



(11)

**EP 3 333 112 A1**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**13.06.2018 Bulletin 2018/24**

(51) Int Cl.:  
**B66C 3/02 (2006.01) B66C 3/14 (2006.01)**

(21) Application number: **16203102.5**

(22) Date of filing: **09.12.2016**

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

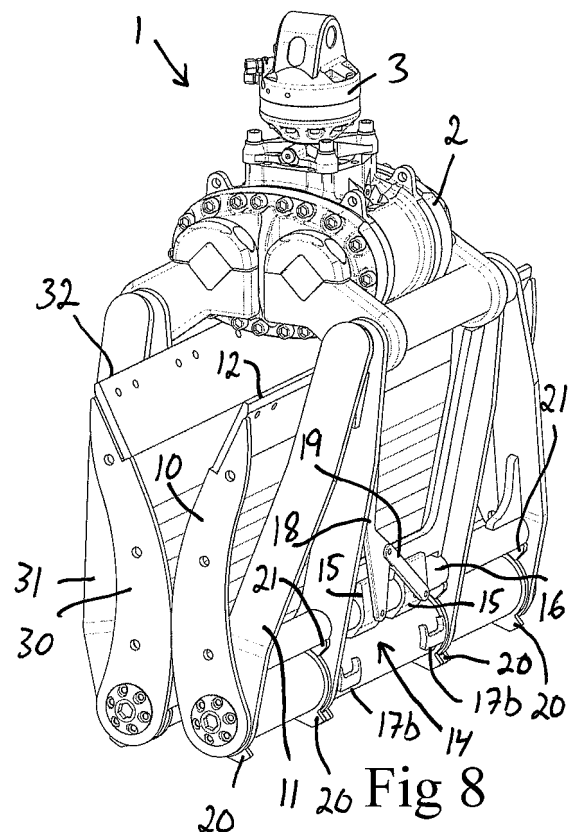
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(54) **LOAD HANDLING TOOL AND HYDRAULIC CRANE COMPRISING SUCH A LOAD HANDLING TOOL**

(57) A load handling tool which is to be attached to a crane boom and comprises first and second bucket jaws (10, 30) pivotally connected to a carrier head (2) via a respective pivot arm (11, 31), and an actuating device (4) for pivoting the pivot arms and the bucket jaws in relation to the carrier head. Each bucket jaw (10, 30) is articulately connected to the associated pivot arm (11, 31) and pivotable in relation to the pivot arm between a fold-down working position and a fold-up storing position, wherein the bucket jaws are configured to be located between the pivot arms and to rest against each other in the fold-up storing position. Each bucket jaw can be locked to the associated pivot arm in the fold-down working position by a locking device (14, 34). The invention also relates to a hydraulic crane provided with such a load handling tool.



**Description****FIELD OF THE INVENTION AND PRIOR ART**

**[0001]** The present invention relates to a load handling tool according to the preamble of claim 1. The invention also relates to a hydraulic crane comprising such a load handling tool.

**[0002]** An ordinary lorry crane may be provided with a load handling tool mounted to an outer end of a crane boom in the form of a so-called outer boom, which is telescopically extensible and articulately connected to another crane boom in the form of a so-called inner boom, wherein the inner boom in its turn is articulately connected to a rotatable column of the crane.

**[0003]** A load handling tool according to the preamble of claim 1 is previously known from EP 2 778 109 A1. This previously known load handling tool has the form of a clam shell bucket with open shells and is intended to be mounted to a crane boom, wherein one of the bucket jaws of the clam shell bucket is provided with a recess for receiving a part of the crane boom in order to allow the crane boom and the clam shell bucket to assume a compact parking position. The clam shell bucket disclosed in EP 2 778 109 A1 is particularly suitable for use with a so-called Z-type crane, which is a hydraulic lorry crane of the type illustrated in EP 1 475 345 A1 and US 4 183 712 A where inner and outer booms of the crane are foldable into a compact Z-shaped parking position when the crane is to be transported or stored. When the outer boom of a Z-type crane is moved between the working position and the parking position, the tip of the outer boom will never pass at the side of the column of the crane, which implies that a clam shell bucket mounted to the outer end of the outer boom will never interfere with the column when the outer boom is moved between the working position and the parking position.

**[0004]** There also exists another conventional type of hydraulic lorry crane, in the following denominated foldable knuckle boom crane, where the outer boom, when moved into a parking position, is folded in the opposite direction in relation to the inner boom as compared to the outer boom of a Z-type crane. Such a foldable knuckle boom crane is for instance illustrated in EP 0 360 071 A1 and EP 1 580 159 A1. When the outer boom of a foldable knuckle boom crane of this type is moved between the working position and the parking position, the tip of the outer boom will pass at the side of the column of the crane, which implies that a clam shell bucket mounted to the outer end of the outer boom will interfere with the column when the outer boom is moved between the working position and the parking position. Therefore, the clam shell bucket has to be removed from the crane before the outer boom is moved from the working position to the parking position. The removal of the clam shell bucket from the outer boom constitutes an undesired time-consuming task for the crane operator and also implies that space on the lorry has to be occupied for storage of the

removed clam shell bucket.

**SUMMARY OF THE INVENTION**

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

**[0006]** According to the invention, this object is achieved by means of a load handling tool having the features defined in claim 1.

**[0007]** The load handling tool of the present invention comprises:

- a carrier head configured for connection to a crane boom;
- first and second bucket jaws located opposite each other, the first bucket jaw being pivotally connected to the carrier head via a first pivot arm and the second bucket jaw being pivotally connected to the carrier head via a second pivot arm so as to allow the bucket jaws to be pivoted towards each other in order to grasp a load and away from each other in order to release a grasped load, each pivot arm having a first end facing the carrier head and an opposite second end, wherein each pivot arm at its first end is pivotally connected to the carrier head; and
- an actuating device for pivoting the pivot arms and thereby the bucket jaws in relation to the carrier head.

**[0008]** Each pivot arm is at its second end articulately connected to the associated bucket jaw so as to allow the bucket jaw to be pivoted in relation to the pivot arm between a fold-down working position and a fold-up storing position, wherein the bucket jaws are configured to be located between the pivot arms and to rest against each other in the fold-up storing position. The load handling tool comprises a first locking device for locking the first bucket jaw to the first pivot arm in the fold-down working position, and a second locking device for locking the second bucket jaw to the second pivot arm in the fold-down working position.

**[0009]** The load handling tool of the present invention can be brought into a compact state by moving the bucket jaws to the fold-up storing position and it may be kept in this compact state under the effect of the actuating device acting on the pivot arms. A collapsible load handling tool of this type is suitable for use with a foldable knuckle boom crane of the above-mentioned type, wherein the load handling tool with the bucket jaws in the fold-up storing position may remain connected to the outer end of the outer boom when the outer boom is moved between the working position and the parking position, as explained in closer detail in the description following below.

**[0010]** Further features of the load handling tool according to the present invention will appear from the description following below and the dependent claims.

**[0011]** The invention also relates to a hydraulic crane having the features defined in claim 9.

**[0012]** 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

**[0013]** 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 perspective view of a load handling tool according to a first embodiment of the present invention, as seen with bucket jaws of the load handling tool locked in a fold-down working position,

Fig 2 is a lateral view of the load handling tool of Fig 1 with the bucket jaws locked in the fold-down working position,

Figs 3-5 are partial views of the load handling tool of Fig 1 with the bucket jaws locked in the fold-down working position,

Fig 6 is a perspective view of the load handling tool of Fig 1, as seen with the bucket jaws unlocked in the fold-down working position,

Fig 7 is a partial view of the load handling tool of Fig 1 with the bucket jaws unlocked in the fold-down working position,

Fig 8 is a perspective view of the load handling tool of Fig 1, as seen with the bucket jaws in a fold-up storing position,

Fig 9 is a lateral view of the load handling tool of Fig 1 with the bucket jaws in the fold-up storing position,

Fig 10 is a partial view of the load handling tool of Fig 1 with the bucket jaws in the fold-up storing position,

Fig 11 is a frontal view of a hydraulic crane provided with a load handling tool of the type illustrated in Figs 1-10,

Fig 12 is a frontal view of the hydraulic crane of Fig 11, as seen in a compact parking position,

Fig 13

is a planar view from above of the hydraulic crane of Fig 11 in the parking position,

5 Fig 14

is a lateral view of the hydraulic crane of Fig 11 in the parking position,

Fig 15

is a partial view of the hydraulic crane of Fig 11 in the parking position,

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Figs 16 and 17

are perspective views of a holding- and locking mechanism included in the hydraulic crane of Fig 11,

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Figs 18a-18h

are frontal views of the hydraulic crane of Fig 11, as seen at different stages during the movement of the crane from the parking position to an erected working position,

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Fig 19

is a partial view of the hydraulic crane in the position illustrated in Fig 18c,

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Figs 20-22

are partial views of the hydraulic crane in the position illustrated in Fig 18d,

Figs 23 and 24

are partial views of the hydraulic crane in the position illustrated in Fig 18e, and

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Fig 25

is a perspective view of a load handling tool according to a second embodiment of the invention, as seen with the bucket jaws in a fold-up storing position.

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#### DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

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**[0014]** A load handling tool 1 according to an embodiment of the present invention is illustrated in Fig 1-10. The load handling tool 1 is to be attached to a crane boom, as illustrated in Fig 11. In the illustrated example, the load handling tool 1 is designed as a clamshell bucket with open shells.

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**[0015]** The load handling tool 1 comprises a carrier head 2 and a rotator 3 mounted to the carrier head, wherein the carrier head 2 is configured to be connected to a crane boom via the rotator 3. The load handling tool 1 may be rotated in relation to the crane boom by means of the rotator 3. The load handling tool 1 further comprises first and second bucket jaws 10, 30 which are carried by the carrier head 2 and located opposite each other. The first bucket jaw 10 is pivotally connected to the carrier head 2 via a first pivot arm 11 and the second bucket jaw 30 is pivotally connected to the carrier head 2 via a second pivot arm 31, so as to allow the bucket jaws 10, 30 to be pivoted towards each other in order to grasp a load

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and away from each other in order to release a grasped load. Each bucket jaw 10, 30 has a leading edge 12, 32, wherein the leading edge 12 of the first bucket jaw 10 faces the leading edge 32 of the second bucket jaw 30.

**[0016]** Each pivot arm 11, 31 has a first end 11 a, 31 a facing the carrier head 2 and an opposite second end 11 b, 31 b facing the associated bucket jaw 10, 30, wherein each pivot arm 11, 31 at its first end 11 a, 31 a is pivotally connected to the carrier head 2. The first pivot arm 11 is pivotable in relation to the carrier head 2 about a first pivot axis A1 (see Fig 2) and the second pivot arm 31 is pivotable in relation to the carrier head 2 about a second pivot axis A2, wherein the second pivot axis A2 is located at a distance from and extends in parallel with the first pivot axis A1.

**[0017]** Each pivot arm 11, 31 is at its second end 11 b, 31 b articulately connected to the associated bucket jaw 10, 30 so as to allow the bucket jaw to be pivoted in relation to the pivot arm 11, 31 between a fold-down working position (see Figs 1-7) and a fold-up storing position (see Figs 8-10). The bucket jaws 10, 30 are configured to be located between the pivot arms 11, 31 and to rest against each other in the fold-up storing position, as illustrated in Figs 8 and 9.

**[0018]** The first bucket jaw 10 is pivotable in relation to the first pivot arm 11 about a third pivot axis A3 (see Fig 2), which extends in parallel with the above-mentioned first pivot axis A1, wherein the distance between the first and third pivot axes A1, A3 is larger than the distance between the third pivot axis A3 and the leading edge 12 of the first bucket jaw 10, to thereby allow the first bucket jaw 10 to be received between the first and second pivot arms 11, 31 when it is in the fold-up storing position.

**[0019]** The second bucket jaw 30 is pivotable in relation to the second pivot arm 31 about a fourth pivot axis A4 (see Fig 2), which extends in parallel with the above-mentioned second pivot axis A2, wherein the distance between the second and fourth pivot axes A2, A4 is larger than the distance between the fourth pivot axis A4 and the leading edge 32 of the second bucket jaw 30, to thereby allow the second bucket jaw 30 to be received between the first and second pivot arms 11, 31 when it is in the fold-up storing position.

**[0020]** In the illustrated embodiment, each bucket jaw 10, 30 has a closed bottom surface 13, 33. However, one or more openings could be provided in the bottom surface 13, 33 of one or both bucket jaws.

**[0021]** The load handling tool 1 comprises a first locking device 14 for locking the first bucket jaw 10 to the first pivot arm 11 in the fold-down working position, and a second locking device 34 for locking the second bucket jaw 30 to the second pivot arm 31 in the fold-down working position.

**[0022]** Furthermore, the load handling tool 1 comprises an actuating device 4 for pivoting the pivot arms 11, 31 and thereby the bucket jaws 10, 30 in relation to the carrier head 2. In the embodiment illustrated in Figs 1-10,

the actuating device 4 is a hydraulic motor accommodated in the carrier head 2, for instance a hydraulic motor of the type described in closer detail in DE 202004013158 U1 or EP 1 541 771 B1. The actuating device 4 comprises two rotatably driven pivot shafts which are rotatably mounted to the carrier head 2, each pivot shaft having two opposite shaft ends which project from the carrier head 2 on opposite sides thereof. The first pivot arm 11 is non-rotatably fixed to the opposite shaft ends 5 of a first one of the pivot shafts and the second pivot arm 31 is non-rotatably fixed to the opposite shaft ends 6 of the other pivot shaft. As an alternative, the actuating device may comprise one or two hydraulic cylinders for pivoting the pivot arms 11, 31 and thereby the bucket jaws 10, 30 in relation to the carrier head 2. Any other suitable type of actuating device may also be used for pivoting the pivot arms 11, 31 in relation to the carrier head 2.

**[0023]** A load handling tool 1 according to an alternative embodiment is illustrated in Fig 25. This load handling tool 1 comprises an actuating device 4' in the form of a hydraulic cylinder which is vertically arranged in the carrier head 2 and configured to act on the first and second pivot arms 11, 31 via a link mechanism 6 in order to pivot the pivot arms 11, 31 in relation to the carrier head 2. As to the rest, the load handling tool 1 illustrated in Fig 25 corresponds to the load handling tool illustrated in Figs 1-10.

**[0024]** The above-mentioned first locking device 14 comprises at least one locking member 15 which is moveable between an unlocking position (see Figs 6-8), in which the first bucket jaw 10 is free to pivot in relation to the first pivot arm 11 between the fold-down working position and the fold-up storing position, and a locking position (see Figs 1, 3 and 4), in which the locking member 15 prevents the first bucket jaw 10 from pivoting in relation to the first pivot arm 11 from the fold-down working position towards the fold-up storing position. In the illustrated embodiment, the first locking device 14 comprises two such locking members 15, which are slidably mounted to a cross-bar 16 on the first pivot arm 11 so as to be slidable along this cross-bar 16 between the locking position and the unlocking position. In the illustrated example, each locking member 15 comprises a shoulder 17a (see Fig 7) which is configured to be in contact with a corresponding shoulder 17b (see Fig 8) on the first bucket jaw 10 when the locking member 15 is in the locking position, as illustrated in Fig 4, and thereby prevent the first bucket jaw 10 from pivoting in relation to the first pivot arm 11 towards the fold-up storing position. When the locking member 15 is in the unlocking position, the shoulder 17a on the locking member is no longer in contact with the corresponding shoulder 17b on the first bucket jaw 10, as illustrated in Figs 7 and 8, and the first bucket jaw is thereby allowed to pivot in relation to the first pivot arm 11 between the fold-down working position and the fold-up storing position.

**[0025]** The above-mentioned second locking device 34 comprises at least one locking member 35 which is

moveable between an unlocking position (see Figs 6 and 10), in which the second bucket jaw 30 is free to pivot in relation to the second pivot arm 31 between the fold-down working position and the fold-up storing position, and a locking position (see Fig 1), in which the locking member 35 prevents the second bucket jaw 30 from pivoting in relation to the second pivot arm 31 from the fold-down working position towards the fold-up storing position. In the illustrated embodiment, the second locking device 34 comprises two such locking members 35, which are slidably mounted to a cross-bar 36 on the second pivot arm 31 so as to be slidable along this cross-bar 36 between the locking position and the unlocking position. The locking members 35 of the second locking device 34 have the same configuration and are operated in the same manner as the locking members 15 of the first locking device 14.

**[0026]** In the illustrated embodiment, each locking device 14, 34 comprises a handle 18, 38, by means of which the locking members 15, 35 of the locking device are moveable between the locking position and the unlocking position. The handle 18, 38 is connected to the associated locking members 15, 35 via a link mechanism 19, 39.

**[0027]** The first and second locking devices 14, 34 may of course also be configured and operated in any other suitable manner. Each locking device 14, 34 may for instance comprise a hydraulically or electrically operated actuating unit for moving the locking members 15, 35 between the locking position and the unlocking position.

**[0028]** Each bucket jaw 10, 30 is provided with at least one stop member 20, 40 (see Figs 1, 5, 8 and 10) which is configured to come into contact with a corresponding stop member 21, 41 on the associated pivot arm 11, 31 and thereby stop the pivotal movement of the bucket jaw 10, 30 in relation to the pivot arm 21, 31 when the bucket jaw 10, 30 has been pivoted in relation to the pivot arm 11, 31 from the fold-up storing position to the fold-down working position. In the illustrated embodiment, each bucket jaw 10, 30 is provided with several such stop members 20, 40 distributed along the bucket jaw.

**[0029]** When the bucket jaws 10, 30 are to be moved from the fold-down working position to the fold-up storing position, the locking members 15, 35 are first moved from the locking position to the unlocking position. With the leading edges 12, 32 of the first and second bucket jaws 10, 30 in contact with each other, the load handling tool 1 is thereafter lowered downwards against an upwardly protruding object so that the object will push the leading edges 12, 32 of the bucket jaws 10, 30 upwards in a pivoting movement in relation to the pivot arms 11, 31 about the third and fourth pivot axes A3, A4 until the leading edges 12, 32 assume a position above a horizontal plane across the third and fourth pivot axes A3, A4 and consequently point upwards. The final movement of the bucket jaws 10, 30 to the fold-up storing position is effected by means of the above-mentioned actuating device 4, which pivots the pivot arms 11, 31 towards each other and thereby pushes the bucket jaws 10, 30 towards

each other so that the bucket jaws are forced to pivot further upwards in relation to the pivot arms 11, 31 in order to finally assume the fold-up storing position illustrated in Figs 8 and 9. The bucket jaws 10, 30 are thereafter maintained in the fold-up storing position under the effect of the actuating device 4, which keeps the bucket jaws clamped between the pivot arms 11, 31 in the fold-up storing position. The load handling tool 1 could also be provided with a suitable locking device for keeping the bucket jaws 10, 30 locked in the fold-up storing position. When the load handling tool 1 later on is to be used, the pivot arms 11, 31 are pivoted away from each other by means of the actuating device 4 so that the bucket jaws 10, 30 are allowed to pivot downwards in relation to the pivot arms 11, 31 under the effect of gravity, as illustrated in Figs 18g and 18h.

**[0030]** According to an alternative embodiment (not shown), the load handling tool 1 is provided with hydraulically or electrically operated actuating units for pivoting the bucket jaws 10, 30 in relation to the pivot arms 11, 31 between the fold-down working position and the fold-up storing position.

**[0031]** A hydraulic crane 60 provided with a load handling tool 1 of the type described above is illustrated in Figs 11-24. The illustrated crane 60 is mounted on a frame 61, which for instance may be connected to the chassis of a lorry. The frame 61 is provided with adjustable support legs 62 for supporting the crane 60. The crane 60 comprises:

- a crane base 63, which is fixed to the frame 61;
- a column 64, which is rotatably mounted to the crane base 63 so as to be rotatable in relation to the crane base about an essentially vertical axis of rotation A5 by means of an actuating device (not shown);
- a liftable and lowerable first crane boom 65, in the following denominated inner boom, which is articulately connected to the column 64 in such a manner that it is pivotable in relation to the column about an essentially horizontal axis of rotation A6;
- a first hydraulic cylinder 66 for lifting and lowering the inner boom 65 in relation to the column 64;
- a liftable and lowerable second crane boom 67, in the following denominated outer boom, which is articulately connected to the inner boom 65 in such a manner that it is pivotable in relation to the inner boom about an essentially horizontal axis of rotation A7; and
- a second hydraulic cylinder 68 for lifting and lowering of the outer boom 67 in relation to the inner boom 65.

**[0032]** The outer boom 67 is telescopically extensible to enable an adjustment of the extension length thereof. The outer boom 67 comprises a base section 67a, through which the outer boom 67 is articulately connected to the inner boom 65, and several telescopic crane boom sections 67b which are carried by the base section 67a and displaceable in the longitudinal direction of the

base section by means of hydraulic cylinders 69 for adjustment of the extension length of the outer boom 67.

**[0033]** The illustrated crane 60 is a foldable knuckle boom crane, wherein the inner and outer booms 65, 67 of the crane are foldable into a compact parking position when the crane is to be transported or stored, as illustrated in Figs 12-14. When the inner and outer booms 65, 67 are to be folded into the parking position from the erected working position illustrated in Fig 11, the telescopic crane boom sections 67b of the outer boom 67 are first retracted into the base section 67a of the outer boom, whereupon the outer boom 67 is folded downwards towards the inner boom 65 so as to assume a position essentially in parallel with the inner boom, as illustrated in Fig 18b. Thereafter, the inner boom 65 is folded downwards together with the outer boom 67 towards the frame 61 from the intermediate position illustrated in Fig 18b to the final parking position illustrated in Fig 12. The inner and outer booms 65, 67 are moved in the opposite manner when they are to be moved from the parking position to the erected working position.

**[0034]** The load handling tool 1 is mounted to the outer end of the outer boom 67. In order to prevent the load handling tool 1 from bumping into the column 64 when the inner and outer booms 65, 67 are moved from the erected working position to the parking position or from the parking position to the erected working position, the bucket jaws 10, 30 of the load handling tool 1 has to be in the fold-up storing position and arranged in a suitable fixed position in relation to the outer boom 67. To make this possible, the crane 60 comprises a holding- and locking mechanism 70 (see Figs 15-17) for locking the load handling tool 1 to the second crane boom 67 with the first and second bucket jaws 10, 30 in the fold-up storing position and with the load handling tool 1 in a given fixed position in relation to and at the side of the outer boom 67.

**[0035]** In the illustrated embodiment, the holding- and locking mechanism 70 comprises:

- a first coupling member 72a (see Figs 16, 17 and 24), which is fixed to the outer boom and 67 configured for engagement with a corresponding second coupling member 22 (see Figs 11 and 24) on the first bucket jaw 10;
- a third coupling member 72b (see Figs 16, 17 and 24), which is fixed to the outer boom 67 and configured for engagement with a corresponding fourth coupling member 42 (see Figs 11 and 24) on the second bucket jaw 30; and
- a locking member 73 (see Figs 15-17 and 19), which is moveable between a locking position (see Fig 15), in which the locking member 73 prevents the first and third coupling members 72a, 72b from being disengaged from the corresponding coupling members 22, 42 on the bucket jaws 10, 30, and an unlocking position (see Fig 19), in which the locking member 73 allows the first coupling member 72a to be disengaged from the second coupling member 22 and

the third coupling member 72b to be disengaged from the fourth coupling member 42.

**[0036]** In the illustrated example, the first and third coupling members 72a, 72b have the form of hooks, whereas the second coupling member 22 has the form of a recess in the first bucket jaw 10 and the fourth coupling member 42 has the form of a recess in the second bucket jaw 30. In this case, the first coupling member 72a is insertable into the second coupling member 22 and the third coupling member 72b is insertable into the fourth coupling member 42.

**[0037]** The holding- and locking mechanism 70 further comprises a base structure 74, which is fixed to the base section 67a of the outer boom 67, wherein the first and third coupling members 72a, 72b are fixed to and protrude from the base structure 74. In the illustrated embodiment, the locking member 73 of the holding- and locking mechanism 70 has the form of a lever and is pivotally mounted to the base structure 74 through a joint 75 so as to be pivotable in relation to the base structure 74 about this joint 75 between its locking position and its unlocking position. The locking member 73 is provided with a protruding locking element 76 (see Figs 16 and 19), which is configured to be engaged with the second or fourth coupling member 22, 42 when the locking member 73 is in its locking position. In the illustrated example, the locking element 76 is located next to the third coupling member 72b and configured to be received in the fourth coupling member 42 directly behind the third coupling member 72b when the third coupling member 72b is in engagement with the fourth coupling member 42 and the locking member 73 is in its locking position, to thereby prevent the fourth coupling member 42 from sliding in relation to the third coupling member 72b to a position in which the third coupling member 72b may be moved out of the fourth coupling member 42. The locking element 76 is located on a first side of the above-mentioned joint 75, wherein the centre of gravity of the locking member 73 is located on the opposite side of this joint 75 in order to allow the locking member 73 to be automatically moved between its locking position and its unlocking position by a rotating movement about the joint 75 under the effect of gravity and in dependence on the orientation in space of the locking member 73. Thus, the locking member 73 will act as a rocker arm and assume its locking position or its unlocking position in dependence on the orientation in space of the outer boom 67 and the base structure 74. When the outer boom 67 and the base structure 74 have such an orientation in space that the locking element 76 on the locking member 73 points upwards, the locking member 73 will assume its locking position with the locking element 76 forced outwards away from the outer boom 67, as illustrated in Fig 15. When the outer boom 67 and the base structure 74 have such an orientation in space that the locking element 76 on the locking member 73 points downwards (see Fig 19), the locking member 73 will assume its unlocking position with the locking el-

element 76 forced inwards towards the outer boom 67, as illustrated in Fig 19.

**[0038]** In the illustrated embodiment, a hook-shaped guide member 77 (see Figs 14-17 and 21) is provided on the base structure 74, wherein this guide member 77 is configured for contact with the load handling tool 1 in order to make sure that the load handling tool 1 will be correctly positioned in relation to the base structure 74 with the second and fourth coupling members 22, 42 on the bucket jaws 10, 30 of the load handling tool 1 located in front of the first and third coupling members 72a, 72b on the base structure 74. The hook-shaped guide member 77 is configured to engage with a part 11 a of the first pivot arm 11, as illustrated in Figs 14 and 15.

**[0039]** When the crane 60 is in the parking position, the holding- and locking mechanism 70 keeps the load handling tool 1 fixed to the outer boom 67 in a position above the outer boom and at the side of the column 64 and the inner boom 65, as illustrated in Figs 12-14, wherein the hook-shaped guide member 77 is in engagement with the first pivot arm 11, the first and third coupling members 72a, 72b on the base structure 74 are in engagement with the corresponding coupling members 22, 42 on the bucket jaws 10, 30 and the locking member 73 is in its locking position with the locking element 76 received in the fourth coupling member 42. When the crane 60 is to be moved into the erected working position, the inner boom 65 is first pivoted in relation to the column 64 and lifted upwards from the position illustrated in Fig 12 to the position illustrated in Fig 18a and further on to the position illustrated in Fig 18b. When the outer boom 67 and the load handling tool 1 pivot together with the inner boom 65 from the position illustrated in Fig 12 to the position illustrated in Fig 18b, the locking member 73 remains in its locking position and thereby prevents the load handling tool 1 from moving in relation to the outer boom 67. In the next step, the outer boom is pivoted in relation to the inner boom 65 and lifted upwards from the position illustrated in Fig 18b to the position illustrated in Fig 18c and further on to the position illustrated in Fig 18d, wherein the locking member 73 is automatically pivoted under the effect of gravity from its locking position to its unlocking position, which implies that the locking element 76 no longer prevents the second and fourth coupling members 22, 42 on the bucket jaws 10, 30 from being released from the corresponding first and third coupling members 72a, 72b on the base structure 74. With the outer boom 67 in the position illustrated in Fig 18d, the second and fourth coupling members 22, 42 on the bucket jaws 10, 30 are released from the corresponding first and third coupling members 72a, 72b on the base structure 74 by a short extension of the outer boom 67. Thereafter, the load handling tool 1 may be released from the hook-shaped guide member 77 on the base structure 74 by a rotation of the load handling tool 1 by means of the rotator 3 from the position illustrated in Figs 18d and 20 to the position illustrated in Figs 18e and 23. The load handling tool 1 is now hanging freely at the outer end of

the outer boom 67, and the bucket jaws 10, 30 may be allowed to pivot downwards under the effect of gravity from the fold-up storing position to the fold-down working position by pivoting the pivot arms 11, 31 outwards away from each other, as illustrated in Figs 18g and 18h. Finally, the locking members 15, 35 of the first and second locking devices 14, 34 are moved from the unlocking position to the locking position in order to lock the bucket jaws 10, 30 to the pivot arms 11, 31 in the fold-down working position.

**[0040]** When the bucket jaws 10, 30 have been pivoted from the fold-down working position to the fold-up storing position, the load handling tool 1 may be fixed to the outer boom 67 by means of the holding- and locking mechanism 70 and the crane 60 moved to the parking position by performing the steps illustrated in Figs 18a-18h in the opposite order.

**[0041]** The holding- and locking mechanism 70 may of course also have any other suitable configuration than the one illustrated in the drawings.

**[0042]** 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 load handling tool to be attached to a crane boom, the load handling tool (1) comprising:
  - a carrier head (2) configured for connection to a crane boom;
  - first and second bucket jaws (10, 30) located opposite each other, the first bucket jaw (10) being pivotally connected to the carrier head (2) via a first pivot arm (11) and the second bucket jaw (30) being pivotally connected to the carrier head (2) via a second pivot arm (31) so as to allow the bucket jaws (10, 30) to be pivoted towards each other in order to grasp a load and away from each other in order to release a grasped load, each pivot arm (11, 31) having a first end (11a, 31a) facing the carrier head (2) and an opposite second end (11b, 31b), wherein each pivot arm (11, 31) at its first end (11a, 31a) is pivotally connected to the carrier head (2); and
  - an actuating device (4) for pivoting the pivot arms (11, 31) and thereby the bucket jaws (10, 30) in relation to the carrier head (2),

## characterized in:

- **that** each pivot arm (11, 31) at its second end (11b, 31b) is articulately connected to the as-

sociated bucket jaw (10, 30) so as to allow the bucket jaw to be pivoted in relation to the pivot arm (11, 31) between a fold-down working position and a fold-up storing position, wherein the bucket jaws (10, 30) are configured to be located between the pivot arms (11, 31) and to rest against each other in the fold-up storing position; and

- **that** the load handling tool (1) comprises a first locking device (14) for locking the first bucket jaw (10) to the first pivot arm (11) in the fold-down working position, and a second locking device (34) for locking the second bucket jaw (30) to the second pivot arm (31) in the fold-down working position.

2. A load handling tool according to claim 1, **characterized in:**

- **that** the first pivot arm (11) is pivotable in relation to the carrier head (2) about a first pivot axis (A1);

- **that** the second pivot arm (31) is pivotable in relation to the carrier head (2) about a second pivot axis (A2), which extends in parallel with the first pivot axis (A1);

- **that** the first bucket jaw (10) is pivotable in relation to the first pivot arm (11) about a third pivot axis (A3), which extends in parallel with the first pivot axis (A1), wherein the distance between the first and third pivot axes (A1, A3) is larger than the distance between the third pivot axis (A3) and the leading edge (12) of the first bucket jaw (10);

- **that** the second bucket jaw (30) is pivotable in relation to the second pivot arm (31) about a fourth pivot axis (A4), which extends in parallel with the second pivot axis (A2), wherein the distance between the second and fourth pivot axes (A2, A4) is larger than the distance between the fourth pivot axis (A4) and the leading edge (32) of the second bucket jaw (30).

3. A load handling tool according to claim 2, **characterized in that** the first pivot axis (A1) is located at a distance from the second pivot axis (A2).

4. A load handling tool according to any of claims 1-3, **characterized in:**

- **that** the first locking device (14) comprises at least one locking member (15) which is moveable between an unlocking position, in which the first bucket jaw (10) is free to pivot in relation to the first pivot arm (11) between the fold-down working position and the fold-up storing position, and a locking position, in which the locking member (15) prevents the first bucket jaw (10) from

pivoting in relation to the first pivot arm (11) from the fold-down working position towards the fold-up storing position; and

- **that** the second locking device (34) comprises at least one locking member (35) which is moveable between an unlocking position, in which the second bucket jaw (30) is free to pivot in relation to the second pivot arm (31) between the fold-down working position and the fold-up storing position, and a locking position, in which the locking member (35) prevents the second bucket jaw (30) from pivoting in relation to the second pivot arm (31) from the fold-down working position towards the fold-up storing position.

5. A load handling tool according to claim 4, **characterized in:**

- **that** the first locking device (14) comprises a handle (18), by means of which said at least one locking member (15) of the first locking device is moveable between the locking position and the unlocking position; and

- **that** the second locking device (34) comprises a handle (38), by means of which said at least one locking member (35) of the second locking device is moveable between the locking position and the unlocking position.

6. A load handling tool according to claim 4 or 5, **characterized in:**

- **that** said locking member (15) of the first locking device (14) is slidably mounted to a bar (16) on the first pivot arm (11) so as to be slidable along this bar (16) between the locking position and the unlocking position; and

- **that** said locking member (35) of the second locking device (34) is slidably mounted to a bar (36) on the second pivot arm (31) so as to be slidable along this bar (36) between the locking position and the unlocking position.

7. A load handling tool according to any of claims 1-6, **characterized in:**

- **that** the first bucket jaw (10) is provided with at least one stop member (20) which is configured to come into contact with a corresponding stop member (21) on the first pivot arm (11) and thereby stop the pivotal movement of the first bucket jaw (10) in relation to the first pivot arm (11) when the first bucket jaw (10) has been pivoted in relation to the first pivot arm (11) from the fold-up storing position to the fold-down working position; and

- **that** the second bucket jaw (30) is provided with at least one stop member (40) which is con-



figured to come into contact with a corresponding stop member (41) on the second pivot arm (31) and thereby stop the pivotal movement of the second bucket jaw (30) in relation to the second pivot arm (31) when the second bucket jaw (30) has been pivoted in relation to the second pivot arm (31) from the fold-up storing position to the fold-down working position.

8. A load handling tool according to any of claims 1-7, **characterized in that** the load handling tool (1) is a clamshell bucket with open shells.

9. A hydraulic crane comprising:

- a crane base (63);
- a column (64), which is rotatably mounted to the crane base (63) so as to be rotatable in relation to the crane base about an essentially vertical axis of rotation (A5);
- a liftable and lowerable first crane boom (65), which is articulately connected to the column (64) so as to be pivotable in relation to the column about an essentially horizontal axis of rotation (A6); and
- a liftable and lowerable second crane boom (67), which is articulately connected to the first crane boom (65) so as to be pivotable in relation to the first crane boom about an essentially horizontal axis of rotation (A7),

**characterized in that** the crane (60) comprises a load handling tool (1) according to any of claims 1-8 mounted to an outer end of the second crane boom (67).

10. A hydraulic crane according to claim 9, **characterized in that** the crane (60) comprises a holding- and locking mechanism (70) for locking the load handling tool (1) to the second crane boom (67) with the first and second bucket jaws (10, 30) in the fold-up storing position and with the load handling tool (1) in a given fixed position in relation to and at the side of the second crane boom (67).

11. A hydraulic crane according to claim 10, **characterized in that** the holding- and locking mechanism (70) comprises:

- a first coupling member (72a), which is fixed to the second crane boom (67) and configured for engagement with a corresponding second coupling member (22) on the first bucket jaw (10);
- a third coupling member (72b), which is fixed to the second crane boom (67) and configured for engagement with a corresponding fourth coupling member (42) on the second bucket jaw

(30); and

- a locking member (73), which is moveable between a locking position, in which the locking member (73) prevents the first coupling member (72a) from being disengaged from the second coupling member (22) and the third coupling member (72b) from being disengaged from the fourth coupling member (42), and an unlocking position, in which the locking member (73) allows the first coupling member (72a) to be disengaged from the second coupling member (22) and the third coupling member (72b) to be disengaged from the fourth coupling member (42).

12. A hydraulic crane according to claim 11, **characterized in:**

- **that** the first coupling member (72a) has the form of a hook and the second coupling member (22) has the form of a recess, wherein the first coupling member (72a) is insertable into the second coupling member (22); and
- **that** the third coupling member (72b) has the form of a hook and the fourth coupling member (42) has the form of a recess, wherein the third coupling member (72b) is insertable into the fourth coupling member (42).

13. A hydraulic crane according to claim 12, **characterized in:**

- **that** the holding- and locking mechanism (70) comprises a base structure (74), which is fixed to the second crane boom (67), wherein the first and third coupling members (72a, 72b) are fixed to the base structure (74); and
- **that** the locking member (73) of the holding- and locking mechanism (70) has the form of a lever and is pivotally mounted to the base structure (74) through a joint (75) so as to be pivotable in relation to the base structure (74) about this joint (75) between its locking position and its unlocking position.

14. A hydraulic crane according to claim 13, **characterized in:**

- **that** the locking member (73) of the holding- and locking mechanism (70) is provided with a protruding locking element (76), which is configured to be engaged with the second or fourth coupling member (22, 42) when the locking member (73) is in its locking position; and
- **that** the locking element (76) is located on a first side of said joint (75), wherein the centre of gravity of the locking member (73) is located on the opposite side of said joint (75) in order to allow the locking member (73) to be moved be-

tween its locking position and its unlocking position under the effect of gravity in dependence on the orientation in space of the second crane boom (67).

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15. A hydraulic crane according to claim 13 or 14, **characterized in:**

- **that** the second crane boom (67) is telescopically extensible so as to enable an adjustment of the extension length thereof, wherein the second crane boom (67) comprises a base section (67a), through which the second crane boom (67) is articulately connected to the first crane boom (65), and one or more telescopic crane boom sections (67b) carried by the base section (67a); and
- **that** the base structure (74) of the holding- and locking mechanism (70) is fixed to the base section (67a) of the second crane boom (67).

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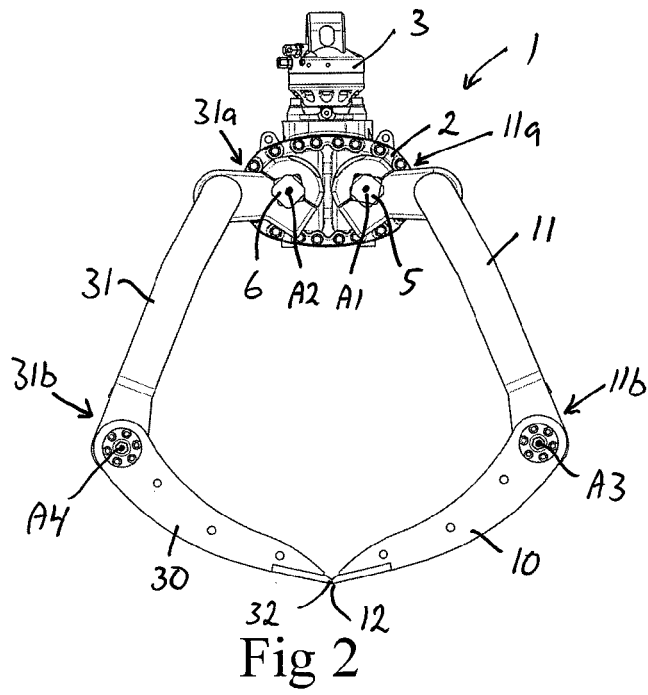
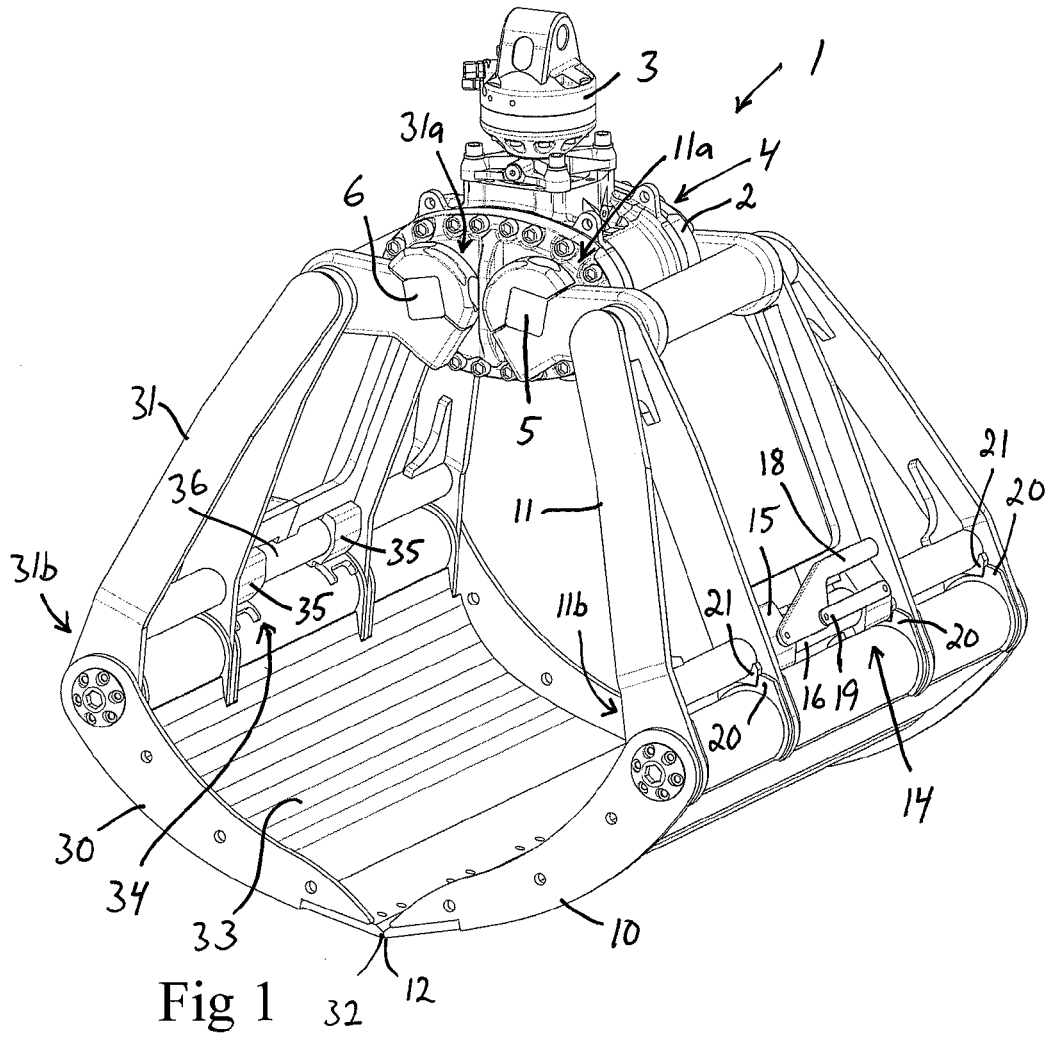
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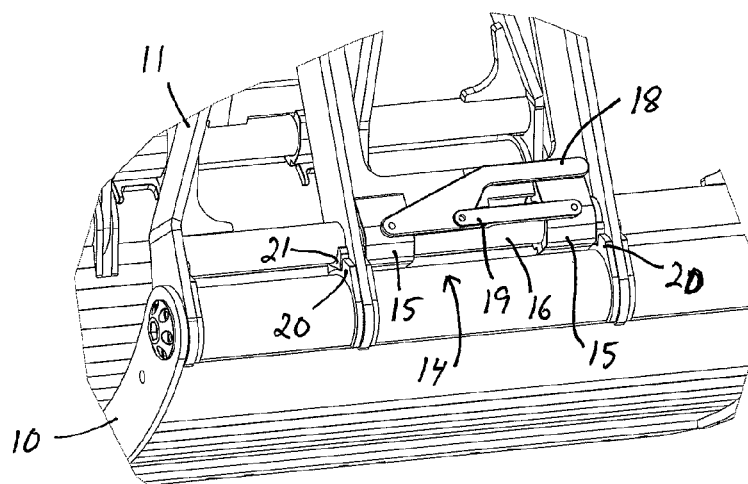


Fig 3

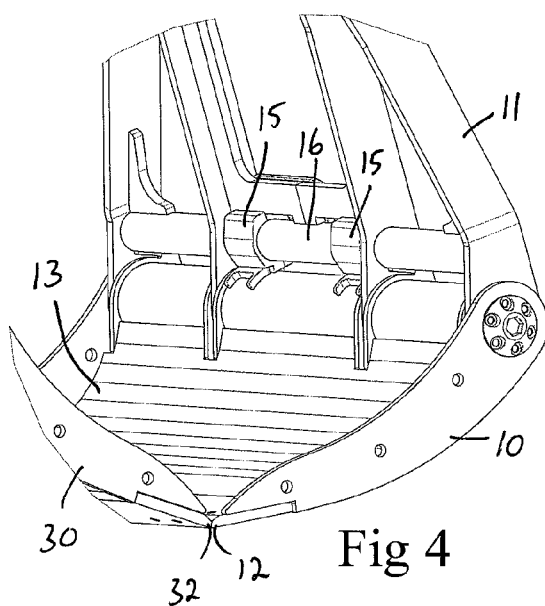


Fig 4

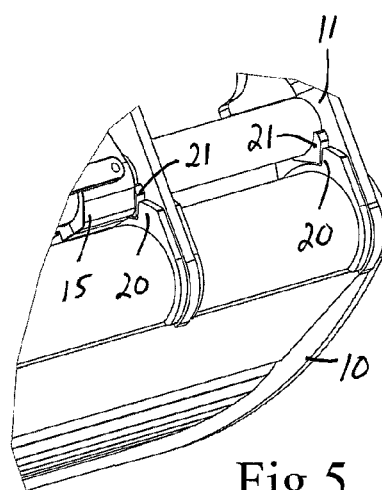


Fig 5

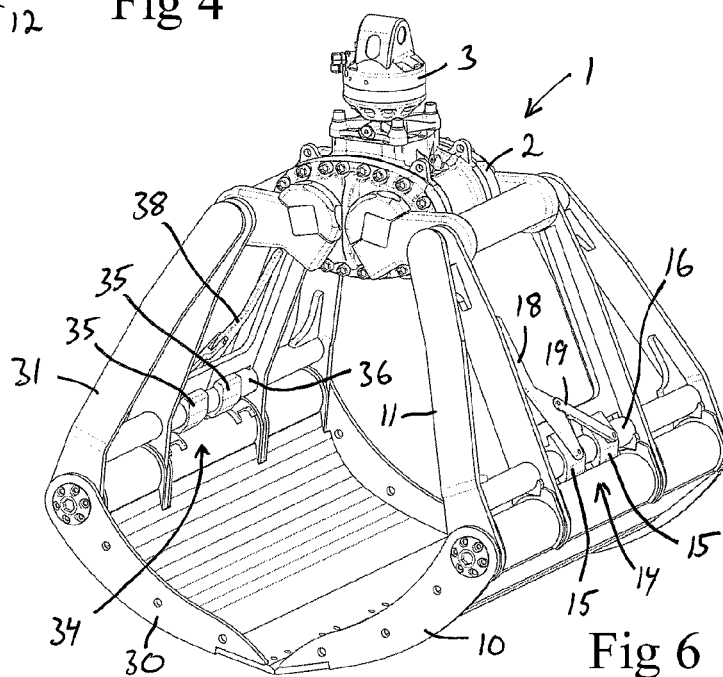


Fig 6

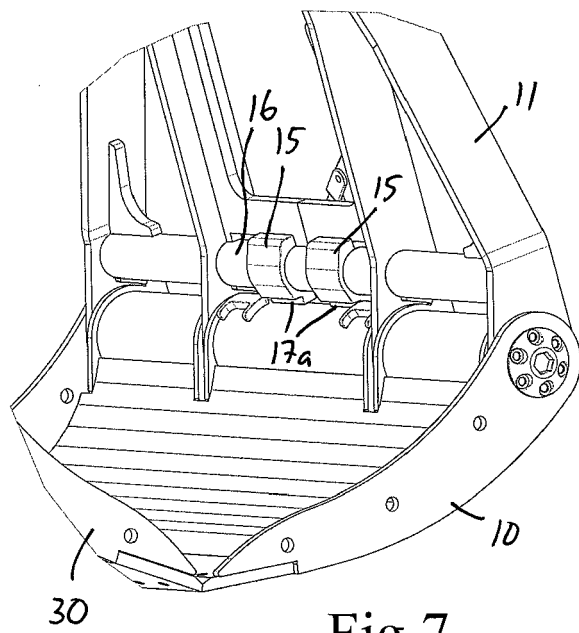


Fig 7

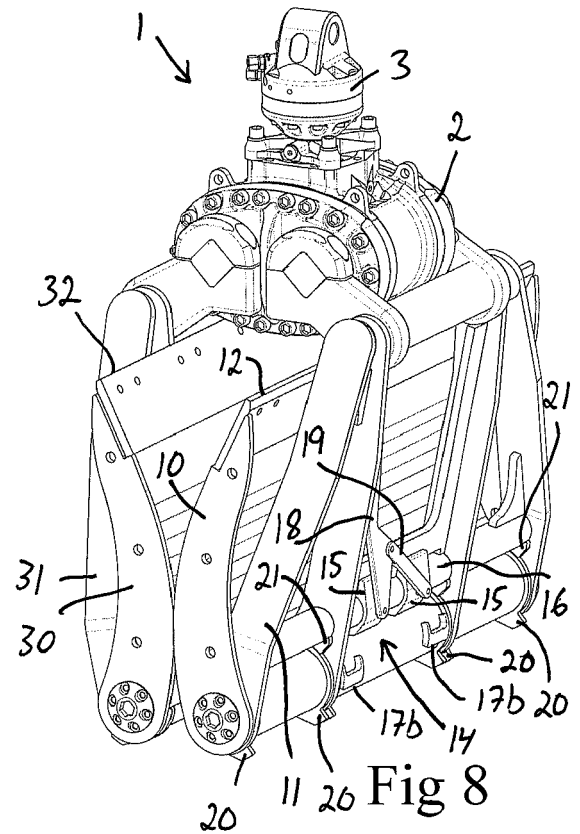


Fig 8

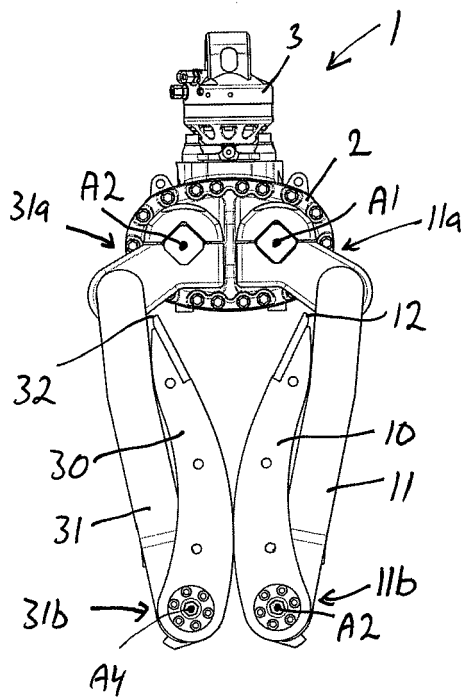


Fig 9

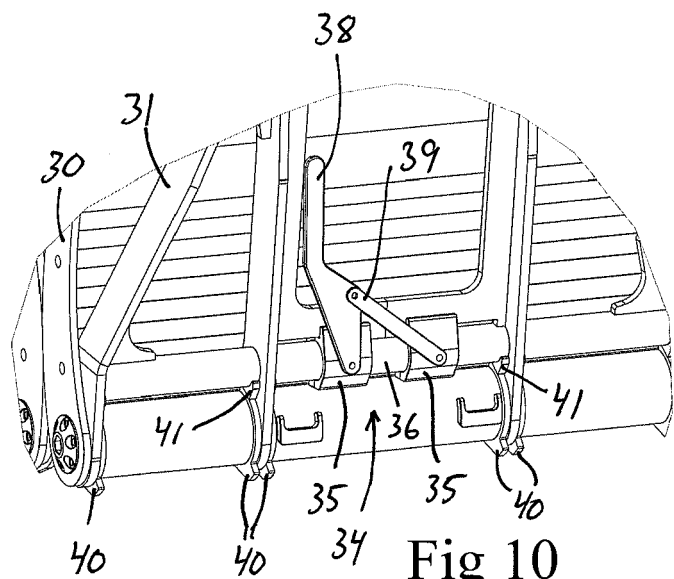


Fig 10

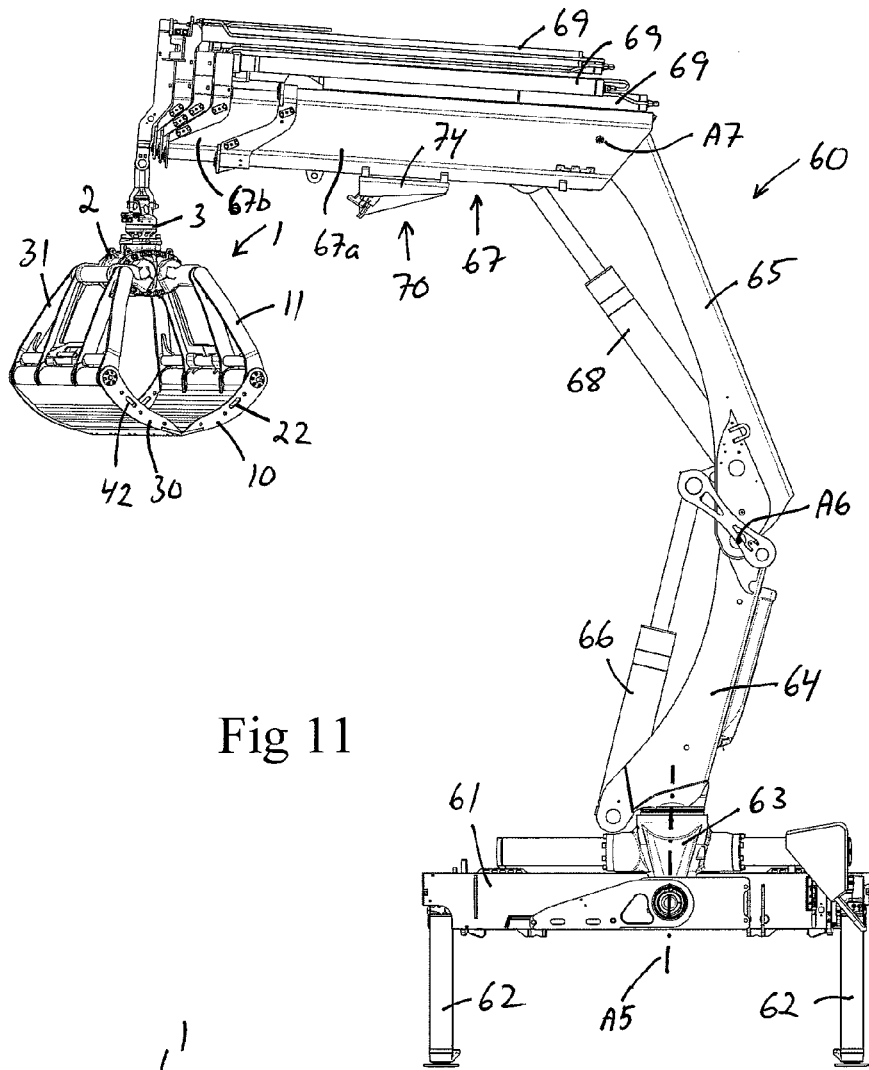


Fig 11

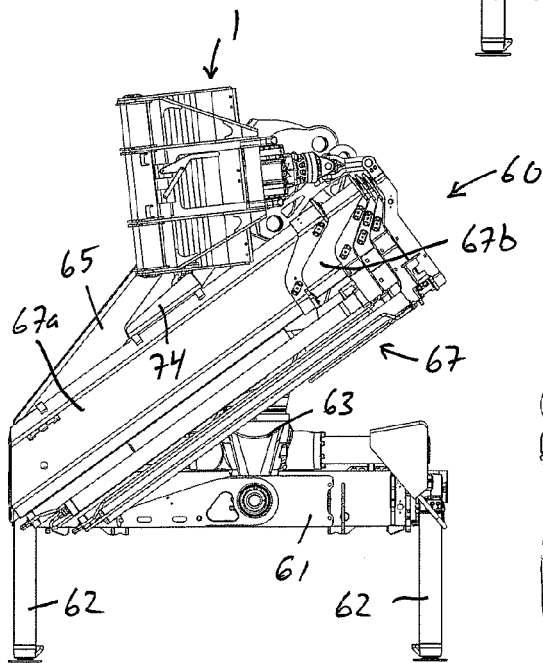


Fig 12

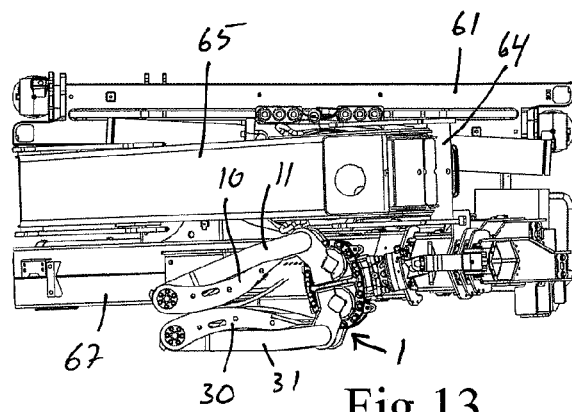


Fig 13

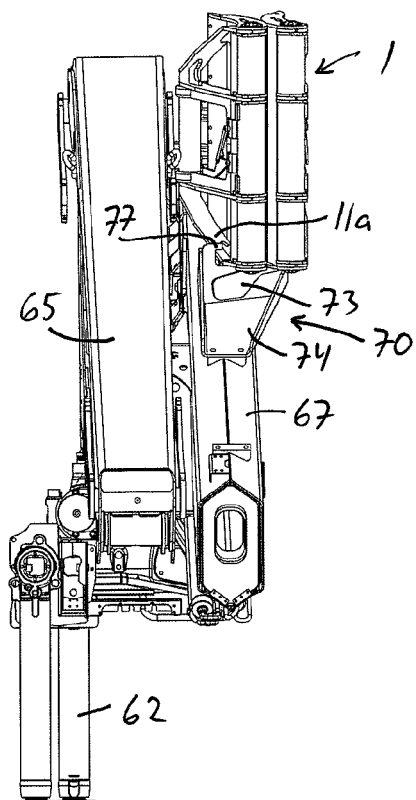


Fig 14

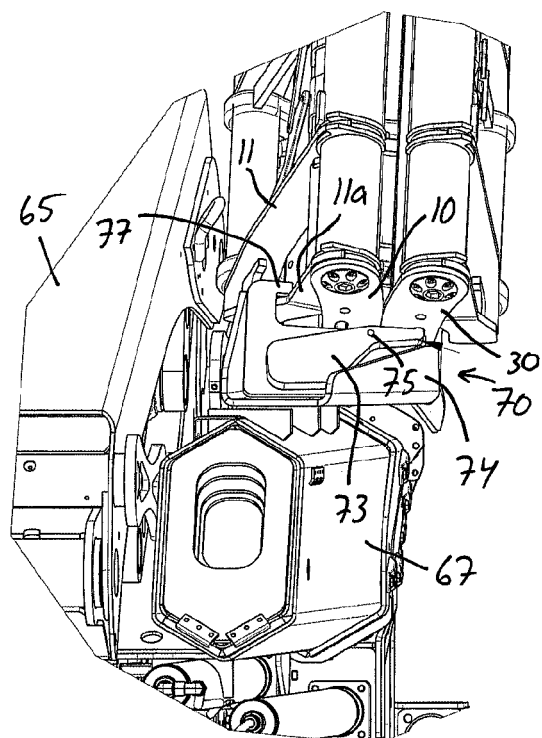


Fig 15

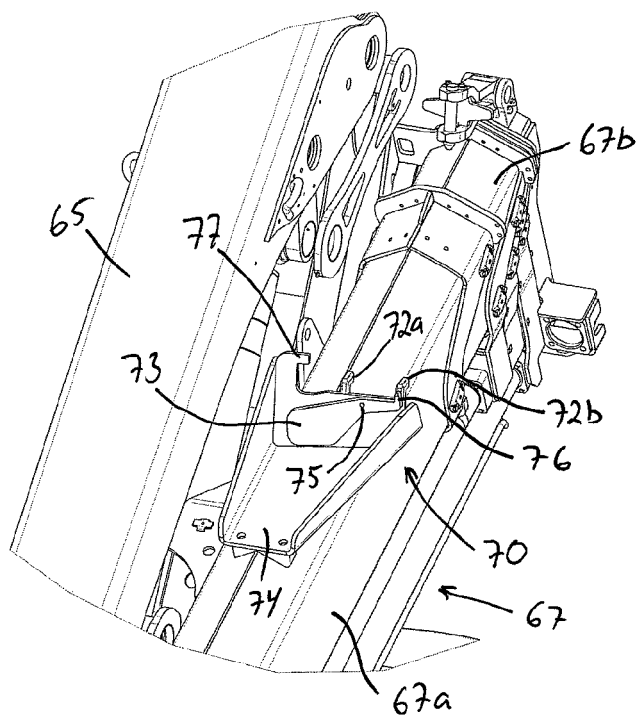


Fig 16

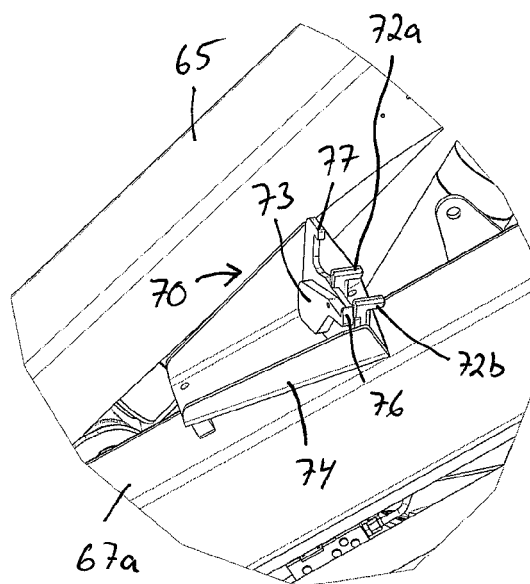


Fig 17

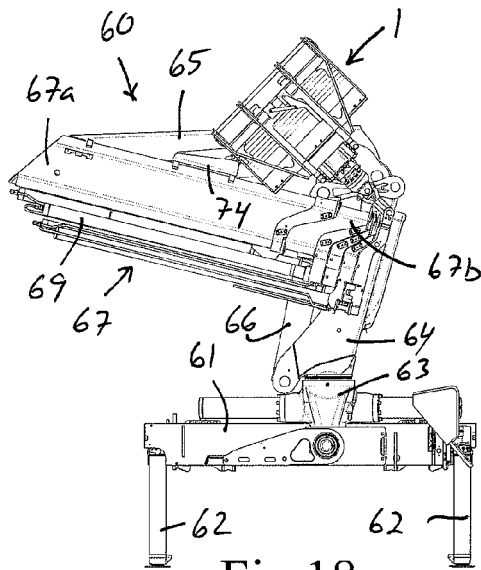


Fig 18a

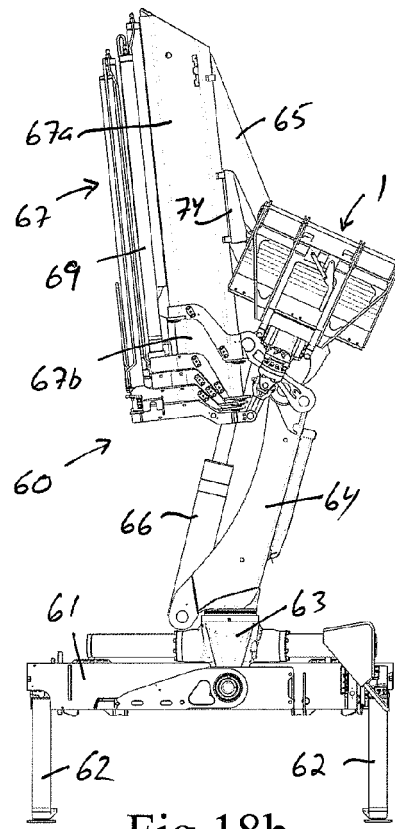


Fig 18b

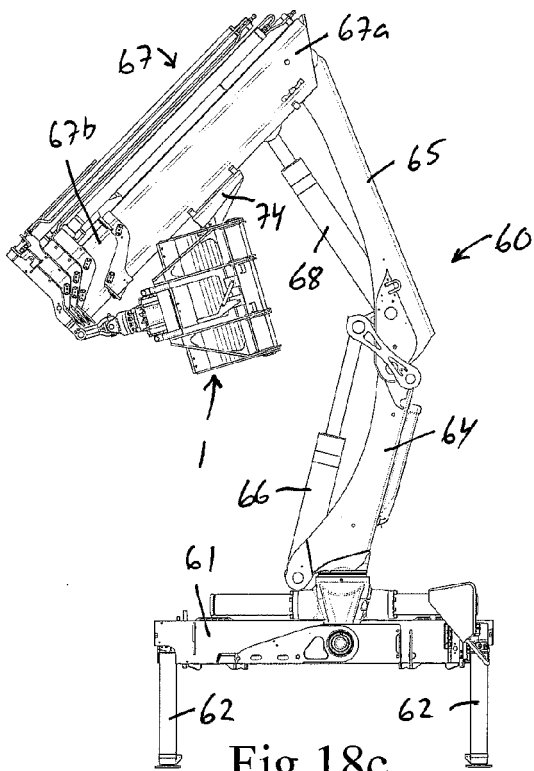


Fig 18c

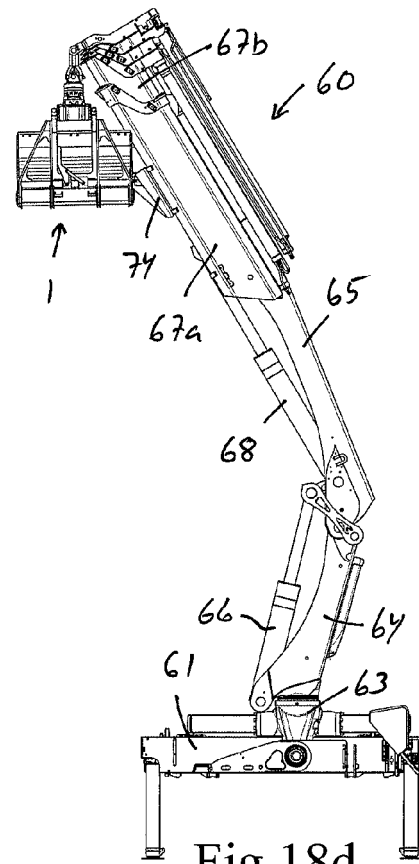


Fig 18d



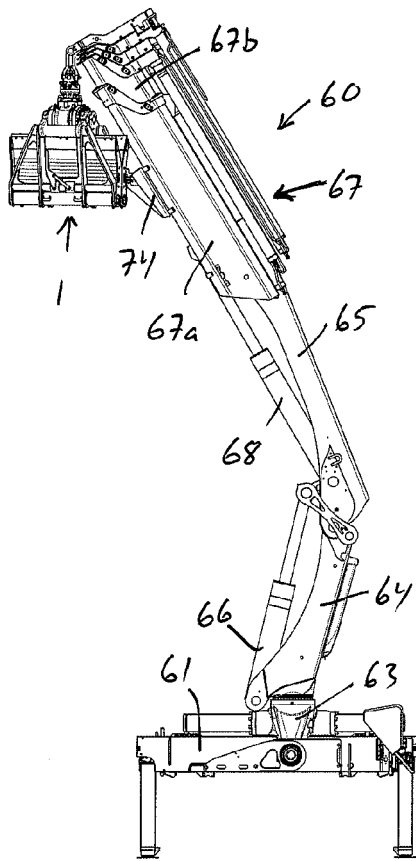


Fig 18e

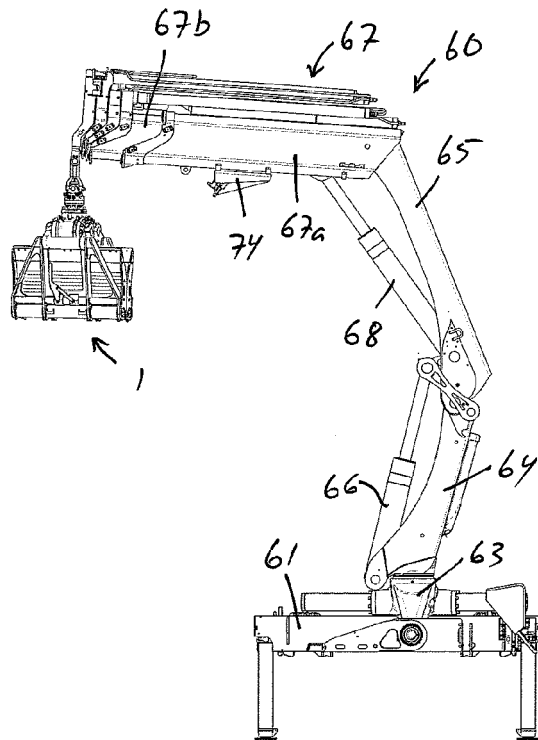


Fig 18f

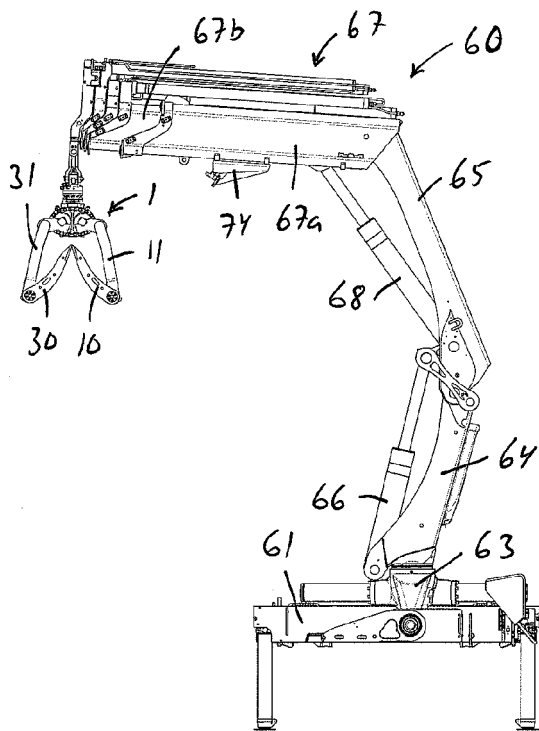


Fig 18g

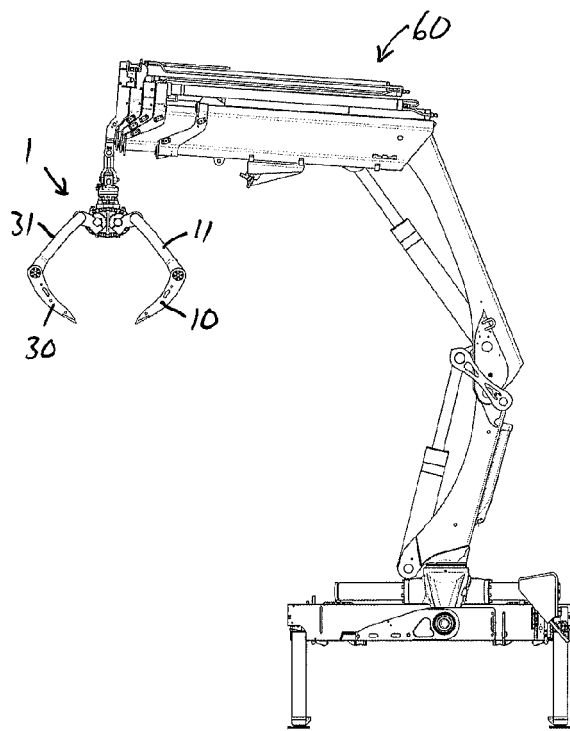


Fig 18h

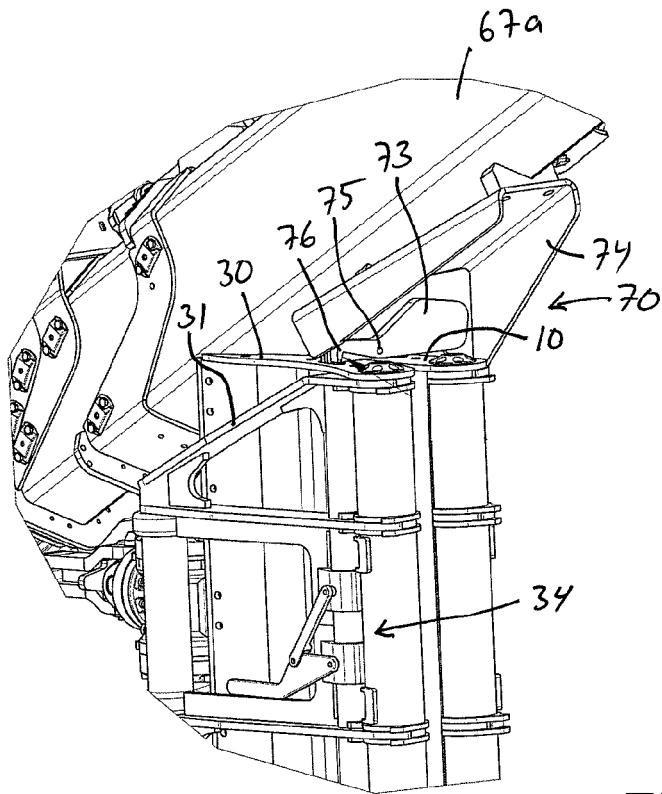


Fig 19

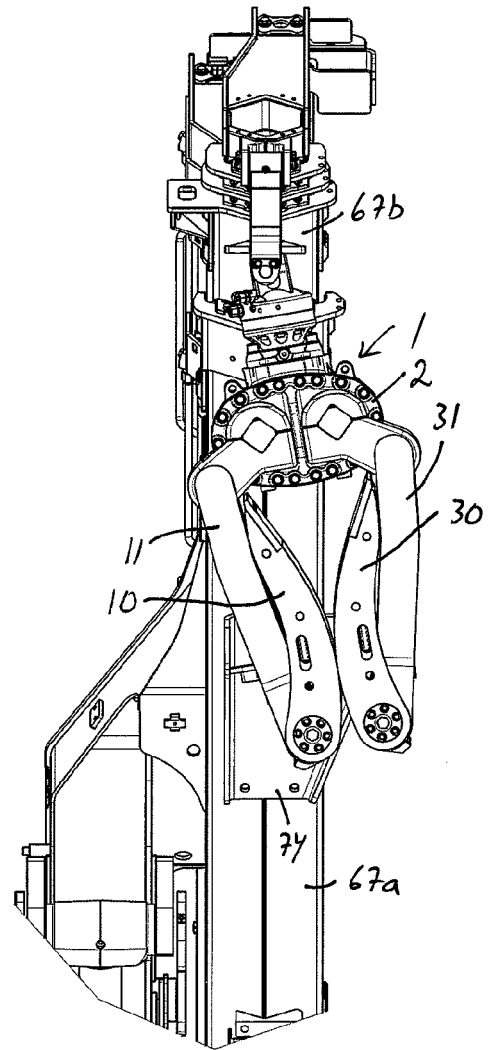


Fig 20

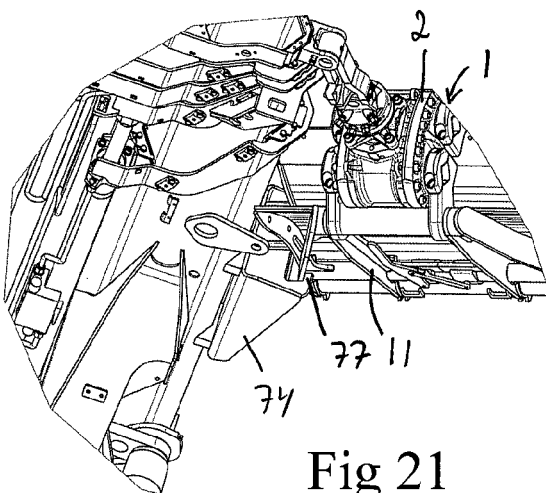


Fig 21

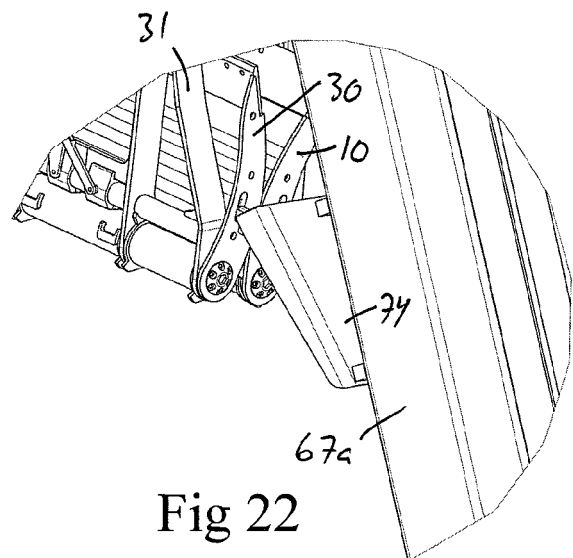


Fig 22

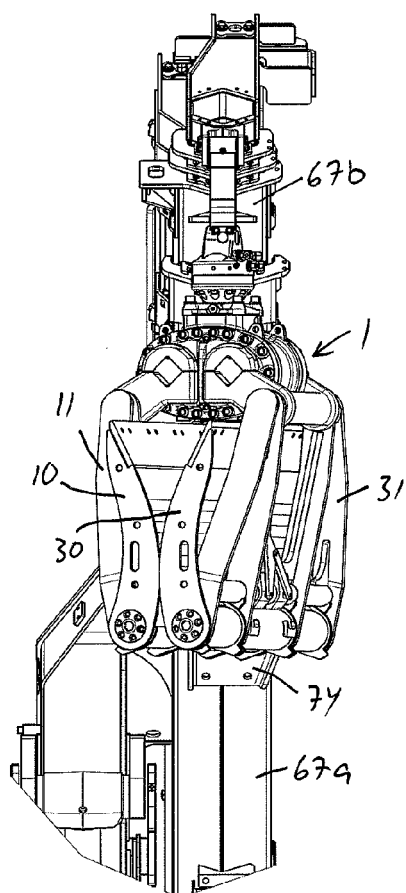


Fig 23

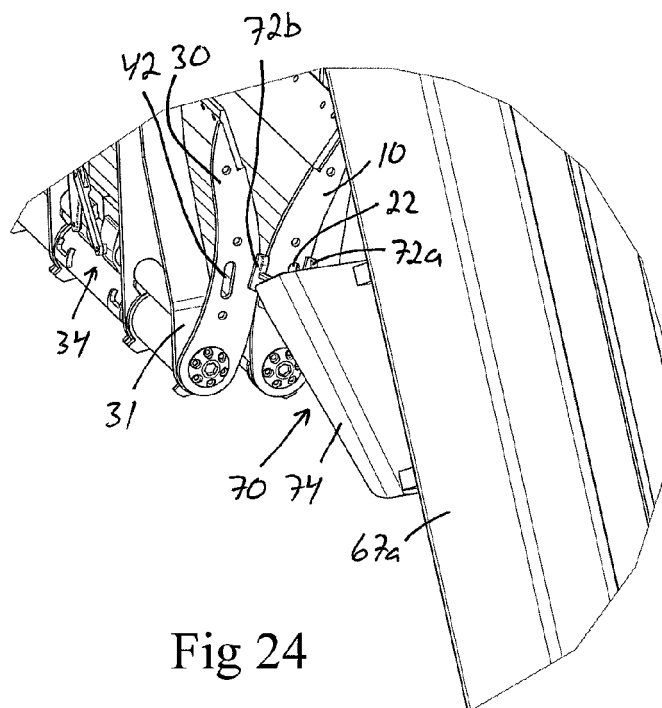


Fig 24

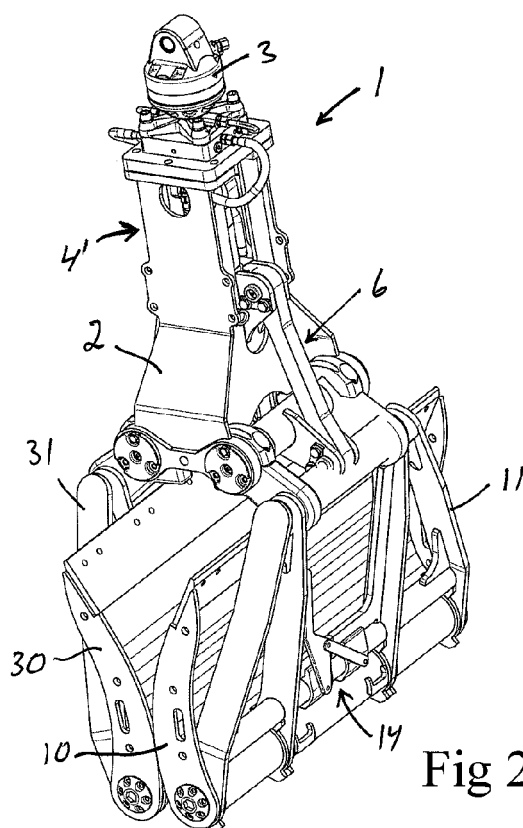


Fig 25



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Application Number  
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			B66C
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 2 June 2017	Examiner Verheul, Omiros
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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