fixed in relation to the second base part of the link system so that the actuating rod is prevented from moving in its axial direction in relation to the second base part in connection with a rotation of the actuating rod.

[0014] With this arrangement of the link system and the supporting elements, the supporting elements are simultaneously moveable in opposite directions in an efficient manner by rotation of the actuating rod and without any axial or other translational movement of the actuating rod. Thus, the interface between the actuating rod and the tool used by the crane operator to rotate the actuating rod will remain in a given position on the connecting unit during the rotation of the actuating rod, which will make it easy for the crane operator to effect the rotation of the actuating rod.

[0015] Further features of the connecting unit accord-

ing to the present invention will appear from the description following below and the dependent claims.

[0016] The invention also relates to a hydraulic crane having the features defined in claim 14.

[0017] 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

[0018] 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 connecting unit according to a first embodiment of the present invention and an associated crane implement in the form of an additional crane boom,
Fig 2	is a perspective view of the connecting unit and crane implement of Fig 1 mounted to a loader crane,
Fig 3	is a longitudinal section through the connecting unit of Fig 1, as seen with the insertion part of the connecting unit received in a hollow crane boom section at the tip of a crane boom,
Fig 4	is a cut according to the line IV-IV in Fig 3, with a supporting element of the connecting unit shown in a retracted position,
Fig 5	is a cut corresponding to Fig 4, with the supporting element shown in an advanced position,
Fig 6	is a partly cut perspective view of the connecting unit of Fig 1, with the supporting elements shown in retracted positions,
Fig 7	is a longitudinal section through the connecting unit of Fig 1, with the supporting elements shown in retracted positions,
Figs 8a-8c	are partly cut lateral views of the connecting unit of Fig 6, with the supporting elements shown in different positions,
Fig 9	is a partly cut perspective view of a connecting unit according to a second embodiment of the invention,
Figs 10a and 10b	are longitudinal sections through the connecting unit of Fig 9, with the supporting elements shown in different positions,
Fig 11	is a partly cut perspective view of a connecting unit according to a third embodiment of the invention,
Figs 12a and 12b	are longitudinal sections through the connecting unit of Fig 11, with the supporting elements shown in different positions,
Fig 13	is a partly cut perspective view of a connecting unit according to a fourth embodiment of the invention,
Fig 14	is a partly cut lateral view of the connecting unit of Fig 13,
Fig 15	is a longitudinal section through the connecting unit of Fig 13,
Figs 16 and 17	are perspective views of a connecting unit according to a fifth embodiment of the invention,
Fig 18	is a cut perspective view of the connecting unit of Figs 16 and 17, as seen with the insertion part of the connecting unit received in a hollow crane boom section at the tip of a crane boom,
Figs 19a and 19b	are longitudinal sections through a part of the connecting unit of Figs 16 and 17, with the supporting elements shown in different positions,
Figs 20a and 20b	are cross-sectional views of the connecting unit of Figs 16 and 17 and a hollow crane boom section, with the supporting elements shown in different positions,
Fig 21	is a perspective view of parts included in the connecting unit of Figs 16 and 17,
Figs 22a and 22b	are perspective views of some of the parts illustrated in Fig 21, with the supporting elements shown in different positions, and
Fig 23	is an exploded view of the parts il-

lustrated in Figs 22a and 22b.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0019] A connecting unit 1 according to different embodiments of the present invention is illustrated in Figs 1-23. The connecting unit 1 is configured for detachable mounting to the tip 2 of a crane boom 27 in order to form a connection between the crane boom and an associated crane implement 4. In the example illustrated in Figs 1 and 2, the crane implement 4 is an additional crane boom, which is telescopically extensible and articulately connected to the connecting unit 1 in such a manner that it is pivotable in relation to it about an axis of rotation that is essentially horizontal when the connecting unit 1 is mounted to the first-mentioned crane boom 27. A hydraulic cylinder 6 is arranged between the connecting unit 1 and the additional crane boom 4 in order to pivot the additional crane boom 4 in relation to the connecting unit 1. As an alternative, the connecting unit 1 could be configured to carry any other suitable type of crane implement, such as for instance an aerial working platform.

[0020] The connecting unit 1 comprises an insertion part 10, which is adapted to be inserted into a hollow crane boom section 27b6 at the tip 2 of the crane boom 27, and a holding part 11, which is rigidly fixed to the insertion part 10 and configured to form a support for the crane implement 4. The holding part 11 is configured to project from the tip 2 of the crane boom 27 when the connecting unit 1 is mounted to the tip of the crane boom with the insertion part 10 received in said hollow crane boom section 27b6.

[0021] The connecting unit 1 comprises at least one supporting element 12a, 12b, 12a', 12b' which is moveably mounted to the insertion part 10 so as to be moveable transversely to the longitudinal axis of the insertion part in order to allow the supporting element to be pushed outwards in relation to the longitudinal axis of the insertion part 10 and against an inner surface of said hollow crane boom section 27b6 and thereby take up a play between the insertion part 10 and this hollow crane boom section. Thus, each supporting element 12a, 12b, 12a', 12b' is moveable in relation to the insertion part 10 between a retracted position and an advanced position. The connecting unit 1 also comprises an actuating device 13 for moving the supporting elements 12a, 12b, 12a', 12b' transversely to the longitudinal axis of the insertion part 10. Thus, each supporting element 12a, 12b, 12a', 12b' are moveable in relation to the insertion part 10 under the effect of the actuating device 13.

[0022] In the example illustrated in Fig 2, the connecting unit 1 is mounted to a crane boom 27 of a hydraulic loader crane 20. The illustrated crane 20 is mounted on a frame 21, which for instance may be connected to the chassis of a lorry. The frame 21 is provided with adjustable support legs 22 for supporting the crane 20. The crane 20 comprises:

- a crane base 23, which is fixed to the frame 21;
- a column 24, which is rotatably mounted to the crane base 23 so as to be rotatable in relation to the crane base about an essentially vertical axis of rotation by means of an actuating unit;
- a liftable and lowerable first crane boom 25, in the following denominated inner boom, which is articulately connected to the column 24 in such a manner that it is pivotable in relation to the column about an essentially horizontal axis of rotation;
- a first hydraulic cylinder 26 for lifting and lowering the inner boom 25 in relation to the column 24;
- a liftable and lowerable second crane boom 27, in the following denominated outer boom, which is articulately connected to the inner boom 25 in such a manner that it is pivotable in relation to the inner boom about an essentially horizontal axis of rotation; and
- a second hydraulic cylinder 28 for lifting and lowering of the outer boom 27 in relation to the inner boom 25.

[0023] 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.

[0024] The outer boom 27 is telescopically extensible to enable an adjustment of the extension length thereof. The outer boom 27 comprises a base section 27a, through which the outer boom 27 is articulately connected to the inner boom 25, and several telescopic and hollow crane boom sections 27b1-27b6 which are carried by the base section 27a and displaceable in the longitudinal direction of the base section by means of hydraulic cylinders 29 for adjustment of the extension length of the outer boom 27. In this case, the connecting unit 1 is detachably mountable to the outer boom 27 by insertion of the insertion part 10 into the inner space of the foremost telescopic crane boom section 27b6 through an opening at the outer end of this crane boom section. The connecting unit 1 of the present invention may of course also be designed for mounting to a hollow crane boom section of any other desired type of crane boom.

[0025] In the embodiments illustrated in Figs 3-8 and Figs 16-23, the actuating device 13 comprises:

- a rotatable actuating rod 35, which extends through an inner space 36 of the insertion part 10 and which is arranged to be rotatable by an operator of the crane when the connecting unit is mounted to the tip 2 of the crane boom 27 with the insertion part 10 received in the crane boom section 27b6; and
- a link system 37, 37', which is arranged in the inner space 36 of the insertion part 10 and configured to

transfer a rotary motion of the actuating rod 35 into a translational motion of the supporting elements 12a, 12b, 12a', 12b', wherein the link system 37, 37' is configured to exert a pushing force on each supporting element 12a, 12b, 12a', 12b' when the actuating rod 35 is rotated in a first rotary direction and to exert a pulling force on each supporting element 12a, 12b, 12a', 12b' when the actuating rod 35 is rotated in an opposite second rotary direction.

[0026] Thus, each supporting element 12a, 12b, 12a', 12b' is moveable in relation to the insertion part 10 from the retracted position to the advanced position by rotation of the actuating rod 35 in said first rotary direction, and moveable in relation to the insertion part 10 from the advanced position to the retracted position by rotation of the actuating rod 35 in said second rotary direction. The actuating rod 35 is at one end provided with a tool fitting 38 designed for detachable engagement with a tool to be used for rotating the actuating rod 35 in order to control the movement of the supporting elements 12a, 12b, 12a', 12b' in relation to the insertion part 10. The actuating rod 35 extends through a recess 39 in an external wall 40 of the connecting unit 1 to thereby make the tool fitting 38 accessible from the outside of the connecting unit 1 when the insertion part 10 is received inside the associated crane boom section 27b6.

[0027] In the illustrated embodiments, the rotatable actuating rod 35 is configured to control the movement of two supporting elements 12a, 12b, 12a', 12b'. However, a rotatable actuating rod 35 of the type described above may also be configured to control the movement of only one supporting element or more than two supporting elements.

[0028] In the embodiments illustrated in Figs 1-15, the connecting unit 1 is provided with two supporting elements 12a, 12b arranged at a distance from each other as seen in the longitudinal direction of the insertion part 10, wherein one supporting element 12a preferably is arranged at a first end of the insertion part 10 and the other supporting element 12b preferably is arranged at an opposite second end of the insertion part.

[0029] In the embodiments illustrated in Figs 1-15, each supporting element 12a, 12b is slidably mounted to a wall 30 of the insertion part 10 so as to be linearly slidable perpendicularly to the longitudinal axis of the insertion part. The slidable connection between the supporting element 12a, 12b and the associated wall 30 may for instance be achieved in that a cylindrical base part 14 of the supporting element 12a, 12b extends through a corresponding channel 31 in a sleeve-shaped holding member 32 fixed to said wall 30, wherein an outer surface of the cylindrical base part 14 is in sliding contact with the inner surface of the channel 31. The supporting elements 12a, 12b may be configured to be moveable downwards and upwards in relation to the insertion part 10, wherein the supporting elements are arranged at an underside of the insertion part 10, as illustrated in Figs 1-15, or at an upper side of the insertion part. When the supporting elements 12a, 12b are moveable downwards and upwards in relation to the insertion part 10, each supporting element preferably has a V-shaped or convex contact surface 15 configured for engagement with a V-shaped internal wall surface 33 (see Figs 4 and 5) at the lower or upper edge of the associated crane boom section 27b6. Hereby, the supporting elements 12a, 12b will prevent the insertion part 10 from moving upwards and downwards and also laterally in relation to the said crane boom section 27b6 when they are pressed against the V-shaped internal wall surface 33 of the crane boom section. When the supporting elements 12a, 12b are provided with V-shaped contact surfaces 15, the supporting elements may also effect a centering of the insertion part 10 inside the associated crane boom section 27b6 when they are pressed against the V-shaped internal wall surface 33 of the crane boom section.

[0030] In the embodiments illustrated in Figs 1-15, each supporting element 12a, 12b comprises a support member 16, which is fixed to an outer end of the cylindrical base part 14 of the supporting element and located on the outside of the insertion part 10, wherein the above-mentioned contact surface 15 of the supporting element is provided on this support member 16.

[0031] The link system 37 illustrated in Figs 3-8 comprises:

- a first link mechanism 37a configured to act on a first supporting element 12a, wherein this first link mechanism 37a is in engagement with the actuating rod 35 through a first connection member 41a, which is provided with an internal thread 42 (see Fig 7) that is in engagement with an external thread 43 on the actuating rod 35 so that a rotation of the actuating rod will result in a relative movement between the first connection member 41a and the actuating rod 35 in the axial direction of the actuating rod; and
- a second link mechanism 37b configured to act on a second supporting element 12b, wherein the actuating rod 35 is rotatably connected to the second link mechanism 37b through a second connection member 41b, the actuating rod 35 being axially fixed to the second connection member 41b so that the second connection member and the actuating rod are prevented from moving in relation to each other in the axial direction of the actuating rod 35 in connection with a rotation of the actuating rod.

[0032] With the above-mentioned arrangement of the connection members 41a, 41b, the distance between them is gradually changed when the actuating rod 35 is rotated.

[0033] In the embodiment illustrated in Figs 3-8, the first link mechanism 37a comprises a first link 45, which at a first end is articulately connected to the first supporting element 12a and at an opposite second end is articulately connected to the first connection member 41a,

and a second link 46, which at a first end is articulately connected to the first connection member 41a and at an opposite second end is articulately connected to a wall 47 of the insertion part 10. The second link mechanism 37b comprises a third link 48, which at a first end is articulately connected to the second supporting element 12b and at an opposite second end is articulately connected to the second connection member 41, and a fourth link 49, which at a first end is articulately connected to the second connection member 41b and at an opposite second end is articulately connected to said wall 47 of the insertion part 10. Each one of the above-mentioned links 45, 46, 48, 49 suitably comprises two link elements arranged in parallel with each other on opposite sides of the associated connection member 41a, 41b, as illustrated in Fig 6.

[0034] In the illustrated example, the distance between the first and second connection members 41a, 41b is arranged to be at a maximum when the supporting elements 12a, 12b are in the retracted position, wherein the two links of each link mechanism 37a, 37b are inclined away from the two links of the other link mechanism 37b, 37a. In this case, the distance between the first and second connection members 41a, 41b is:

- reduced when the actuating rod 35 is rotated in the above-mentioned first direction in order to move the supporting elements 12a, 12b outwards in relation to the longitudinal axis of the insertion part 10, as illustrated in Figs 8a-8c, and
- increased when the actuating rod 35 is rotated in the opposite direction in order to move the supporting elements 12a, 12b inwards in relation to the longitudinal axis of the insertion part 10.

[0035] As an alternative, the distance between the first and second connection members 41a, 41b may be arranged to be at a minimum when the supporting elements 12a, 12b are in the retracted position, wherein the two links of each link mechanism 37a, 37b are inclined towards the two links of the other link mechanism 37b, 37a. In the latter case, the distance between the first and second connection members 41a, 41b is increased when the actuating rod 35 is rotated to move the supporting elements 12a, 12b outwards in relation to the longitudinal axis of the insertion part 10 and reduced when the actuating rod 35 is rotated in the opposite direction in order to move the supporting elements 12a, 12b inwards in relation to the longitudinal axis of the insertion part 10.

[0036] The connecting unit 1 may be locked to the associated crane boom section 27b6 by means of a locking bolt (not shown) that is inserted into holes 50 provided in the insertion part 10 and corresponding holes provided at the outer end of the crane boom section 27b6.

[0037] The embodiment illustrated in Figs 9 and 10 corresponds to the embodiment illustrated in Figs 3-8, with the exception that the actuating rod 35 has been replaced by a hydraulic cylinder 51, which is configured to control the movements of the supporting elements 12a, 12b via a link system 37 designed in essentially the same way as the link system described above. The piston rod 52 of the hydraulic cylinder 51 is articulately connected to one of the link mechanisms 37a, 37b of the link system 37 and the cylinder part 53 of the hydraulic cylinder is articulately connected to the other link mechanism. The hydraulic cylinder 51 is connectable to the hydraulic system of the crane 20 by means of a hydraulic coupling (not shown) when the insertion part 10 of the connecting unit 1 has been inserted into the crane boom section 27b6. The supply of hydraulic fluid to the hydraulic cylinder 51 is preferably controlled by the crane operator by means of a valve device (not shown), which is fixed to the connecting unit 1 and provided with a manually manoeuvrable manoeuvring member that is accessible from the outside of the connecting unit 1 when the insertion part 10 is received inside the crane boom section 27b6.

[0038] In the embodiment illustrated in Figs 11 and 12, the actuating device 13 comprises a first hydraulic cylinder 55a for effecting the movement of the first supporting element 12a and a second hydraulic cylinder 55b for effecting the movement of the second supporting element 12a. Each hydraulic cylinder 55a, 55b comprises a cylinder part 56 and a piston 57 displaceably received inside the cylinder part, wherein each supporting element 12a, 12b is connected to the piston 57 of the associated hydraulic cylinder. In the illustrated example, the cylindrical base part 14 of each supporting element 12a, 12b is fixed directly to the piston 57 of the associated hydraulic cylinder, which implies that this base part 14 will function as a piston rod for the hydraulic cylinder. The hydraulic cylinders 55a, 55b are connectable to the hydraulic system of the crane 20 by means of a hydraulic coupling (not shown) when the insertion part 10 of the connecting unit 1 has been inserted into the crane boom section 27b6. The supply of hydraulic fluid to the hydraulic cylinders 55a, 55b is preferably controlled by the crane operator by means of a valve device (not shown), which is fixed to the connecting unit 1 and provided with a manually manoeuvrable manoeuvring member that is accessible from the outside of the connecting unit 1 when the insertion part 10 is received inside the crane boom section 27b6.

[0039] The embodiment illustrated in Figs 13-15 corresponds to the embodiment illustrated in Figs 3-8, with the exception that the actuating rod 35 has been replaced by a flexible and elongated pulling element 60 in the form of a rope, a wire, a cable, a band or the similar, which is configured to control the movements of the supporting elements 12a, 12b via a link system 37 designed in essentially the same way as the link system described above. The pulling element 60 runs over a pulley 61, which is rotatably connected to the second link mechanism 37b of the link system 37. One end of the pulling element 60 is fixed to the first link mechanism 37a of the link system and the other end of the pulling element is fixed to a connection member 62, which in its turn is fixed

to an external wall 40 of the connecting unit 1. The connection member 62 is provided with a shaft 63, which extends through a recess 64 in the external wall 40. A nut 64 is in threaded engagement with an external thread on the shaft 63 and abuts against a shoulder 65 on the outside of the external wall 40. By rotation of the nut 64, the pulling element 60 can be made to exert a pulling force on the first and second link mechanisms 37a, 37b in order to thereby push the supporting elements 12a, 12b outwards in relation to the longitudinal axis of the insertion part 10. When the insertion part 10 is to be released from the associated crane boom section 27b6, the nut is rotated in the opposite direction in order to reduce the tension of the pulling element 60 and thereby allow the gravity to force the insertion part 10 downwards towards the support members 16 of the supporting elements 12a, 12b.

[0040] As a further alternative, the actuating device 13 could comprise one or more electric motors for effecting the movement of the supporting elements 12a, 12b.

[0041] In the embodiment illustrated in Figs 16-23, the connecting unit 1 comprises a first supporting element 12a' arranged on a first side of the actuating rod 35 and a second supporting element 12b' arranged opposite the first supporting element 12a' on an opposite second side of the actuating rod 35, wherein the supporting elements 12a', 12b' are laterally moveable in relation to the insertion part 10.

[0042] In the embodiment illustrated in Figs 16-23, each supporting element 12a', 12b' comprises a base structure 70 and two support members 71 which are fixed to the base structure 70 and moveable in relation to the insertion part 10 together with the base structure 70. Each support member 71 of the first supporting element 12a' is moveable through an associated recess 72 in a first lateral wall 73 of the insertion part 10, and each support member 71 of the second supporting element 12b' is moveable through an associated recess 74 in a second lateral wall 75 of the insertion part 10 located opposite said first lateral wall 73.

[0043] The link system 37' included in the connecting unit 1 illustrated in Figs 16-23 comprises:

- a first base part 80a, which is provided with an internal thread 81 (see Figs 19a and 19b) that is in engagement with an external thread 82 on the actuating rod 35 so that a rotation of the actuating rod 35 will result in a movement of the first base part 80a in the axial direction of the actuating rod;
- a second base part 80b, which is fixed to the insertion part 10 and prevented from moving in relation to the insertion part in the longitudinal direction thereof; and
- a first set of links 83a, through which the first supporting element 12a' is connected to the first and second base parts 80a, 80b, and a second set of links 83b, through which the second supporting element 12b' is connected to the first and second base parts 80a, 80b.

[0044] In the illustrated example, the second base part 80b is fixed to the insertion part 10 by means of two locking pins 88a, 88b, which are fixed to the second base part 80b on opposite sides thereof. A first locking pin 88a has an inner end received in a hole 93a on a first side of the second base part 80b and an outer end received in a recess 89a provided in the first lateral wall 73 of the insertion part 10. A second locking pin 88b has an inner end received in a hole 93b on a second side of the second base part 80b and an outer end received in a recess 89b provided in the second lateral wall 75 of the insertion part 10. Each locking pin 88a, 88b is provided with an external thread that is in engagement with an internal thread in the associated hole 93a, 93b. Thus, the position of each locking pin 88a, 88b in relation to the second base part 80b may be adjusted by rotation of the locking pin.

[0045] The actuating rod 35 is axially fixed in relation to the second base part 80b of the link system 37' so that the actuating rod is prevented from moving in its axial direction in relation to the second base part 80b when the actuating rod is rotated. In the illustrated example, the actuating rod 35 extends through a through hole 92 in the second base part 80b.

[0046] In the illustrated example, the above-mentioned first set of links 83a comprises:

- a first link 84, which at a first end is articulately connected to the first supporting element 12a' and at an opposite second end is articulately connected to the first base part 80a.
- a second link 85, which at a first end is articulately connected to the first supporting element 12a' and at an opposite second end is articulately connected to the second base part 80b; and

[0047] In the illustrated example, the above-mentioned second set of links 83b comprises:

- a third link 86, which at a first end is articulately connected to the second supporting element 12b' and at an opposite second end is articulately connected to the first base part 80a, and
- a fourth link 87, which at a first end is articulately connected to the second supporting element 12b' and at an opposite second end is articulately connected to the second base part 80b.

[0048] With the above-mentioned arrangement of the first and second base parts 80a, 80b, the first base part 80a is moved in relation to the second base part 80b in the axial direction of the actuating rod 35 when the actuating rod is rotated. The distance between the first and second base parts 80a, 80b is arranged to be at a maximum when the supporting elements 12a', 12b' are in the retracted position. The first base part 80a is moved towards the second base part 80b when the actuating rod 35 is rotated in the above-mentioned first rotary direction in order to move the supporting elements 12a', 12b' out-

wards in relation to the longitudinal axis of the insertion part 10, as illustrated in Figs 19a and 19b, and the first base part 80a is moved away from the second base part 80b when the actuating rod 35 is rotated in the above-mentioned second rotary direction in order to move the supporting elements 12a', 12b' inwards in relation to the longitudinal axis of the insertion part 10.

[0049] The first and second supporting elements 12a', 12b' are to be in the retracted position during the insertion of the insertion part 10 into a hollow crane boom section 27b6 at the tip of a crane boom 27. Thereafter, the crane operator rotates the actuating rod 35 in the above-mentioned first rotary direction in order to move the first base part 80a of the link system 37' towards the second base part 80b and thereby make the links 84-87 push the first and second supporting elements 12a', 12b' in opposite directions outwards in relation to the longitudinal axis of the insertion part 10. Each support member 71 of the first supporting element 12a' is thereby moved through the associated recess 72 in the first lateral wall 73 of the insertion part 10 and into contact with a first lateral wall 90 of the hollow crane boom section 27b6 on a first side of the insertion part 10, at the same time as each support member 71 of the second supporting element 12b' is moved through the associated recess 74 in the second lateral wall 75 of the insertion part 10 and into contact with a second lateral wall 91 of the hollow crane boom section 27b6 on an opposite second side of the insertion part 10. When the connecting unit 1 is to be released from the crane boom 27, the crane operator rotates the actuating rod 35 in the above-mentioned second rotary direction in order to move the first base part 80a of the link system 37' away the second base part 80b and thereby make the links 84-87 pull the first and second supporting elements 12a', 12b' inwards in relation to the longitudinal axis of the insertion part 10, wherein the support members 71 are moved out of contact with the lateral walls 90, 91 of the hollow crane boom section 27b6.

[0050] In order to adapt the supporting elements 12a', 12b' to the internal width of the insertion part 10, a plate-like element 76, a so-called shim, of suitable thickness may be positioned in contact with the outwardly facing surface of the base structure 70 of each supporting element 12a', 12b'. Each shim 76 is configured to come into contact with the adjacent lateral wall 73, 75 of the insertion part 10 when the supporting elements 12a', 12b' reach the advanced position to thereby stabilize the insertion part 10 in relation to the supporting elements 12a', 12b'. Thus, each shim 76 is configured to take up the possible play between the associated base structure 70 and the adjacent lateral wall 73, 75 of the insertion part 10 when the supporting elements 12a', 12b' are in the advanced position with the support members 71 in contact with the lateral walls 90, 91 of the hollow crane boom section 27b6. If the supporting elements 12a', 12b' are so dimensioned that no such play exists, no shim 76 is necessary.

[0051] 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 basic idea of the invention such as defined in the appended claims.

Claims

1. A connecting unit configured for detachable mounting to the tip (2) of a crane boom (27) in order to form a connection between the crane boom and an associated crane implement (4), the connecting unit (1) comprising:

   - an insertion part (10) adapted to be inserted into a hollow crane boom section (27b6) at the tip of the crane boom; and
   - a holding part (11), which is fixed to the insertion part (10) and configured to form a support for the crane implement (4), **characterized in that** the connecting unit (1) further comprises:
   - one or more supporting elements (12a, 12b; 12a', 12b'), each of which being moveably mounted to the insertion part (10) so as to be moveable transversely to the longitudinal axis of the insertion part in order to allow the supporting element (12a, 12b; 12a', 12b') to be pushed outwards in relation to the longitudinal axis of the insertion part (10) and against an inner surface of said crane boom section (27b6) and thereby take up a play between the insertion part (10) and the crane boom section (27b6); and
   - an actuating device (13) for moving said one or more supporting elements (12a, 12b; 12a', 12b') transversely to the longitudinal axis of the insertion part (10).

2. A connecting unit according to claim 1, **characterized in that** the actuating device (13) comprises:

   - a rotatable actuating rod (35), which extends through an inner space (36) of the insertion part (10) and which is arranged to be rotatable by an operator when the connecting unit (1) is mounted to the tip (2) of the crane boom with the insertion part (10) received in said crane boom section (27b6); and
   - a link system (37; 37') arranged in the inner space (36) of the insertion part (10), the link system (37; 37') being configured to transfer a rotary motion of the actuating rod (35) into a translational motion of the supporting elements (12a, 12b; 12a', 12b'), wherein the link system (37; 37') is configured to exert a pushing force on each supporting element (12a, 12b; 12a', 12b') when the actuating rod (35) is rotated in a first rotary direction and to exert a pulling force on

each supporting element (12a, 12b; 12a', 12b') when the actuating rod (35) is rotated in an opposite rotary direction.

3. A connecting unit according to claim 2, **characterized in that** the actuating rod (35) extends through a recess (39) in an external wall (40) of the connecting unit (1).

4. A connecting unit according to claim 2 or 3, **characterized in:**

- **that** the connecting unit (1) comprises two such supporting elements (12a, 12b) arranged at a distance from each other as seen in the longitudinal direction of the insertion part (10);
- **that** the link system (37) comprises a first link mechanism (37a) configured to act on a first one (12a) of said supporting elements, wherein the first link mechanism (37a) is in engagement with the actuating rod (35) through a first connection member (41a), which is provided with an internal thread (42) that is in engagement with an external thread (43) on the actuating rod (35) so that a rotation of the actuating rod (35) will result in a relative movement between the first connection member (41a) and the actuating rod (35) in the axial direction of the actuating rod; and
- **that** the link system (37) comprises a second link mechanism (37b) configured to act on a second one (12b) of said supporting elements, wherein the actuating rod (35) is rotatably connected to the second link mechanism (37b) through a second connection member (41b), the actuating rod (35) being axially fixed to the second connection member (41b) so that the second connection member (41b) and the actuating rod (35) are prevented from moving in relation to each other in the axial direction of the actuating rod (35) in connection with a rotation of the actuating rod.

5. A connecting unit according to claim 4, **characterized in:**

- **that** the first link mechanism (37a) comprises a first link (45), which at a first end is articulately connected to the first supporting element (12a) and at an opposite second end is articulately connected to the first connection member (41a), and a second link (46), which at a first end is articulately connected to the first connection member (41a) and at an opposite second end is articulately connected to a wall of the insertion part (10); and
- **that** the second link mechanism (37b) comprises a third link (48), which at a first end is articulately connected to the second supporting element (12b) and at an opposite second end is articulately connected to the second connection member (41b), and a fourth link (49), which at a first end is articulately connected to the second connection member (41b) and at an opposite second end is articulately connected to a wall of the insertion part (10).

6. A connecting unit according to any of claims 1-5, **characterized in that** each supporting element (12a, 12b) is slidably mounted to a wall (30) of the insertion part (10) so as to be linearly slidable perpendicularly to the longitudinal axis of the insertion part.

7. A connecting unit according to any of claims 1-6, **characterized in:**

- **that** the supporting elements (12a, 12b) are arranged at an underside or upper side of the insertion part (10) and configured to be moveable upwards and downwards in relation to the insertion part (10); and
- **that** each supporting element (12a, 12b) has a V-shaped or convex contact surface (15) configured for engagement with a V-shaped internal wall surface (33) of said crane boom section (27b6).

8. A connecting unit according to claim 2 or 3, **characterized in:**

- **that** the connecting unit (1) comprises a first supporting element (12a') arranged on a first side of the actuating rod (35) and a second supporting element (12b') arranged opposite the first supporting element (12a') on an opposite second side of the actuating rod (35);
- **that** the link system (37') comprises a first base part (80a), which is provided with an internal thread (81) that is in engagement with an external thread (82) on the actuating rod (35) so that a rotation of the actuating rod (35) will result in a movement of the first base part (80a) in the axial direction of the actuating rod;
- **that** the link system (37') comprises a second base part (80b), which is fixed to the insertion part (10) and prevented from moving in relation to the insertion part in the longitudinal direction thereof;
- **that** the link system (37') comprises a first set of links (83a), through which the first supporting element (12a') is connected to the first and second base parts (80a, 80b), and a second set of links (83b), through which the second supporting element (12b') is connected to the first and second base parts (80a, 80b); and
- **that** the actuating rod (35) is axially fixed in

relation to the second base part (80b) of the link system so that the actuating rod is prevented from moving in its axial direction in relation to the second base part (80b) in connection with a rotation of the actuating rod (35).

9. A connecting unit according to claim 8, **characterized in:**

- **that** said first set of links (83a) comprises:

  • a first link (84), which at a first end is articulately connected to the first supporting element (12a') and at an opposite second end is articulately connected to the first base part (80a), and
  • a second link (85), which at a first end is articulately connected to the first supporting element (12a') and at an opposite second end is articulately connected to the second base part (80b); and

- **that** said second set of links (83b) comprises:

  • a third link (86), which at a first end is articulately connected to the second supporting element (12b') and at an opposite second end is articulately connected to the first base part (80a), and
  • a fourth link (87), which at a first end is articulately connected to the second supporting element (12b') and at an opposite second end is articulately connected to the second base part (80b).

10. A connecting unit according to claim 8 or 9, **characterized in that** the first supporting element (12a') comprises a base structure (70) and two or more support members (71) which are fixed to the base structure (70) and moveable in relation to the insertion part (10) together with the base structure, wherein each support member (71) of the first supporting element (12a') in moveable through an associated recess (72) in a first lateral wall (73) of the insertion part (10).

11. A connecting unit according to claim 10, **characterized in that** the second supporting element (12b') comprises a base structure (70) and two or more support members (71) which are fixed to the base structure (70) and moveable in relation to the insertion part (10) together with the base structure, wherein each support member (71) of the second supporting element (12b') is moveable through an associated recess (74) in a second lateral wall (75) of the insertion part (10) located opposite said first lateral wall (73).

12. A connecting unit according to claim 1, **characterized in that** the actuating device (13) comprises at least one hydraulic cylinder (51; 55a, 55b) for effecting the movement of said one or more supporting elements (12a, 12b).

13. A connecting unit according to claim 12, **characterized in that** each supporting element (12a, 12b) is associated with its own hydraulic cylinder (55a, 55b) and is connected to a piston (57) of this hydraulic cylinder.

14. A hydraulic crane comprising at least one liftable and lowerable crane boom (27), which at an outer end is provided with a hollow crane boom section (27b6), **characterized in that** the hydraulic crane (20) comprises a connecting unit (1) according to any of claims 1-13 and a crane implement (4) which is connectable to said crane boom (27) by means of the connecting unit (1), wherein the insertion part (10) of the connecting unit (1) is insertable into said hollow crane boom section (27b6).

15. A hydraulic crane according to claim 14, **characterized in that** the crane implement is an additional crane boom (4) or a working platform.

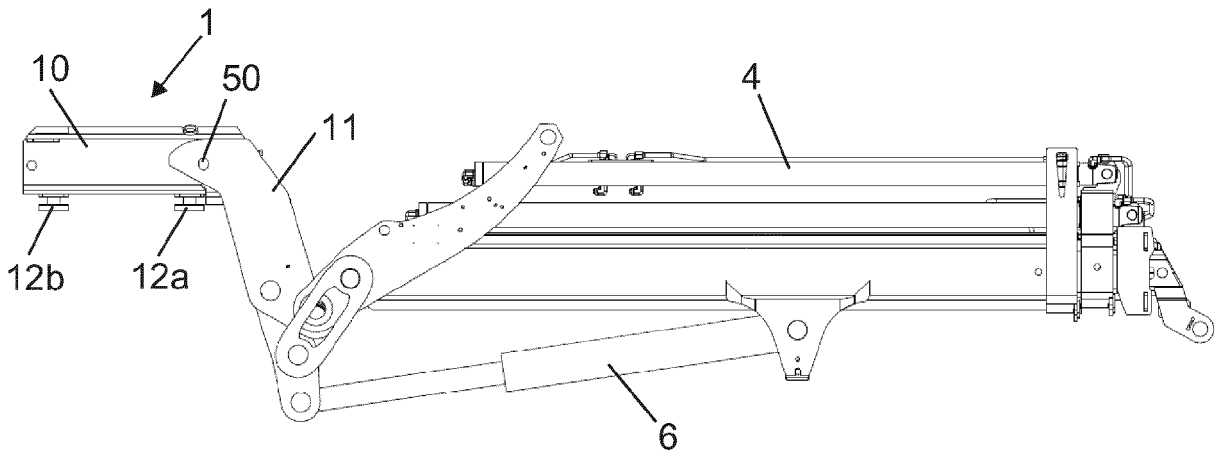
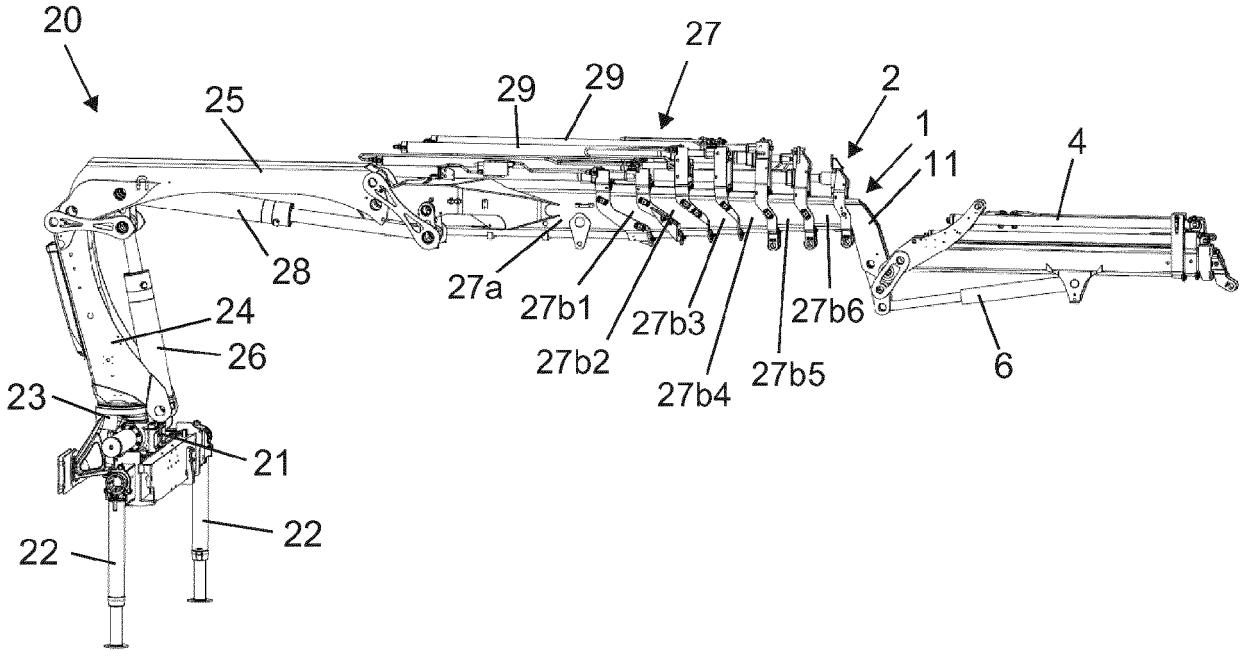

1
10
50
11
4
12b
12a
6

Fig 1


20
25
29
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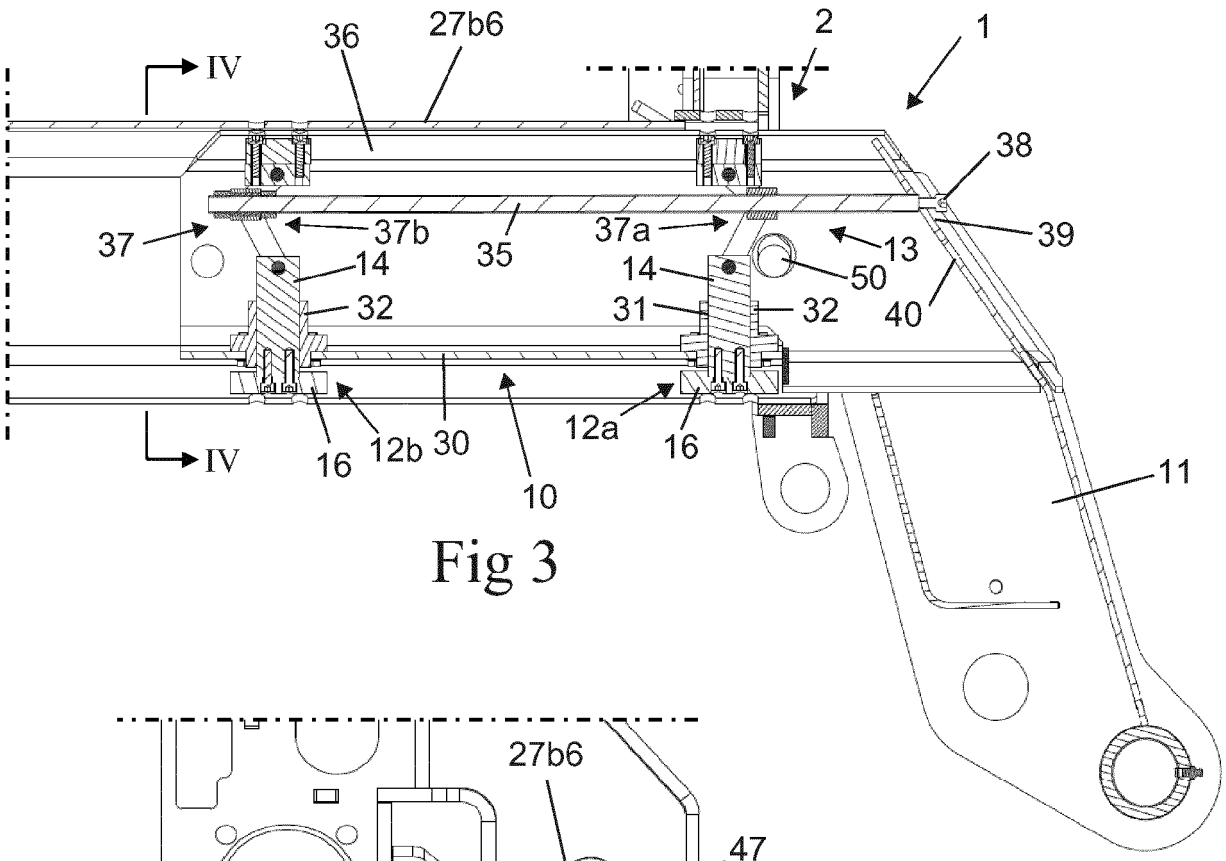
27
2
1
11
4
28
27a
27b1
27b3
27b6
24
26
27b2
27b4
27b5
6
23
21
22
22

Fig 2


IV
36
27b6
2
1
38
37
37b
35
37a
13
39
14
14
50
32
31
32
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IV
16
12b
30
12a
16
10
11

Fig 3

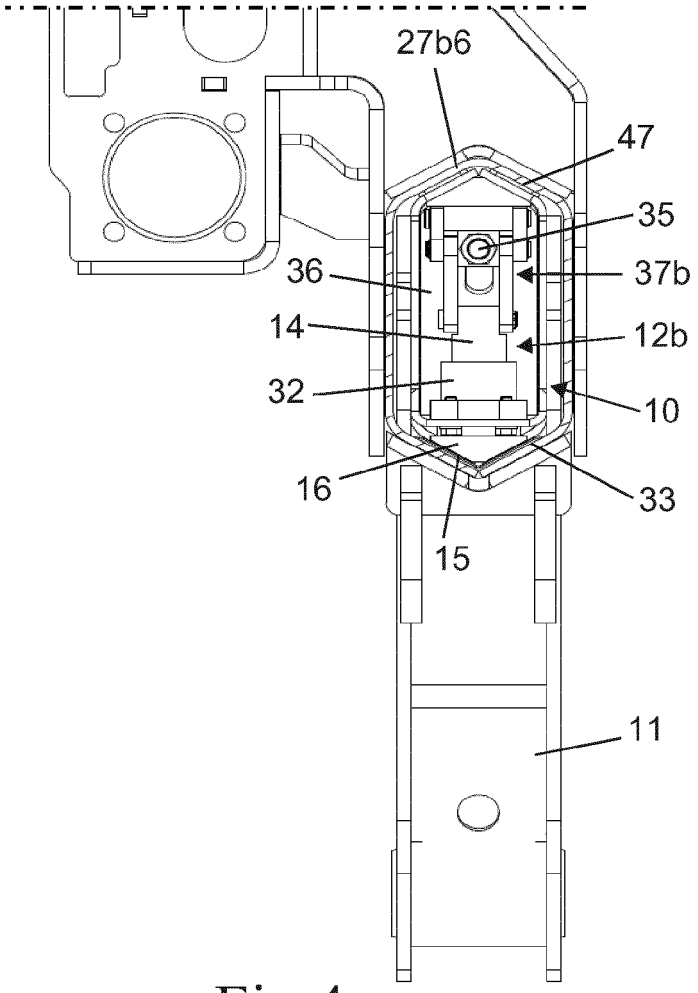

27b6
47
35
36
37b
14
12b
32
10
16
33
15
11

Fig 4

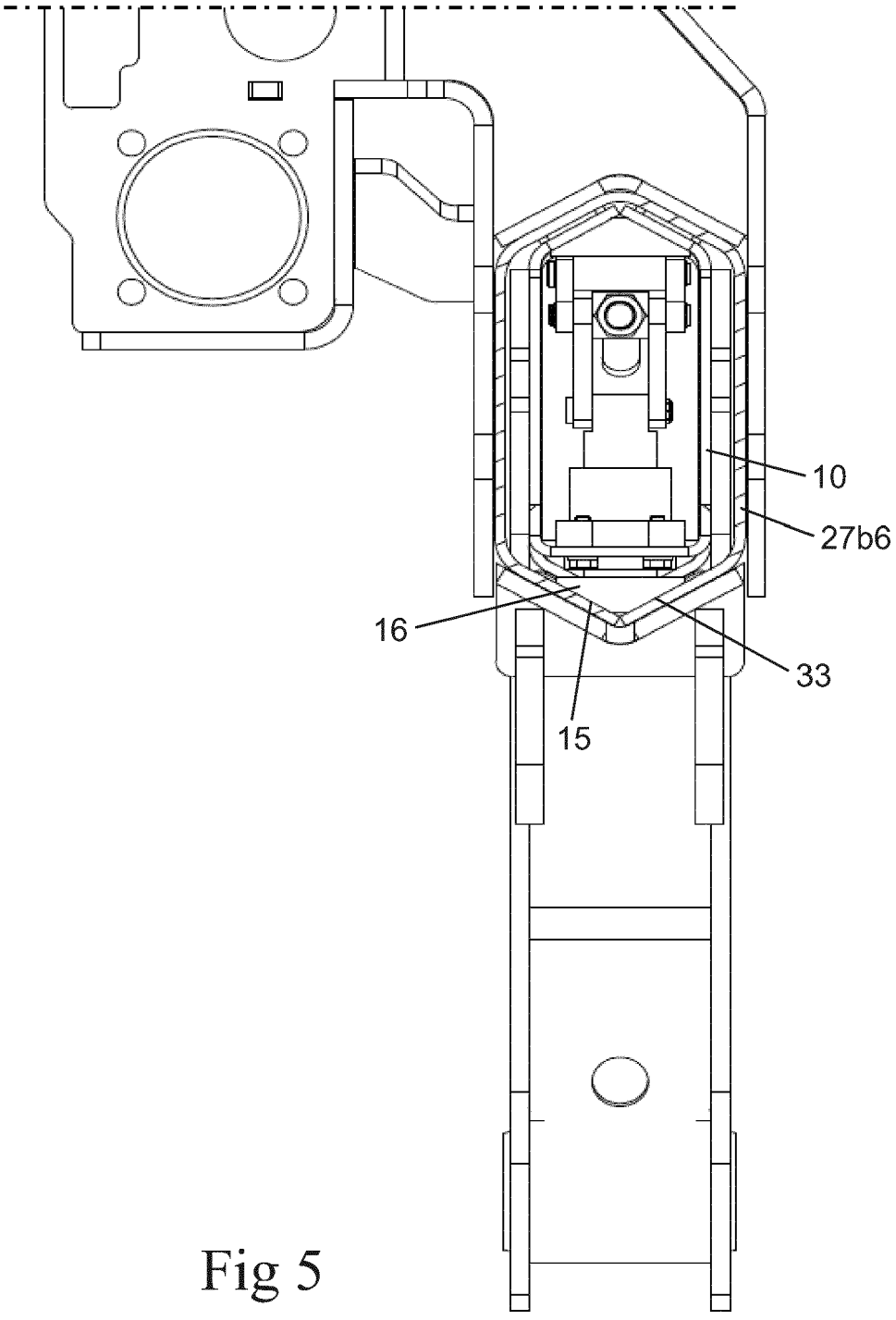


Fig 5

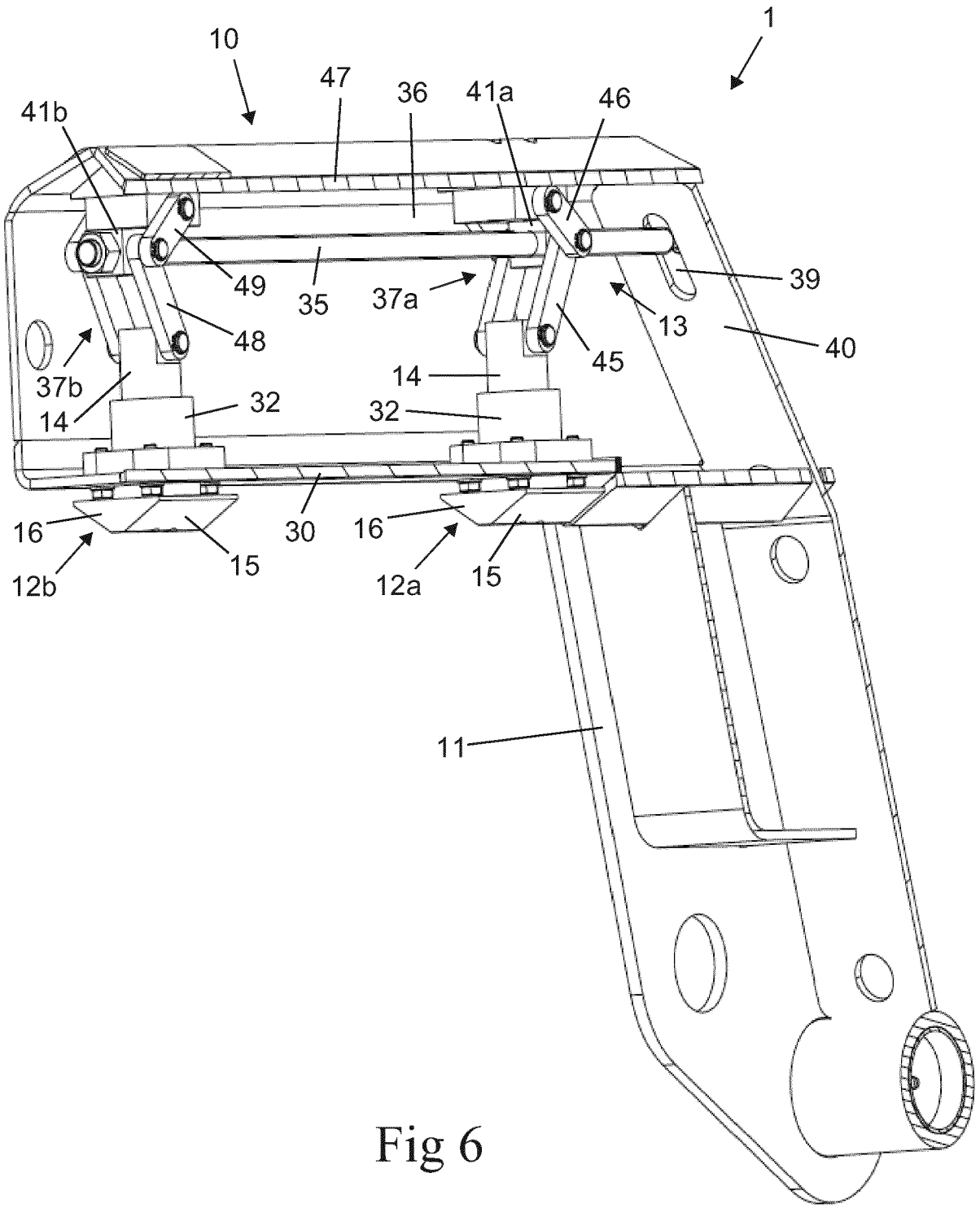
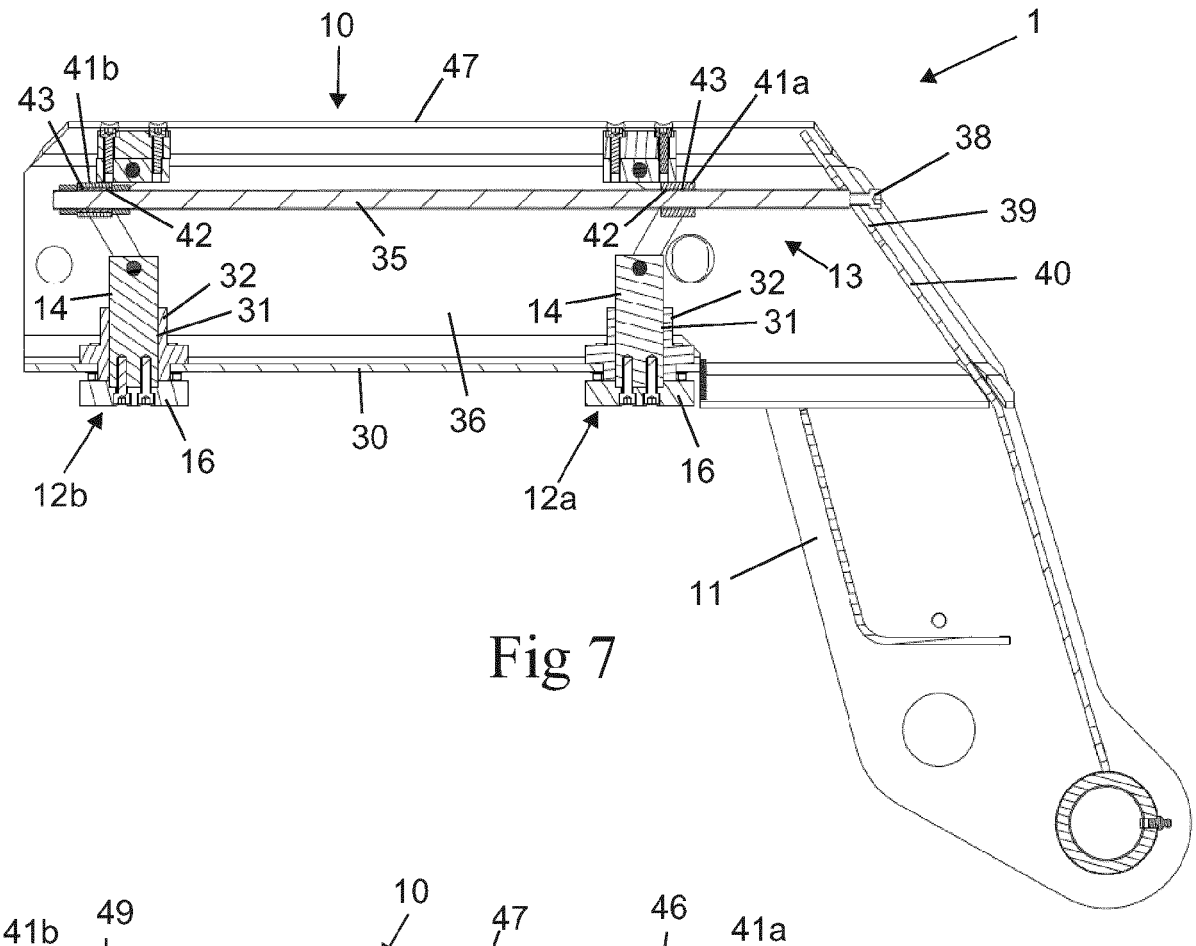

1
10
47
36
41a
46
41b
49
35
37a
39
13
40
48
45
37b
14
32
14
32
16
30
16
15
12b
12a
15
11

Fig 6


10
1
41b
47
43
41a
43
38
42
42
39
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40
32
32
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31
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31
30
36
16
16
12b
12a
11

Fig 7

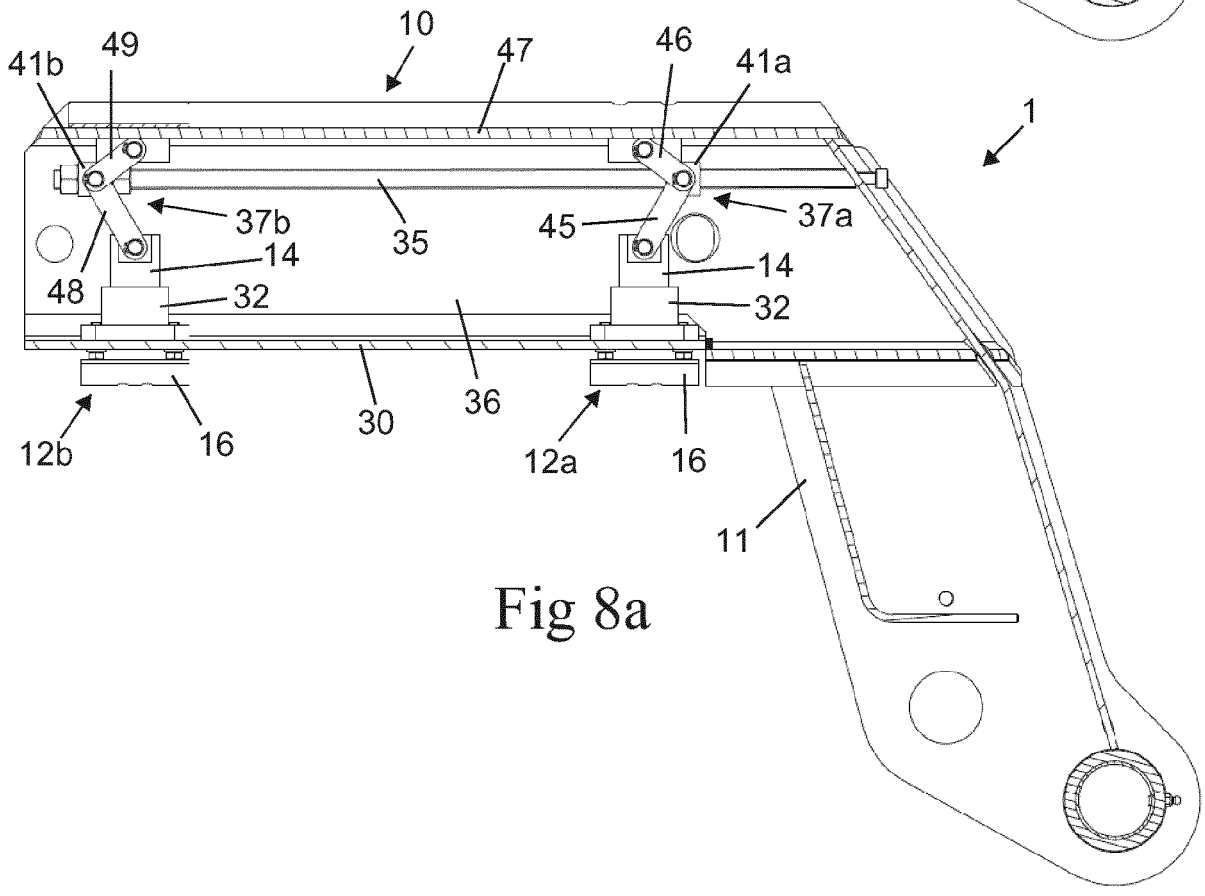
10
41b
49
47
46
41a
1
37b
35
45
37a
14
14
48
32
32
30
36
16
16
12b
12a
11

Fig 8a

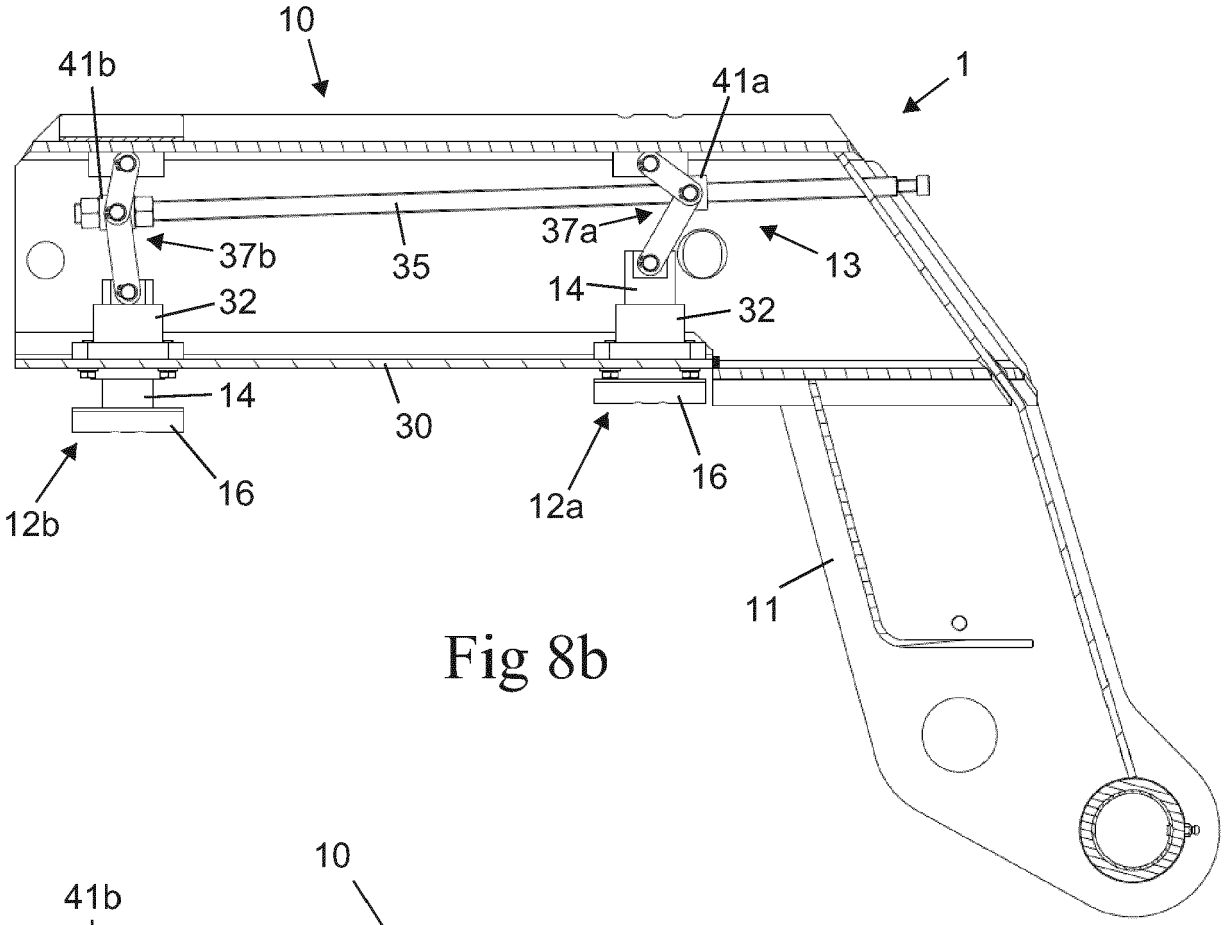
10
41b
41a
1
37b
35
37a
13
32
14
32
14
30
16
12b
16
12a
11

Fig 8b

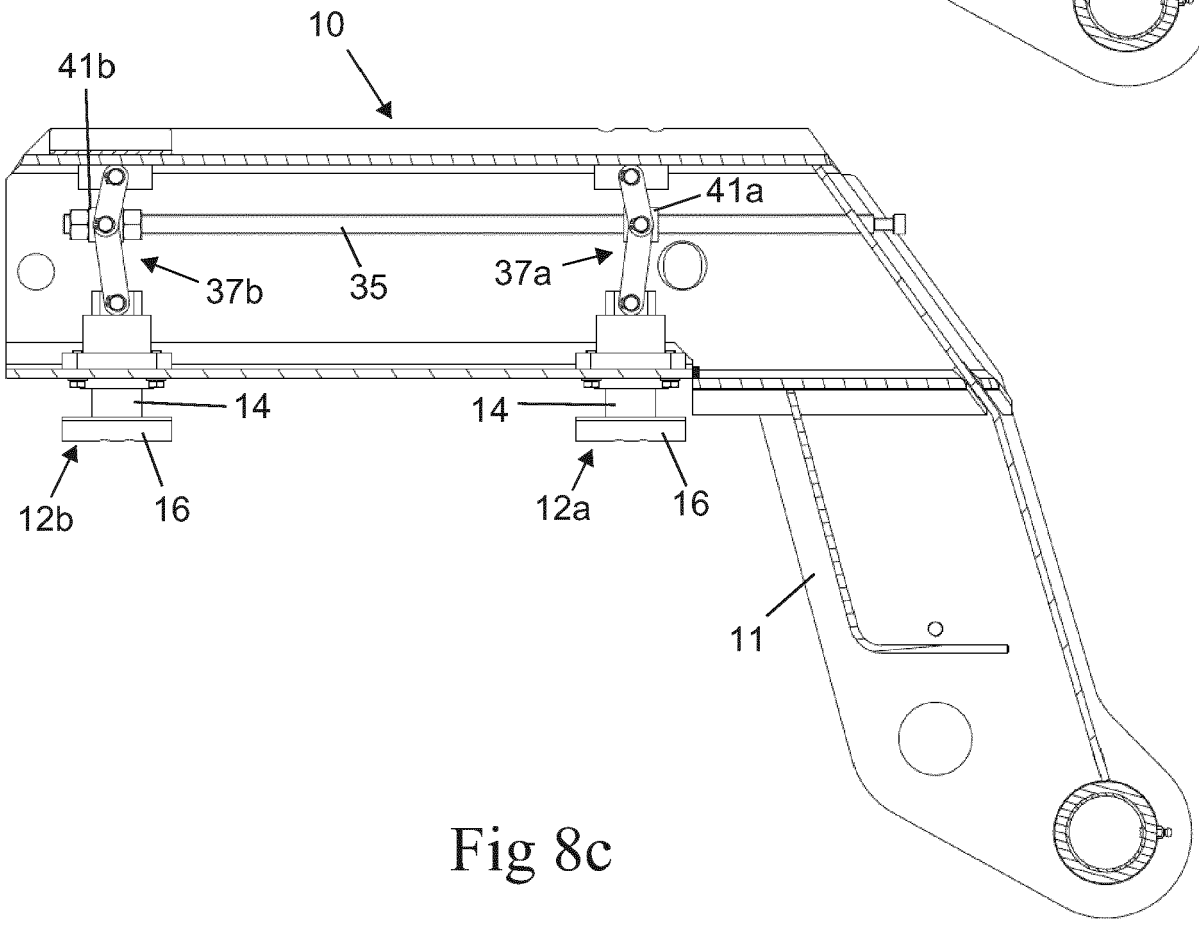
10
41b
41a
37b
35
37a
14
14
12b
16
12a
16
11

Fig 8c

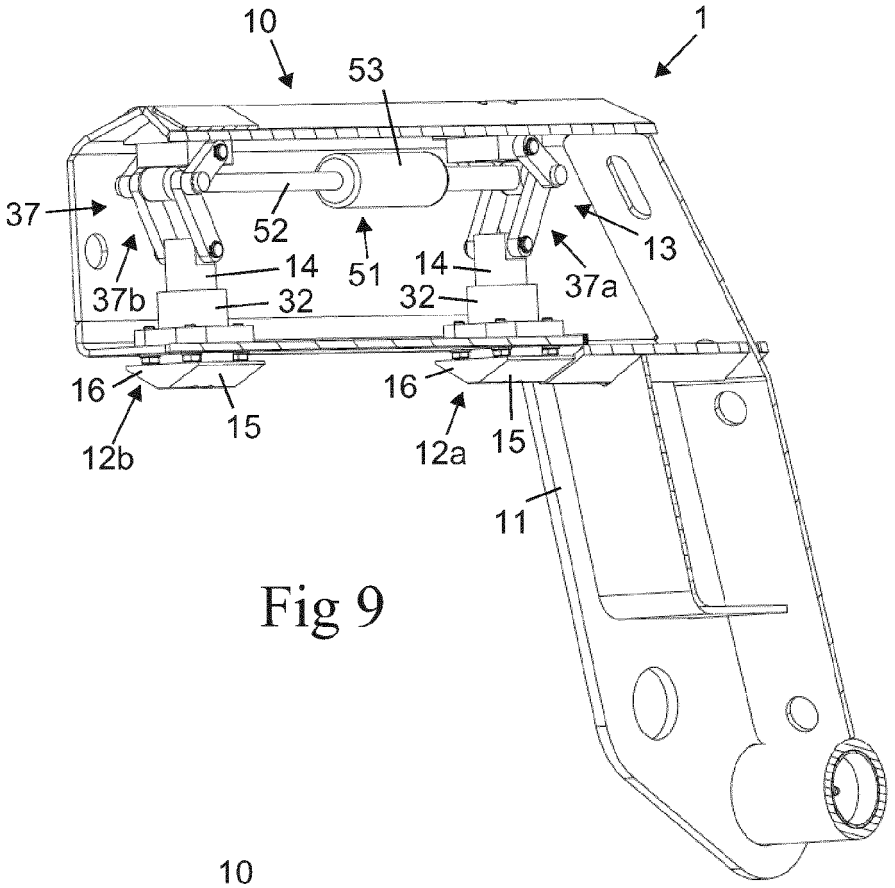

Fig 9

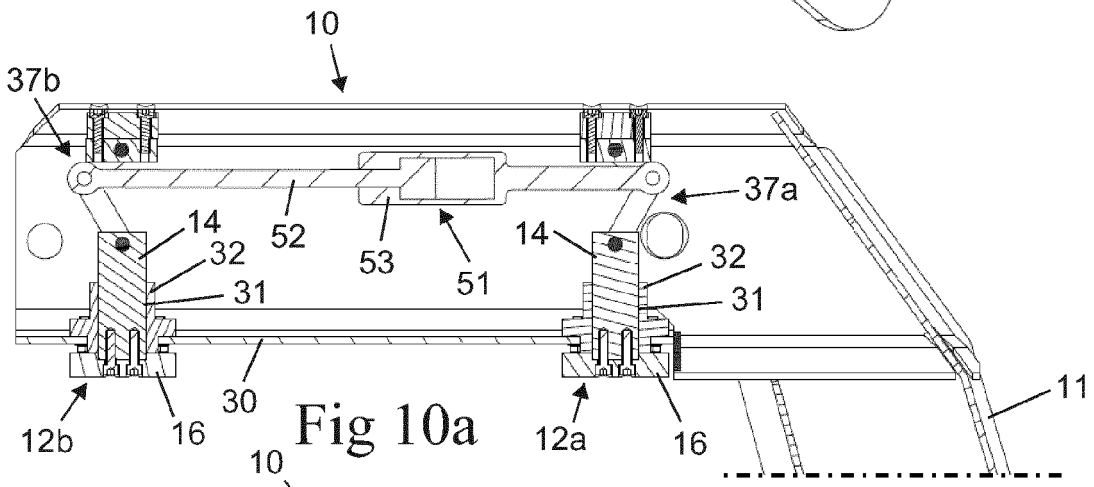

Fig 10a

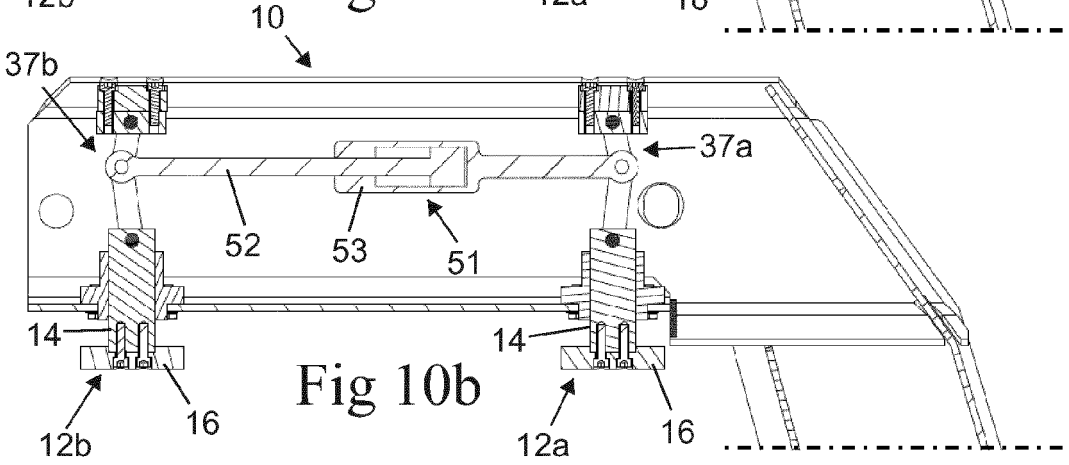

Fig 10b

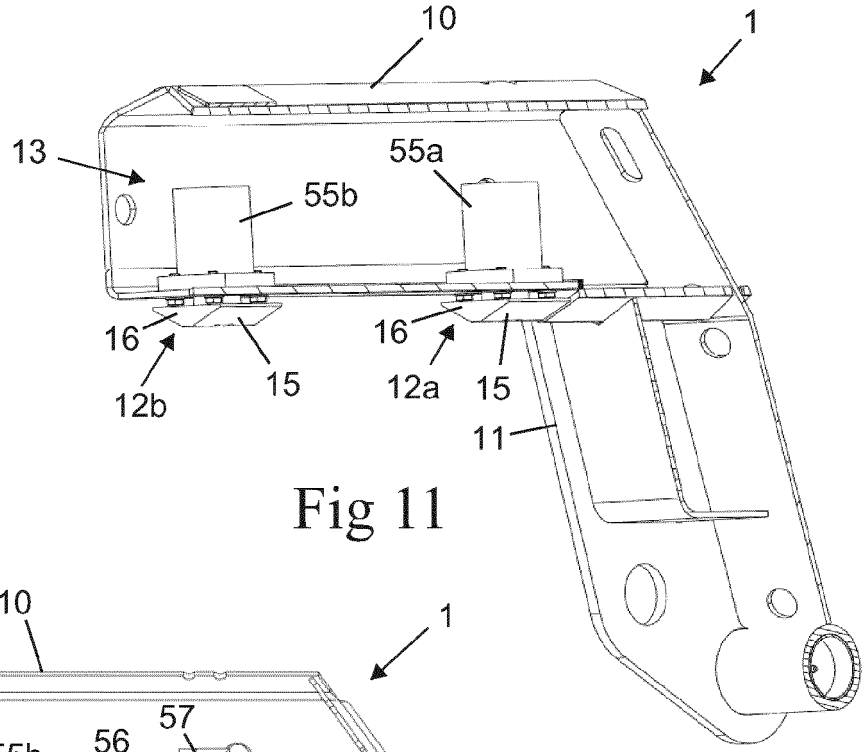

Fig 11

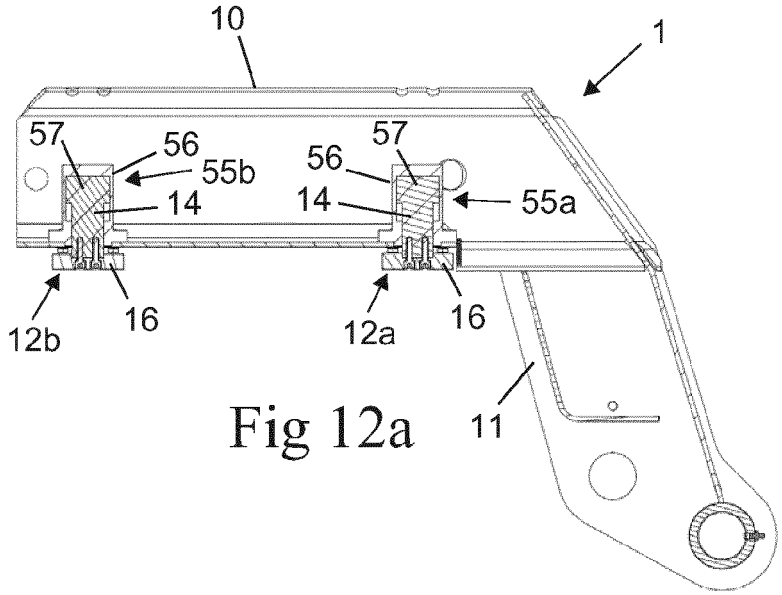

Fig 12a

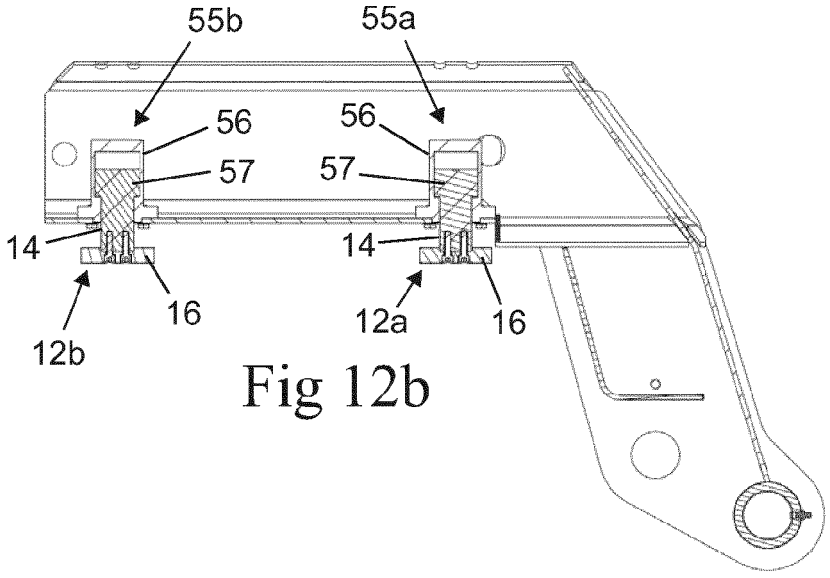

Fig 12b

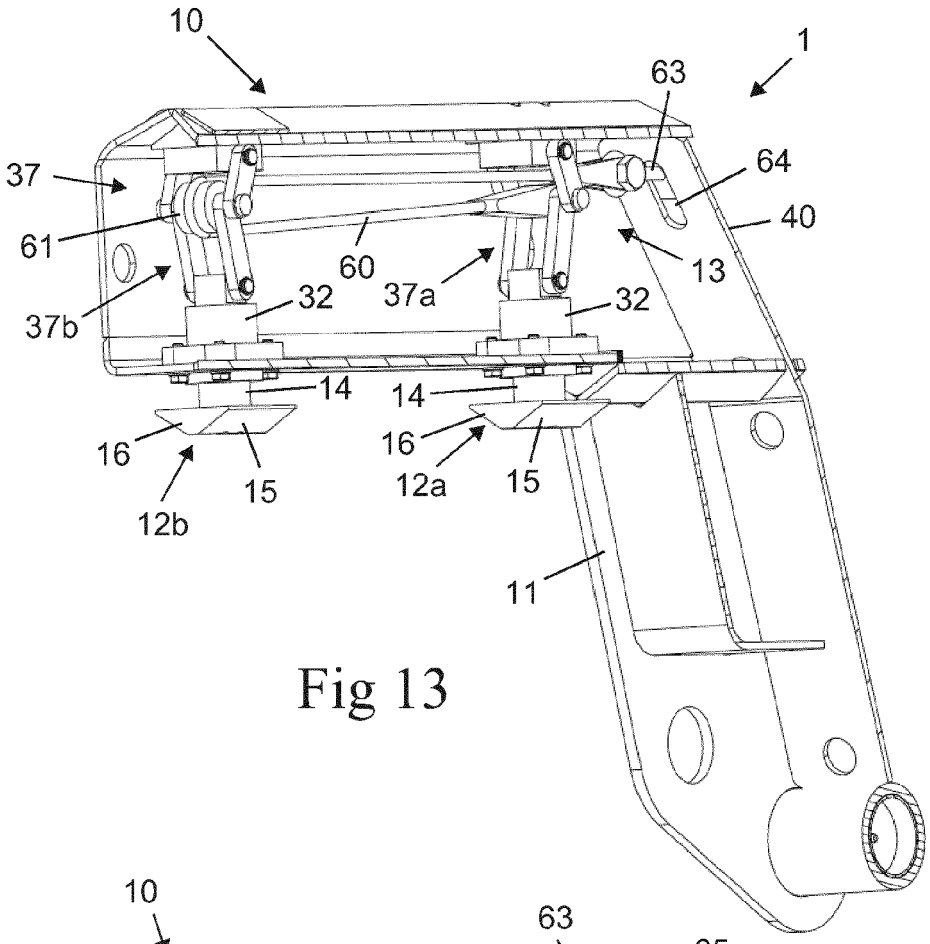

Fig 13

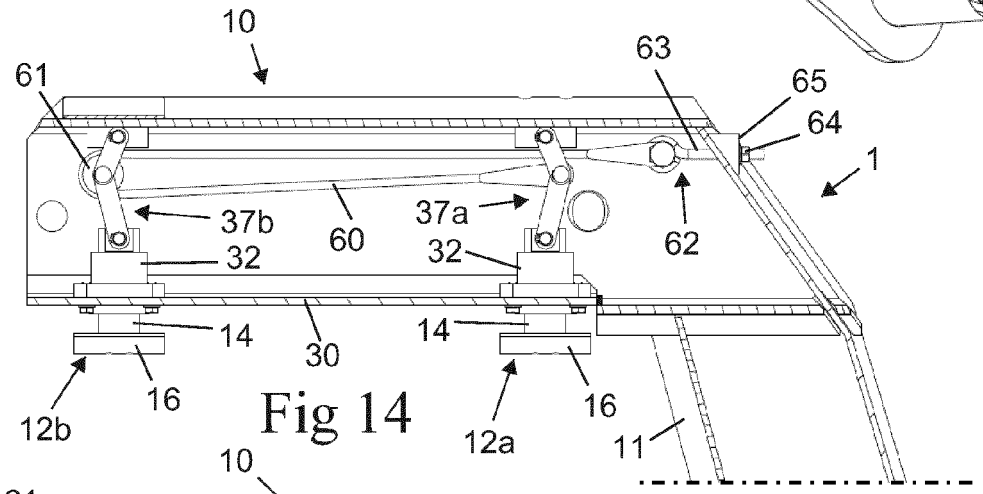

Fig 14

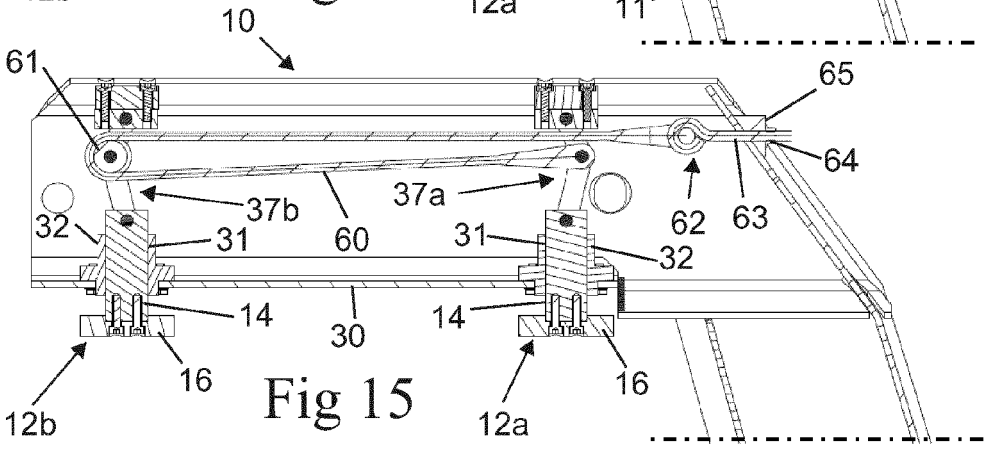

Fig 15

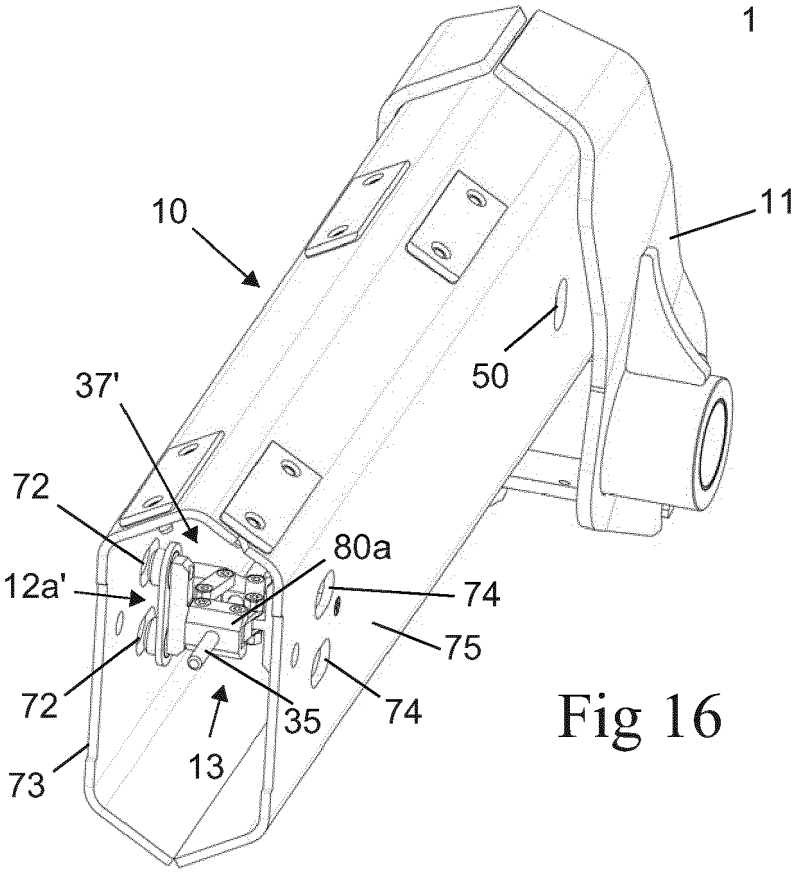

Fig 16

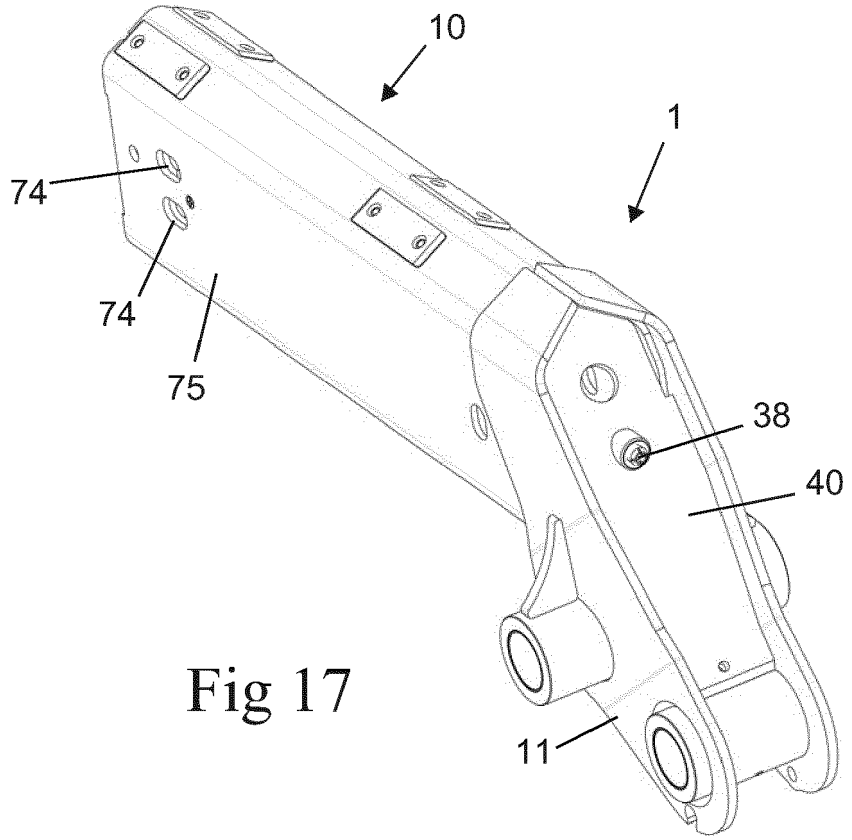

Fig 17

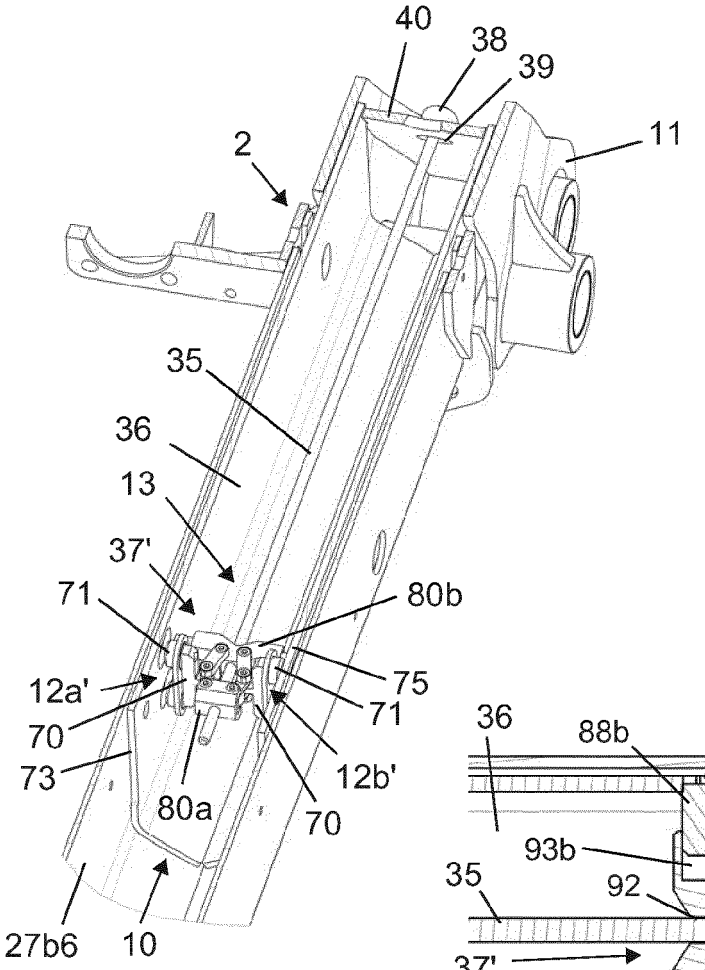

Fig 18

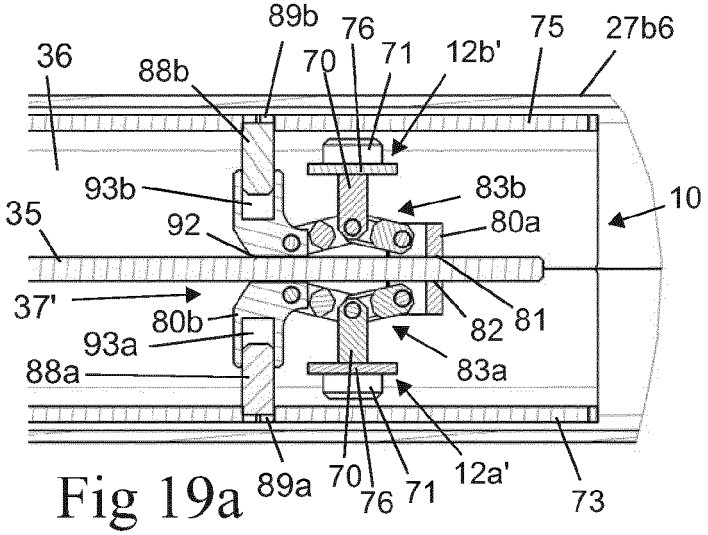

Fig 19a

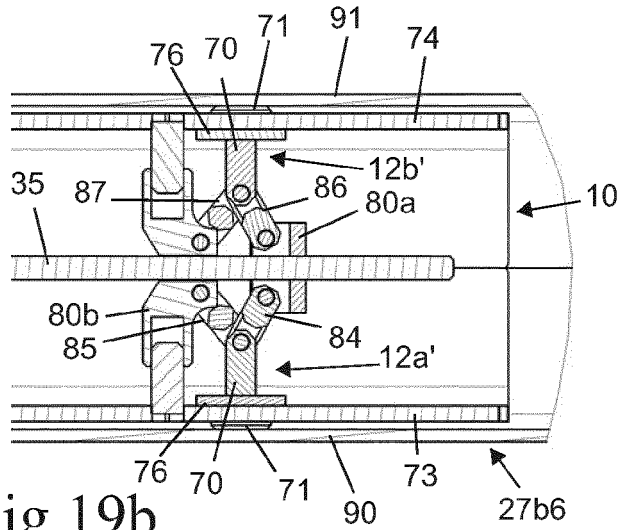

Fig 19b

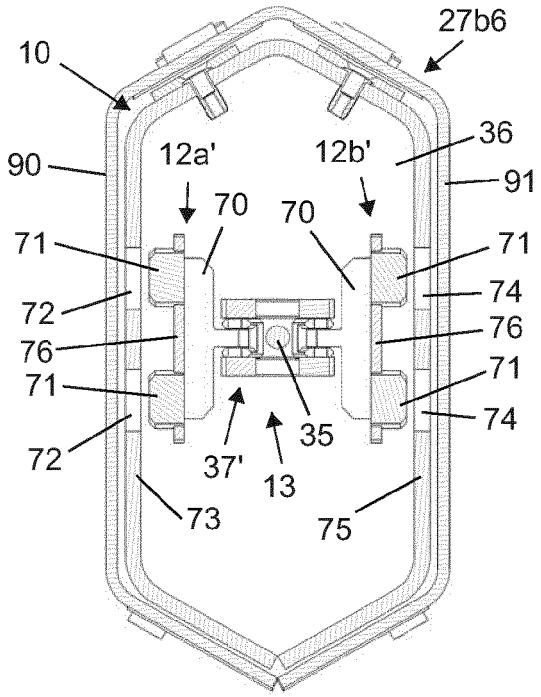

Fig 20a

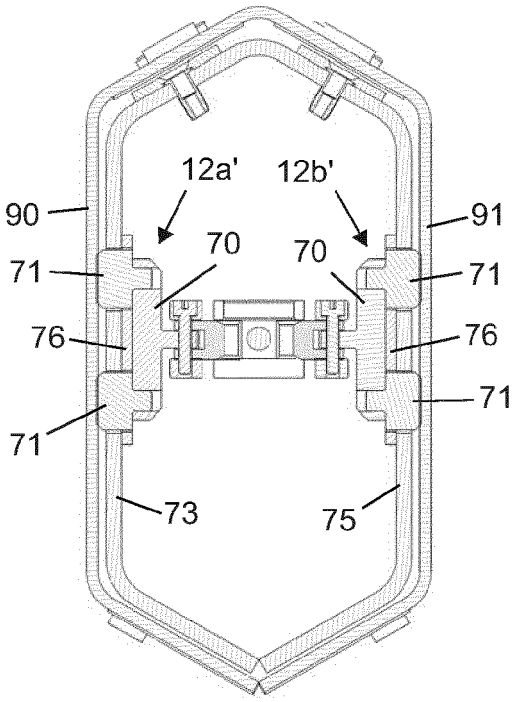

Fig 20b

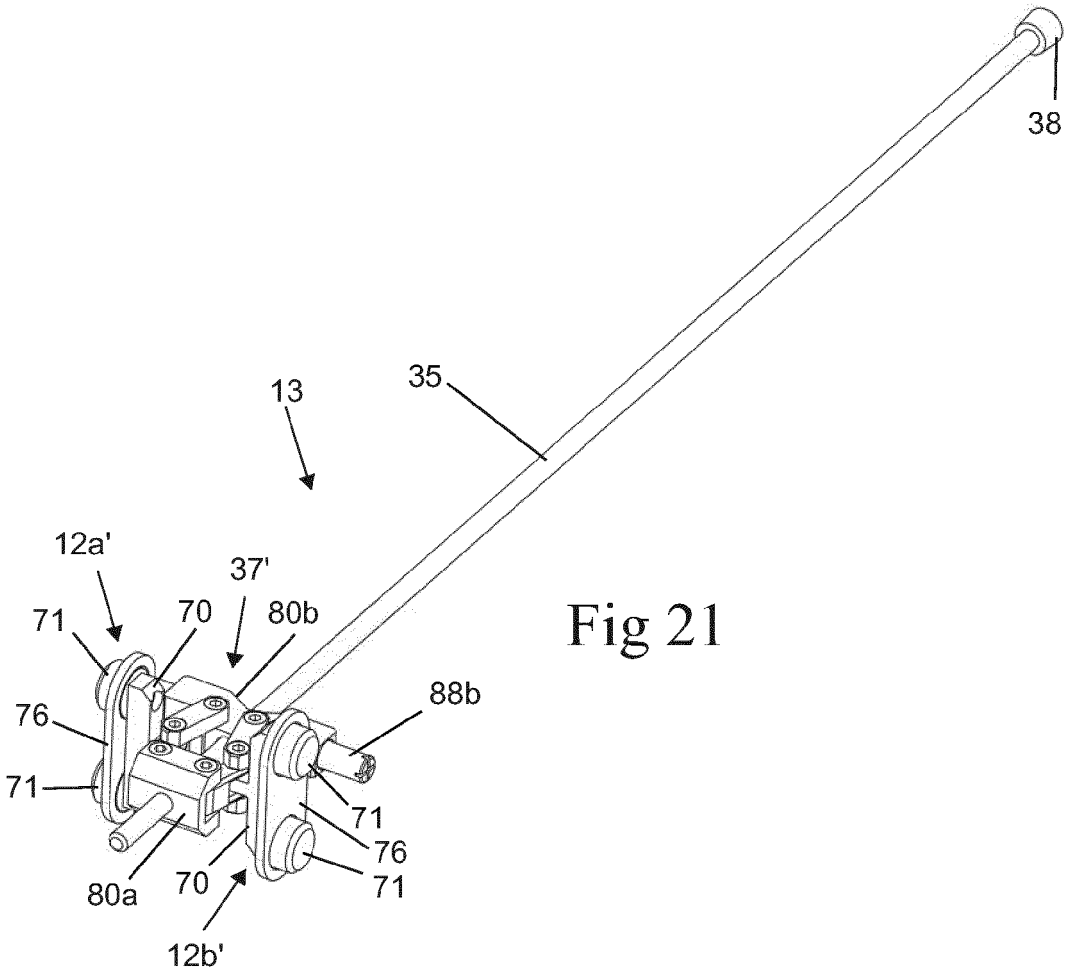

Fig 21

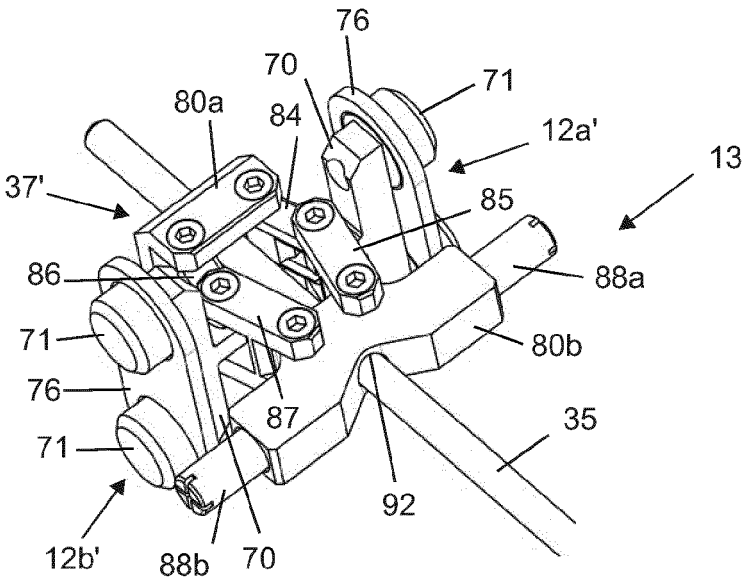

Fig 22a

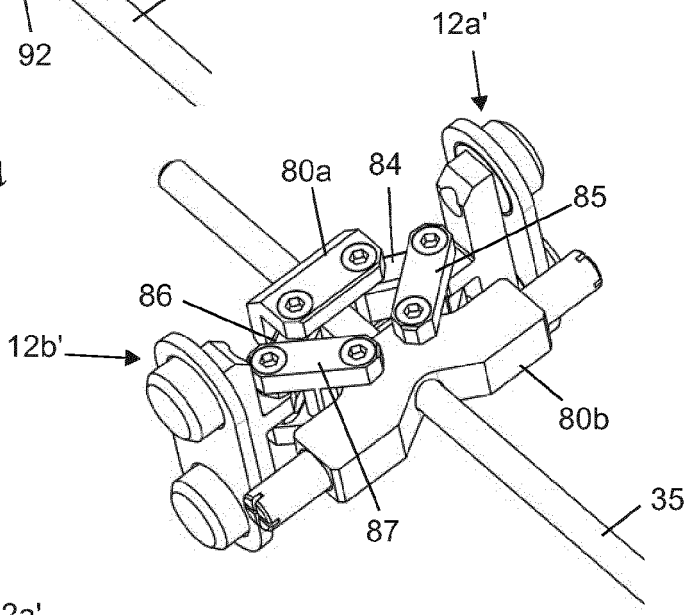

Fig 22b

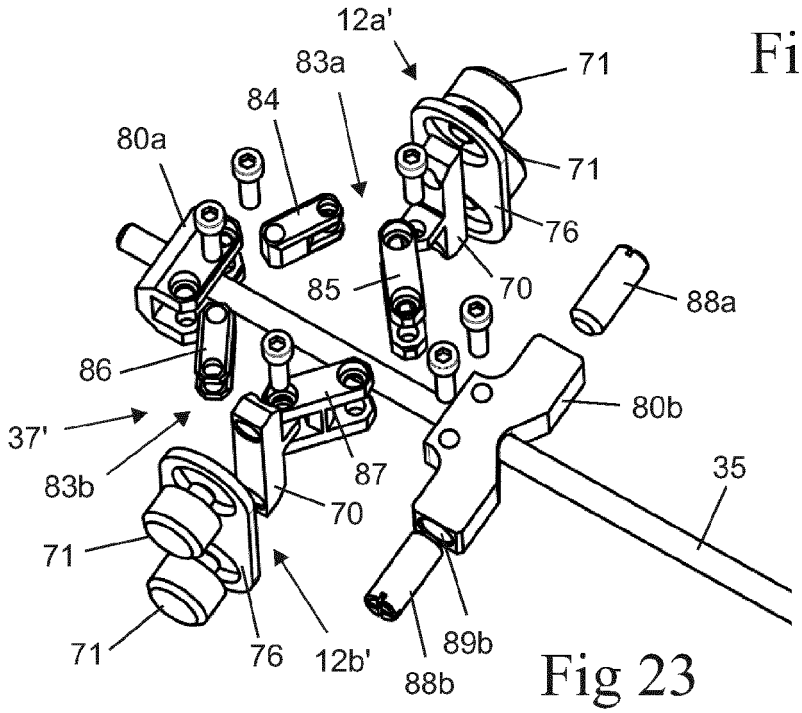

Fig 23

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EUROPEAN SEARCH REPORT

Application Number
EP 18 20 7620

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 10 2011 116083 A1 (HYDROSAAR GMBH [DE]) 11 April 2013 (2013-04-11) * abstract; figures * * paragraph [0001] - paragraph [0007] * * paragraph [0016] - paragraph [0035] * -----	1,6,7, 12-15	INV. B66C23/66 B66F11/04
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TECHNICAL FIELDS SEARCHED (IPC)

B66C
E02F
B66F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16 May 2019	Verheul, Omiros

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