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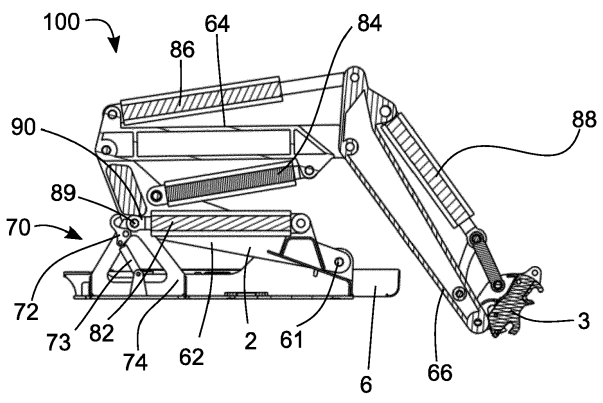
(54) LOCKING ARRANGEMENT FOR AN ARTICULATED BOOM UNIT OF A CONSTRUCTION MACHINE

(57) The present invention relates to an arrangement (100) for a construction machine (1), comprising a machine frame (6) and an articulated boom (2) being arranged on the machine frame, the articulated boom comprising a proximal arm (62) that is mounted in an articulated manner to the machine frame and a distal arm (66) that is connected in an articulated manner to the proximal arm. The arrangement is configured to be operated in an operational mode, in which the proximal arm and the machine frame are interlocked. The invention further relates to a construction machine with such an arrangement. The invention also relates to a method for changing an operational mode of the construction machine, the method comprising the step of interlocking or unlocking a proximal arm of the articulated boom with or from the machine frame for switching between a first operational mode and a second operational mode of the construction machine.

Fig. 20



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Description

Technical field

[0001] The invention concerns an arrangement for a construction machine, wherein the arrangement comprises a machine frame and an articulated boom. The articulated boom is arranged on the machine frame. The invention also concerns a construction machine, which comprises a chassis for moving the construction machine on a ground and an upper structure. The upper structure is arranged on the chassis and comprises a machine frame and an articulated boom.

[0002] The invention further concerns a method for changing an operational mode of a construction machine, which has a machine frame and an articulated boom. The invention also concerns a method for retro-fitting a construction machine.

Prior art

[0003] Construction machines are known, which have an articulated boom at the front or back of a machine frame, wherein said articulated boom can be operated in different operational modes. A multi-operational boom design is commonly realized by hydraulically operated boom arms, wherein selected positioning cylinders of the articulated boom may be activated to hold selected boom arms in place. Positioning cylinders of further boom arms, which are not held in place, may be activated to execute requested articulations and movements of said further arms. Thus, different operational modes are basically realized by holding different arms of the articulated boom in place. Thus, stiffness and load handling capabilities of the articulated boom in said different operational modes are only defined and limited by relative positions and interactions of boom arms and positioning cylinders of the articulated boom, respectively.

Summary of the invention

[0004] According to the present invention, an arrangement for a construction machine is provided. The arrangement comprises a machine frame and an articulated boom. The articulated boom is arranged on the machine frame. The articulated boom comprises a proximal arm and a distal arm, wherein the proximal arm is mounted in an articulated manner to the machine frame and the distal arm is connected in an articulated manner to the proximal arm. The arrangement is configured to be operated in an operational mode in which the proximal arm and the machine frame are interlocked.

[0005] The arrangement according to the present invention may be provided for different kinds of construction machines, preferably for a combined loader-excavator construction machine. The loader-excavator construction machine may be operated at least in a loader mode and in an excavator mode, wherein the interlocking of the proximal boom arm and the machine frame may be realized in the loader mode.

[0006] The machine frame of the arrangement may be a steel framework or a steel base for supporting the articulated boom on the construction machine. The articulated boom may be any multi-armed boom, in particular a three-armed boom. A bucket, a hammer or a cutter head may be held by and attached to the distal arm of the articulated boom.

[0007] Further equipment, for example an engine, a driver's cabin, a counterweight and/or a tool storage, may also be arranged on the machine frame. At least the machine frame and the articulated boom may be part of an upper structure of the construction machine. The upper structure may comprise at least one battery and at least one electric motor, which may be connected to the battery for operating the construction machine or at least one component thereof. For example, the upper structure and/or the articulated boom may be operated by the electric motor. For this purpose, for example, the electric motor may run at least one hydraulic pump, the articulated boom and/or the upper structure being moved via a hydraulic system that is powered by said hydraulic pump.

[0008] The articulated boom of the arrangement comprises at least two arms, the proximal arm and the distal arm. The proximal arm and the distal arm may be interconnected directly or indirectly via an intermediate arm. The proximal arm itself may be mounted on the machine frame via an articulation, in particular an articulated joint. Thus, the proximal arm may be directly hinged to the machine frame, wherein the distal arm may be indirectly hinged to the machine frame with at least one intermediate arm therebetween. Providing at least one further intermediate arm between the distal arm and the proximal arm may increase the operational range of the construction machine.

[0009] The interlocking of the proximal arm and the machine frame may consist of or may comprise at least one of a locking of the proximal arm in or to the machine frame, a locking of the machine frame in or to the proximal arm, a blocking of the articulation between the proximal arm and the machine frame and/or a latching of the proximal arm to the machine frame. A respective interlock, lock, block and/or latch may be mechanically or physically provided by an interlocking means, a locking means, a blocking means and/or a latching means. At least one of these means may be arranged on the machine frame or on the articulated boom. Respective means may also be arranged in a divided manner on both, the machine frame and on the articulated boom.

[0010] A core idea of the present invention can be seen in that the proximal arm of the multi-armed boom cannot only be held in place hydraulically during at least one operational mode of the construction machine but rather mechanically locked to the machine frame. At least one respective articulation of the proximal arm, which is not intended to be used in an operational mode, may thus be substantially released from forces and moments di-

rectly acting on it. Additionally, forces and moments acting on a hydraulic positioning cylinder of the proximal arm may also be reduced. Limiting the degrees of freedom of the articulated boom by means of locking a boom arm to the machine frame may increase stiffness and load handling capability of the entire boom. Hence, for example, while operating the boom in a loader mode, arising push loads may be better absorbed by the boom and the machine frame.

[0011] A further advantageous effect of the arrangement according to the present invention resides in the fact that an interlocking of the proximal arm and the machine frame may also result in a more compact machine design during a certain operational mode. This may result in a lower center of gravity of the construction machine, which in turn may lead to an increased tilt stability of the construction machine.

[0012] The arrangement according to the present invention may be configured to be operated in at least one further operational mode, in which the proximal arm and the machine frame are not interlocked. The operational mode, in which the proximal arm and the machine frame are interlocked, may be a loader mode. An operational mode, in which the proximal arm and the machine frame are not interlocked, may be an excavator mode. Optionally, a further operational mode, in which the proximal arm and the machine frame are not interlocked, may be a dozer mode. Not interlocking the proximal arm may be understood as not locking the proximal arm in or to the machine frame, not blocking the articulation between the proximal arm and the machine frame and/or not latching the proximal arm to the machine frame. The distal arm may be movable in all operational modes, wherein the proximal arm may only be articulated when it is not interlocked. The movement range of the articulated boom may be larger when the proximal arm and the machine frame are not interlocked.

[0013] The arrangement according to the present invention may further comprise a locking device that is arranged on the machine frame, wherein the locking device is configured to engage with the proximal arm or vice versa so as to block any relative movement between said proximal arm and the machine frame. Alternatively or additionally, the locking device may be arranged on the proximal arm. The proximal arm may also be configured to engage with the locking device. The locking device provides a mechanical connection between the proximal arm and the machine frame, wherein the mechanical connection can be selectively toggled on and off. The connection may comprise a force-locking and/or a form-locking component. The locking device may be an integral part of the machine frame and/or the proximal arm. The locking device may also be a separate part of the arrangement being mounted to the machine frame and/or the proximal arm. The locking device may be operated by a simple manual interaction or remotely without manual intervention. Thus, the locking device may efficiently provide a stiff and rigid connection between the proximal arm and the machine frame.

[0014] The locking device may comprise at least one hydraulically or electrically operated hook for engaging with the proximal arm and/or with the machine frame. The proximal arm or the machine frame may comprise a stud or pin, in which the hook may engage for interlocking the proximal arm and the machine frame. Optionally, the hook may be part of a hook fastener as the locking device. The hook fastener may be arranged on the proximal arm and/or on the machine frame. The hook may be swiveled between an unhooked position and a hooked-up position by a hydraulic cylinder or by an actuator to catch and release the stud or pin. Such a remotely or manually controlled connection of the proximal arm and the machine frame may provide a robust interlocking.

[0015] Additionally or alternatively to the hook, the locking device may consist of or may comprise a bolt, a detent or any other type of fastener. The bolt, the detent or the fastener may comprise the same functionality as the hook, in particular with respect to its mechanical engaging and interlocking ability.

[0016] The arrangement according to the present invention may comprise a pin that is arranged on the proximal arm, in particular a pin for fixing a piston rod eye of a positioning cylinder of the proximal arm, wherein the pin is configured to be locked to the machine frame. The locking device or the hook may engage with the pin. The positioning cylinder of the proximal arm may be arranged on the machine frame, wherein its piston rod may be connected to the proximal arm at a distal end thereof. For this purpose, the piston rod eye may enclose the pin. Even though the pin may be circularly enclosed by the piston rod eye, the pin may comprise exposed portions to be used for interlocking the proximal arm and the machine frame. For example, at least one exposed portion of the pin may be locked with the locking device. The hydraulically or electrically operated hook may engage with the pin by hooking up at least one of the exposed portions of the pin. Utilizing and locking a pin of a piston rod eye may provide a compact and flush locking of the proximal arm in the machine frame or a locking device. A retro-fit of a construction machine, especially with such an interlocking concept, may thus be realized efficiently.

[0017] Alternatively, a double hook may be provided for engaging with a stud or pin of the proximal arm. The pin for fixing a piston rod eye of a positioning cylinder of the proximal arm may comprise two exposed portions sidewise of a middle portion of the pin. The piston rod eye may enclose the pin at the middle portion. The hydraulically or electrically operated double hook may engage the pin via both exposed portions.

[0018] The arrangement according to the present invention may further comprise an arm support that comprises a supporting portion for supporting the proximal arm when interlocked with the machine frame, wherein the arm support is configured to absorb forces induced by the proximal arm. The supporting portion may be a contact or engagement area on which the proximal arm

may rest before, during or after being interlocked with the machine frame. The contact or engagement area may be a seating or a surface for supporting the proximal arm during the operational mode, in which the movement of the proximal arm is blocked. The proximal arm may be moved until a contact with the arm support is realized and then locked by the locking device. Thus, the arm support may comprise a double functionality in supporting the proximal arm and in providing a stop for locking the proximal arm. The position of the proximal arm, when resting on the arm support, may be defined as a locking position of the proximal arm. Especially a planar contact between the proximal arm and the machine frame may further increase the stiffness of the interconnection between the proximal arm and the machine frame.

[0019] In the interlocked position, the proximal arm may be arranged in a substantially flush fashion with respect to the machine frame or at least forming an acute angle with the machine frame.

[0020] A substantially flush locking position of the proximal arm may be a folded position of the proximal arm. In the folded position, the proximal arm may be arranged substantially parallel to a base plate of the machine frame. The piston rod of the positioning cylinder of the proximal arm may be in a fully retracted position in said folded position. The proximal arm can be designed in a hollow manner for accommodating at least a part of the positioning cylinder when the proximal arm and the machine frame are interlocked. Specifically, the retracted positioning cylinder may rest in-between elongated side portions of the proximal arm. Operating an articulated boom, which proximal arm may be locked to the machine body of the construction machine in such a flush fashion, may provide a compact machine design. An operational mode suitable for height limited construction sites may thus be realized. A locked proximal arm may also increase transport safety and may lower the transport height of the construction machine when transported on a lorry, for example.

[0021] The articulated boom of the arrangement according to the present invention may further comprise an intermediate arm that is interconnected in an articulated manner between the proximal arm and the distal arm. The articulated boom may be a three-armed boom. The intermediate arm may respectively comprise an articulation with the proximal arm and an articulation with the distal arm. The intermediate arm may be pivotable when the proximal arm and the machine frame are interlocked and/or not interlocked. Optionally, the intermediate arm may be lockable to the proximal arm, the machine frame and/or the distal arm. Providing an intermediate arm generally widens the work range of the construction machine.

[0022] A positioning cylinder of the intermediate arm may be arranged below the intermediate arm, connecting the proximal arm and the intermediate arm at distal ends thereof. A distal end of an arm may be that end, which is remoter from the machine frame. The connection at distal ends of these arms increases the foldability of the intermediate arm. Furthermore, a positioning cylinder of the distal arm may be arranged above the intermediate arm. This positioning cylinder may connect the intermediate arm and the distal arm at proximal ends thereof. A proximal end of an arm may be the closer end of the arm with respect to machine. Hence, the positioning cylinder of the distal arm may be arranged above the positioning cylinder of the intermediate arm, also when the proximal arm and the machine frame are interlocked. Both of these cylinders may be arranged above the positioning cylinder of the proximal arm. All of these positioning cylinders may be arranged in a single plane.

[0023] In the arrangement according to the present invention, the intermediate arm, a positioning cylinder of the intermediate arm and a positioning cylinder of the distal arm may be arranged substantially parallel to each other. An effect of this arrangement can be seen in that the positioning cylinder of the intermediate arm and the positioning cylinder of the distal arm may remain parallel to each other regardless of the articulation and moving positions of the proximal arm, the intermediate arm and/or of the distal arm. Hence, the cylinders that are provided between the proximal arm and the distal arm may permanently provide a stiff parallelogram-like arrangement.

[0024] The arrangement according to the present invention may further comprise a tool mount being mounted in an articulated manner to the distal arm for mounting a tool on the articulated boom. The tool mount may be configured to hold different tools. The tool or a further tool to be mounted on the tool mount may be provided on the machine frame or elsewhere on the upper structure of the construction machine. For this purpose, the machine frame or the upper structure may comprise a tool storage for storing or carrying at least one tool. The tool may be an additional tool that is held in reserve while another tool is already mounted on the tool mount. The distal arm of the articulated boom may be pivoted to the tool, which is stored in the tool storage, to be picked by the tool mount. Picking or changing a tool may be carried out when the proximal arm and the machine frame are interlocked or not interlocked. In particular, an unlocking step of the proximal arm may precede the picking or changing step of the tool. Said different tools, which can be mounted to the tool mount, may be provided for different operational modes. The different tools may be buckets of different sizes, for example an excavator bucket and a loader bucket.

[0025] A construction machine according to the present invention comprises a chassis for moving the construction machine on a ground and an upper structure. The upper structure is arranged on the chassis and has an arrangement with a machine frame and an articulated boom. The articulated boom is arranged on the machine frame. The articulated boom comprises a proximal arm mounted in an articulated manner to the machine frame and a distal arm connected in an articulated manner to the proximal arm. The arrangement or the con-

struction machine is configured to be operated in an operational mode in which the proximal arm and the machine frame are interlocked.

[0026] The upper structure of the construction machine may be part of the machine body of the construction machine. The upper structure may be pivotably arranged on the chassis, in particular pivotably about a vertical axis. The chassis of the construction machine may be a chain-driven chassis or a wheel-driven chassis. The chassis may further comprise a tool storage for storing a tool to be mounted on the tool mount of the distal arm.

[0027] According to the present invention, the upper structure of the construction machine may further comprise a recess for accommodating the proximal arm of the arrangement when interlocked with the machine frame of the arrangement. Further machine equipment may be arranged on the machine frame sidewise of the recess. The recess allows for a flush interlocking of the proximal arm with the machine frame. The construction machine according to the present invention may further be configured to be operated in a loader mode, in which the proximal arm of the arrangement is interlocked with the machine frame of the arrangement and/or in an excavator mode, in which the proximal arm of the arrangement is not interlocked with the machine frame of the arrangement. The articulated boom may preferably be a three-armed boom. When operated in the loader mode, the three-armed articulated boom may be moved by pivoting the intermediate arm and the distal arm only, while the proximal arm is locked to the machine frame. When operated in the excavator mode, also the proximal arm of the three-armed boom may be pivotable.

[0028] A method for changing an operational mode of a construction machine according to the present invention comprises the step of interlocking or unlocking a proximal arm of an articulated boom with or from a machine frame for switching between a first operational mode and a second operational mode of the construction machine. The construction machine comprises the machine frame and the articulated boom, wherein the articulated boom is arranged on the machine frame. The proximal arm and the machine frame may be interlocked in the first operational mode, wherein the proximal arm and the machine frame may not be interlocked in the second operational mode.

[0029] Changing an operational mode may comprise switching from an excavator mode to a loader mode or vice versa. Said changing of an operational mode may also comprise the interchanging of tools by dropping or grabbing a tool by a tool mount, which is arranged at a distal end of the articulated boom.

[0030] A method for retro-fitting a construction machine according to the present invention comprises the step of adding the arrangement according to any of the described embodiments to a construction machine, in particular to a combined loader-excavator construction machine. Retro-fitting a construction machine may also be an upgrading or redesigning of the construction machine.

Brief description of the figures

[0031]

Fig. 1 shows a side view of a construction machine according to an embodiment of the present invention in an excavator mode.

Fig. 2 shows a perspective view of the construction machine of Fig. 1 during an operational mode change from or to the excavator mode shown in Fig. 1.

Fig. 3 shows a side view of the construction machine of Fig. 1 in a hammer mode.

Fig. 4 shows a perspective view of the construction machine of Fig. 1 during an operational mode change from or to the hammer mode shown in Fig. 3.

Fig. 5 shows a side view of the construction machine of Fig. 1 in a loader mode.

Fig. 6 shows a side view of the construction machine of Fig. 1 in a dozer mode or during an operational mode change from or to the loader mode shown in Fig. 5.

Fig. 7 shows a plan view of the bottom side of an upper structure of the construction machine of Fig. 1 with a tool changer in a stowed condition.

Fig. 8 shows a plan view of the upper side of the upper structure of the construction machine of Fig. 1 with the tool changer in the stowed condition.

Fig. 9 shows a plan view of the bottom side of the upper structure of the construction machine of Fig. 1 with the tool changer in an alignment condition.

Fig. 10 shows a plan view of the upper side of the upper structure of the construction machine of Fig. 1 with the tool changer in the alignment condition of Fig. 9.

Fig. 11 shows a plan view of the bottom side of the upper structure of the construction machine of Fig. 1 with the tool changer in a further alignment condition.

Fig. 12 shows a plan view of the upper side of the upper structure of the construction machine of Fig. 1 with the tool changer in the further alignment condition of Fig. 11.

Fig. 13 shows a side view of a loaded tool changer of the construction machine of Fig. 1 according to an embodiment of the present invention.

Fig. 14 shows a further side view of the loaded tool changer of Fig. 13.

Fig. 15. shows a plan view from above of the loaded tool changer of Fig. 13.

Fig. 16 shows a side view of the tool changer of Fig.

13 without tools.

Fig. 17 shows a further side view of the tool changer of Fig. 16.

Fig. 18. shows a plan view from above of the tool changer of Fig. 16.

Fig. 19 shows a perspective view of an arrangement comprising a machine frame and an articulated boom of the construction machine of Fig. 1 according to an embodiment of the present invention in an unlocked configuration.

Fig. 20 shows a sectional side view of the arrangement of Fig. 19.

Fig. 21 shows a perspective view of the arrangement of Fig. 19 in a locked configuration.

Fig. 22 shows a sectional side view of the arrangement of Fig. 21.

Detailed description of embodiments

[0032] Embodiments of the present invention are subsequently described with reference to the attached Figs. 1 to 22.

[0033] Figs. 1 to 6 show a multi tool construction machine 1 according to an embodiment of the present invention, wherein the construction machine 1 is shown in different operational modes. The construction machine 1 comprises a chassis 4, an upper structure 5 and an articulated boom 2.

[0034] The chassis 4 may be a chain-driven chassis 4 or a wheel-driven chassis (not shown). The upper structure 5 may be arranged on the chassis 4 in a pivotable manner to be rotatable with respect to the chassis 4. The rotatability of the upper structure 5 with respect to the chassis 4 may be provided around a vertical axis of rotation. Optionally, the upper structure 5 is 360°-rotatable with respect to the chassis 4.

[0035] The upper structure 5 may comprise a machine frame 6 as a base frame or basic framework of the upper structure 5. The upper structure 5 may further comprise a driver's cabin 9, an engine-hydraulic unit 15, and/or a counterweight 16. A hydraulic pump (not shown) for operating hydraulic actuators and a swing drive (not shown) for rotating the upper structure 5 with respect to the chassis 4 may further be provided. The driver's cabin 9, the engine-hydraulic unit 15, and the counterweight 16 may be arranged on the machine frame 6. The upper structure 5 may further comprise a recess 7. The recess 7 may be formed above the machine frame 6 for accommodating at least part of the articulated boom 2, i.e. the proximal arm 62, when being folded towards or against the machine frame 6. The driver cabin 9, the engine-hydraulic unit 15 and/or the counterweight 16 may be arranged around the recess 7. In other words, the recess 7 may be surrounded by the driver cabin 9, the engine-hydraulic unit 15 and/or the counterweight 16. As illustrated in Figs. 8, 10 and 12, the engine-hydraulic unit 15 may be arranged on both sides of the recess 7. The driver cabin 9 as well as the engine-hydraulic unit 15 may be arranged on opposite sides of the upper structure 5 and the machine frame 6, respectively. The articulated boom 2 may be arranged between the driver cabin 9 and the engine-hydraulic unit 15. The construction machine 1 may comprise, instead of or in addition to the engine-hydraulic unit 15, at least one battery (not shown) and at least one electric motor (not shown) for operating the chassis 4, the upper structure 5, the machine frame 6, the hydraulic pump and/or the articulated boom 2.

[0036] The articulated boom 2 may be arranged on the upper structure 5, wherein the articulated boom 2 may be a three-armed boom 2 or optionally a two-armed boom (not shown). At one boom end, the articulated boom 2 may be pivotably attached to the machine frame 6 by means of a first articulation 61. The first articulation 61 may be a pivot joint. The first articulation 61 may be provided at a central position of the machine frame 6 in widthwise direction of the upper structure 5 and in front of to the vertical axis of rotation of the upper structure 5 in lengthwise direction of the upper structure 5. At the other end of the articulated boom 2, which is not attached to the machine frame 6, a tool mount 3 may be pivotably arranged.

[0037] The articulated boom 2 may comprise a proximal arm 62, an intermediate arm 64 and a distal arm 66. The proximal arm 62 may be hinged to the machine frame 6 by means of the first articulation 61, the intermediate arm 64 may be hinged to the proximal arm 62 by means of a second articulation 63 and/or the distal arm 66 may be hinged to the intermediate arm 64 by means of a third articulation 65. The articulations 61, 63, 65 may be designed as pivoting joints. The first articulation 61 may interconnect the proximal arm 62 and the upper structure 5 and the machine frame 6, respectively, the second articulation 63 may interconnect the intermediate arm 64 and the proximal arm 62 and the third articulation 65 may interconnect the distal arm 66 and the intermediate arm 64.

[0038] The articulated boom 2 may further comprise a first positioning cylinder 82 for pivoting the proximal arm 62, a second positioning cylinder 84 for pivoting the intermediate arm 64, a third positioning cylinder 86 for pivoting the distal arm 66 and/or a fourth positioning cylinder 88 for pivoting the tool mount 3.

[0039] The first positioning cylinder 82 may be hinged to the machine frame 6 rearward of the first articulation 61. Furthermore, the first positioning cylinder 82 may be hinged to the backside of the distal end of the proximal arm 62, the backside being that side which is facing away from the intermediate arm 64. The first positioning cylinder 82 may be a boom cylinder for pivoting the entire articulated boom 2 with respect to the machine frame 6. The second positioning cylinder 84 may be hinged to the distal end of the proximal arm 62 and to a distal end of the intermediate arm 64. The second positioning cylinder 84 may be arranged beneath the intermediate arm 64. The third positioning cylinder 86 may be hinged to a proximal end of the intermediate arm 64 and to a proximal

end of the distal arm 66. The third positioning cylinder 86 may be arranged above the intermediate arm 64 and/or above the second positioning cylinder 84. The second positioning cylinder 84 and the third positioning cylinder 86 may be arranged substantially parallel to each other in all operating positions of the boom. The fourth positioning cylinder 88 may be hinged to a proximal end of the distal arm 66 and to the tool mount 3 at the distal end of the distal arm 66. The fourth positioning cylinder 88 may be arranged above the distal arm 66, i.e. on that side of the distal arm 66 which is facing away from the proximal arm 62.

[0040] Different tools 10, 20, 30 may be provided on the construction machine 1, which are configured to be mounted to the tool mount 3 that may be pivotably attached to the distal arm 66. A fourth articulation 67 may interconnect the distal arm 66 and the tool mount 3. Tools 10, 20, 30 not mounted to the tool mount 3 are carried by the construction machine 1. A first tool 10 may be a loader bucket 11, a second tool 20 may be an excavator bucket 21 and a third tool 30 may be a hammer 31, wherein at least the loader bucket 11 and the excavator bucket 21 may be provided on the construction machine 1. The hammer 31 may be a hydraulic hammer. Alternatively, only two tools out of the different tools 10, 20, 30 may be provided on the machine.

[0041] The chassis 4 may comprise a first tool carrier 40 and the upper structure 5 may further comprise a second tool carrier 50, wherein the first tool carrier 40 and/or the second tool carrier 50 may provide a tool storage on the construction machine 1. The second tool carrier may be configured as a tool changer 50. The first tool carrier 40 may be arranged at the rear side of the chassis 4 and may be configured to carry the first tool 10. The first tool carrier 40 may be tiltable and may be moved between an upward position as shown in Figs. 1 to 5 and a downward position as shown in Fig. 6. The upward position may serve for carrying the first tool 10 and the downward position may serve for utilizing the first tool 10, e.g. the loader bucket 11, for carrying out dozer work with the construction machine 1. In other words, in the upward position, the first tool 10 is spaced from the ground, whereas it is in contact with or at least in proximity of the ground in the downward position.

[0042] The second tool carrier 50 may be arranged at the front end of the upper structure 5, wherein the second tool carrier 50 may be positioned adjacent to the articulated boom 2 and/or in front of the engine-hydraulic unit 15. The articulated boom 2 may be arranged in between the driver cabin 9 and the second tool carrier 50. The second tool carrier 50 may be accommodated in a frame recess 8 of the machine frame 6 and may be pivoted from a stowed position, as shown in Figs. 1, 3, 5 and 6, to at least one pivot position, as shown in Figs. 2 and 4. Hereto, the second tool carrier 50 may be pivotably attached to the machine frame 6. A pivoting movement of the second tool carrier 50 may be provided by a positioning cylinder 52, for example a hydraulic positioning cylinder. Two tools 20, 30 may be carried on the second tool carrier 50. The tools 20, 30 may be the excavator bucket 21 and the hammer 31, both mountable to the tool mount 3. The second tool carrier 50 may be operated by at least one battery (not shown) and at least one electric motor (not shown). The at least one battery and the at least one electric motor may power the second tool carrier for providing the pivoting movement.

[0043] Different operational modes of the construction machine 1 are subsequently described with reference to the Figs. 1 to 6.

[0044] Fig. 1 shows the construction machine 1 in an excavator mode being an operational mode of the construction machine 1. In this operational mode, the articulated boom 2 may be arranged in an unlocked configuration such that all boom articulations 61, 63, 65, 67 are unlocked and all arms 62, 64, 66 are movable. In this excavator mode, the excavator bucket 21 may be mounted to the tool mount 3. The loader bucket 11 and the hammer 31 may be carried by the construction machine 1 by depositing them in the tool storage, i.e. the first 10 or second tool carrier 50.

[0045] Fig. 2 shows the construction machine of Fig. 1 during a step of selecting or picking of the excavator bucket 21 by the tool mount 3 attached to the distal arm 66 of the articulated boom 2 for operation of the construction machine 1 in the excavator mode as shown in Fig. 1. Hereto, the excavator bucket 21 may be taken by the tool mount 3 from a first tool retaining portion 152 of the second tool carrier 50. To allow for such a pickup, the second tool carrier 50 may be pivoted from a stowed position as shown in Fig. 1 to a first changing position. This first changing position is situated in a working space of the articulated boom 2, i.e. at a position that is reachable by the tool mount 3 of the articulated boom 2. The tool mount 3 may snap in the excavator bucket 21 automatically.

[0046] Fig. 3 shows the construction machine 1 in a hammer mode as a further operational mode of the construction machine 1. In this operational mode, the articulated boom 2 may be arranged in an unlocked configuration, in which all boom articulations 61, 63, 65, 67 are movable. The hammer 31 may be mounted on the tool mount 3, and the loader bucket 11 and the excavator bucket 21 may be carried by the construction machine 1.

[0047] Fig. 4 shows the construction machine 1 in a step of selecting or picking of the hammer 31 by the tool mount 3 attached to the distal arm 66 of the articulated boom 2 for operation of the construction machine 1 in the hammer mode as shown in Fig. 3. Hereto, the hammer 31 may be taken from a second tool retaining portion 154 of the second tool carrier 50 by the tool mount 3. To allow for such a pickup, the second tool carrier 50 may be pivoted from a stowed position as shown in Fig. 3 to a second changing position. This second changing position is situated in a working space of articulated boom 2. The second changing position may be less changing than the first changing position as shown in Fig. 2. The

tool mount 3 may snap into the hammer 31 automatically.

[0048] Fig. 5 shows the construction machine 1 in a loader mode as a further operational mode of the construction machine 1. In this operational mode, the articulated boom 2 may be arranged in a partly locked configuration, in which the first articulation 61 may be blocked by interlocking the proximal arm 62 of the articulated boom 2 with the upper structure 5 and/or the machine frame 6 of the construction machine 1. In the loader mode, the articulated boom 2 may be de facto a two-armed boom. The loader bucket 11 may be mounted to the tool mount 3, and the excavator bucket 21 and the hammer 31 may be carried by the construction machine 1.

[0049] Fig. 6 shows the construction machine 1 in a dozer mode as a further operational mode of the construction machine 1. In this operational mode, the articulated boom 2 may be not operated. The construction machine 1 exhibits an identical configuration as that shown in Fig. 6 during a change of the operational mode to an excavator mode. For conducting such a change, the loader bucket 11 may be taken by the tool mount 3 from the first tool carrier 40 by pivoting the upper structure 5 around a vertical rotation axis to move the tool mount 3 of the articulated boom above the loader bucket 11 attached to the first tool mount 40. The upper structure 5 may be pivoted about 180 degrees from the front of the chassis 4 to the rear of the chassis 4 for picking up the loader bucket 11. The tool mount 3 may snap in the loader bucket 11 automatically. After picking of the loader bucket 11 with the tool mount 3, the upper structure may be rotated by 180 degrees with respect to the chassis. Thereafter, the proximal arm 62 may be interlocked with the upper structure 5 and the machine frame 6, respectively, as shown in Fig. 5.

[0050] The configuration of the second tool carrier 50, i.e. the tool changer, is subsequently described with reference to Figs. 7 to 12. In these figures, only the upper structure 5 of the construction machine 1 together with the tool changer 50 is illustrated from above and below. The tool changer 50 comprises the positioning cylinder 52 and a tool carrier articulation 54, for example a pivot joint.

[0051] The positioning cylinder 52 may be pivotably attached to the machine frame 6 adjacent to the vertical axis of rotation of the upper structure 5 and further pivotably attached to a base plate 55 of the second tool carrier 50. When extending a piston rod 53 of the positioning cylinder 52, the second tool carrier 50 may be pivoted outwardly to at least one changing position, and when retracting the piston rod 53, the second tool carrier 50 may be pivoted back inwardly into its stowed position.

[0052] For providing a defined pivoting movement of the second tool carrier 50 by means of the positioning cylinder 52, the tool carrier articulation 54 of the second tool carrier 50 may be arranged on the upper structure 5 and the machine frame 6, respectively. The second tool carrier 50 may be hinged to the tool carrier articulation 54 via a hinging portion 156, which may be attached to the base plate 55 and may be constructed as a pivot arm 157 for providing said pivoting movement.

[0053] Figs. 7 and 8 show the second tool carrier 50 in a stowed position, in which the second tool carrier 50 is accommodated in the upper structure 5 and the machine frame 6, respectively. Specifically, in the stowed position, the second tool carrier 50 is positioned in the frame recess 8 within the upper structure 5 and the machine frame 6, respectively. Said recess 8 can be seen from above in Figs. 10 and 12, for example. If the second tool carrier 50 is in said stowed position, the construction machine 1 may be in a loader mode, in which the excavator bucket 21 and the hammer 31 may be carried by the tool carrier 50 as shown in Fig. 8. The stowed position of the tool changer 50 may also be defined as an initial position of a tool exchange process.

[0054] Figs. 9 and 10 show the second tool changer 50 in a first changing position, in which the tool changer 50 is pivoted outwardly and away from the machine frame 6. This first changing position may be an alignment condition, in which a hammer 31 that is provided on the second tool carrier 50 may be picked up with the tool mount 3 of the articulated boom 2 (both not shown). By picking the hammer with the articulated boom 2 from the second tool carrier 50, the operational mode of the construction machine 1 may be changed to a hammer mode. In said hammer mode, the excavator bucket 21 may still be carried on the second tool carrier 50.

[0055] Figs. 11 and 12 show the tool changer 50 in a second changing position pivoted outwardly and away from the machine frame 6. This second changing position may be an alignment condition, in which an excavator bucket 21 that is provided on the second tool carrier 50 may be picked up with the tool mount 3 of the articulated boom 2 (both not shown). By picking the excavator bucket 21 from the second tool carrier 50, the operational mode of the construction machine 1 may be changed to an excavator mode. In said excavator mode, the hammer 31 may still be carried on the second tool carrier 50.

[0056] Figs. 13 to 18 show the tool changer 50 with and without tools 20, 30. The excavator bucket 21 and the hammer 31 may be arranged adjacent to each other on the second tool carrier 50, wherein the excavator bucket 21 may be arranged next to the positioning cylinder 52 and the hammer 31 may be arranged next to the hinging portion 156. The excavator bucket 21 and the hammer 31 may be situated at opposite portions of the tool carrier 50. The hammer 31 may be arranged obliquely with respect to the excavator bucket 21 in a top view from above for providing an orientation of the tools 21, 31 that is aligned, i.e. parallel, with the first and second changing positions, respectively.

[0057] The second tool carrier 50 may have two tool retaining portions 152, 154. The excavator bucket 21 may be carried at the first tool retaining portion 152 and the hammer 31 may be carried at the second tool retaining portion 154. The base plate 55 may be divided into said

two retaining portions 152, 154. Within the first tool retaining portion 152, a seating 56 may be provided for supporting an excavator bucket 21. The seating 56 may comprise an inclined surface for accommodating the excavator bucket 21.

[0058] For securing the tools, the second tool carrier 50 may comprise clamping means 153, 155 for holding the tools. A first clamping means 153 may be provided as a clamp on the first tool retaining portion 152 for holding the excavator bucket 21 and a second clamping means 155 may be provided as a further clamp on the second tool retaining portion 154 for holding the hammer 31. Both clamping means 153, 155 may be actuated by a hydraulic cylinder 151. The first clamping means 153 may be of a pusher-type or pestle-type to exert a pressing force onto the excavator bucket 21 against the seating 56. The second clamping means 155 may be of a pliers-type to exert a holding or pressing force onto the hammer 31 from two opposite sides thereof.

[0059] Figs. 19 to 22 show an arrangement 100 comprising at least part of the machine frame 6, the articulated boom 2, which is pivotably attached to the machine frame 6, and a locking device 70. The articulation 61 of the proximal arm 62 of the articulated boom 2 may be arranged at the front portion of the machine frame 6 and the locking device 70 may be arranged at the rear portion of the machine frame 6. The distance lying therebetween may substantially correspond to the length of the proximal arm 62.

[0060] Furthermore, Figs. 19 to 22 show a folded-in position of the proximal arm 62 and the intermediate arm 64 of the articulated boom 2, wherein the machine frame 6 and the proximal arm 62 as well as the proximal arm 62 and the intermediate arm 64 each form an acute angle. Folded in, the first positioning cylinder 82, the second positioning cylinder 84 and the third positioning cylinder 86 of the articulated boom 2 are substantially parallel to each other.

[0061] The locking device 70 may comprise a double hook 72 or a single hook (not shown) and an arm support 74. The arm support 74 provides a rest surface, against which the proximal arm 62 can be supported. The hook 72 may be hydraulically actuated by a hydraulic cylinder 73.

[0062] Alternatively or additionally, the hook 72 may be electrically actuated by an electric actuator (not shown). The hook 72 may be arranged to engageable with a pin 89 that is mounted to the proximal arm 62. Besides, the pin 89 may primarily serve for fixing a piston rod eye 90 of the first positioning cylinder 82 of the proximal arm 62.

[0063] Figs. 19 and 20 show an unhooked condition, in which the hook 72 does not engage with the pin 89. However, the proximal arm 62 rests on the arm support 74 allowing for hooking up of the hook 72. In this unhooked condition, the articulated boom 2 may be operated as a three-armed boom, for example in the excavator or hammer mode.

[0064] Figs. 21 and 22 show a hooked-up condition, in which the hook 72 engages with the pin 89. The proximal arm 62 rests on the arm support 74 for stabilizing the arrangement 100. Based on this hooked-up condition, the articulated boom 2 may be operated as a two-armed boom, for example in the loader or dozer mode. In this hooked-up condition, the proximal arm 62 is interlocked with the machine frame 6.

[0065] According to the embodiments of the present invention as shown in Figs. 1 to 22, a single construction machine 1 may be efficiently operated in several different operational modes as a plurality of tools 10, 20, 30 is directly provided on the machine body. These tools may be automatically changed by utilizing the tool changer 50, wherein a multiple-armed boom 2 may be partly blocked to allow for variable boom operations tailored to the different operational modes of the construction machine 1.

Claims

1. Arrangement (100) for a construction machine (1), comprising
   a machine frame (6); and
   an articulated boom (2) being arranged on the machine frame (6), the articulated boom (2) comprising a proximal arm (62) that is mounted in an articulated manner to the machine frame (6) and a distal arm (66) that is connected in an articulated manner to the proximal arm (62);
   wherein the arrangement (100) is configured to be operated in an operational mode, in which the proximal arm (62) and the machine frame (6) are interlocked.

2. Arrangement (100) according to claim 1, being configured to be operated
   in a further operational mode, in which the proximal arm (62) and the machine frame (6) are not interlocked.

3. Arrangement (100) according to claim 1 or 2, further comprising
   a locking device (70) being arranged on the machine frame (6);
   wherein the locking device (70) is configured to engage with the proximal arm (62) or vice versa so as to block any relative movement between said proximal arm (62) and the machine frame (6).

4. Arrangement (100) according to claim 3, wherein
   the locking device (70) comprises at least one hydraulically or electrically operated hook (72) for engaging with the proximal arm (62).

5. Arrangement (100) according to any one of the preceding claims, wherein

a pin (89) being arranged to the proximal arm (62), in particular for fixing a piston rod eye (90) of a positioning cylinder (82) of the proximal arm (62), is configured to be locked to the machine frame (6).

6. Arrangement (100) according to any one of the preceding claims, further comprising an arm support (74) comprising a supporting portion for supporting the proximal arm (62) when interlocked with the machine frame (6);
wherein the arm support (74) is configured to absorb forces induced by the proximal arm (62).

7. Arrangement (100) according to any one of the preceding claims, wherein
the proximal arm (62) is lockable substantially flush with the machine frame (6) or in a manner at least forming an acute angle with the machine frame (6) when interlocked therewith.

8. Arrangement (100) according to any one of the preceding claims, wherein
the articulated boom (2) further comprises an intermediate arm (64) that is interconnected in an articulated manner between the proximal arm (62) and the distal arm (66), and
a positioning cylinder (88) of the distal arm (66) is arranged above the intermediate arm (64).

9. Arrangement (100) according to claim 8, wherein
the intermediate arm (64), a positioning cylinder (84) of the intermediate arm (64) and a positioning cylinder (86) of the distal arm (66) are arranged substantially parallel to each other.

10. Arrangement (100) according to any one of the preceding claims, further comprising a tool mount (3) being mounted in an articulated manner to the distal arm (66) for mounting a tool on the articulated boom (2).

11. Construction machine (1), comprising
a chassis (4) for moving the construction machine (1) on a ground; and
an upper structure (5) being arranged on the chassis (4) with an arrangement (100) according to any one of the preceding claims.

12. Construction machine (1) according to claim 11, wherein
the upper structure (5) comprises a recess (7) for accommodating the proximal arm (62) of the arrangement (100) when interlocked with the machine frame (6) of the arrangement (100).

13. Construction machine (1) according to claim 12,
being configured to be operated in a loader mode, in which the proximal arm (62) of the arrangement (100) is interlocked with the machine frame (6) of the arrangement (100), and/or
being configured to be operated in an excavator mode, in which the proximal arm (62) of the arrangement (100) is not interlocked with the machine frame (6) of the arrangement (100).

14. Method for changing an operational mode of a construction machine (1), wherein
the construction machine (1) comprises a machine frame (6) and an articulated boom (2), wherein the articulated boom (2) is arranged on the machine frame (6); and
the method comprises at least the step of interlocking or unlocking a proximal arm (62) of the articulated boom (2) with or from the machine frame (6) for switching between a first operational mode and a second operational mode of the construction machine (1).

15. Method for retro-fitting a construction machine with an arrangement according to any one of claims 1 to 10.

Amended claims in accordance with Rule 137(2) EPC.

1. Arrangement (100) for a construction machine (1), comprising a machine frame (6); and
an articulated boom (2) being arranged on the machine frame (6), the articulated boom (2) comprising a proximal arm (62) that is mounted in an articulated manner to the machine frame (6) and a distal arm (66) that is connected in an articulated manner to the proximal arm (62);
characterized in that the arrangement (100) is configured to be operated in a loader mode, in which the proximal arm (62) and the machine frame (6) are mechanically interlocked.

2. Arrangement (100) according to claim 1, being configured to be operated
in a further operational mode, in which the proximal arm (62) and the machine frame (6) are not interlocked.

3. Arrangement (100) according to claim 1 or 2, further comprising a locking device (70) being arranged on the machine frame (6);
wherein the locking device (70) is configured to engage with the proximal arm (62) or vice versa so as to block any relative movement between said proximal arm (62) and the machine frame (6).

4. Arrangement (100) according to claim 3, wherein
the locking device (70) comprises at least one hydraulically or electrically operated hook (72) for en-

gaging with the proximal arm (62).

5. Arrangement (100) according to any one of the preceding claims, wherein
a pin (89) being arranged to the proximal arm (62), in particular for fixing a piston rod eye (90) of a positioning cylinder (82) of the proximal arm (62), is configured to be locked to the machine frame (6).

6. Arrangement (100) according to any one of the preceding claims, further comprising an arm support (74) comprising a supporting portion for supporting the proximal arm (62) when interlocked with the machine frame (6);
wherein the arm support (74) is configured to absorb forces induced by the proximal arm (62).

7. Arrangement (100) according to any one of the preceding claims, wherein
the proximal arm (62) is lockable substantially flush with the machine frame (6) or in a manner at least forming an acute angle with the machine frame (6) when interlocked therewith.

8. Arrangement (100) according to any one of the preceding claims, wherein
the articulated boom (2) further comprises an intermediate arm (64) that is interconnected in an articulated manner between the proximal arm (62) and the distal arm (66), and
a positioning cylinder (88) of the distal arm (66) is arranged above the intermediate arm (64).

9. Arrangement (100) according to claim 8, wherein
the intermediate arm (64), a positioning cylinder (84) of the intermediate arm (64) and a positioning cylinder (86) of the distal arm (66) are arranged substantially parallel to each other.

10. Arrangement (100) according to any one of the preceding claims, further comprising a tool mount (3) being mounted in an articulated manner to the distal arm (66) for mounting a tool on the articulated boom (2).

11. Construction machine (1), comprising
a chassis (4) for moving the construction machine (1) on a ground; and
an upper structure (5) being arranged on the chassis (4) with an arrangement (100) according to any one of the preceding claims.

12. Construction machine (1) according to claim 11, wherein
the upper structure (5) comprises a recess (7) for accommodating the proximal arm (62) of the arrangement (100) when interlocked with the machine frame (6) of the arrangement (100).

13. Construction machine (1) according to claim 12, being configured to be operated in a loader mode, in which the proximal arm (62) of the arrangement (100) is interlocked with the machine frame (6) of the arrangement (100), and/or
being configured to be operated in an excavator mode, in which the proximal arm (62) of the arrangement (100) is not interlocked with the machine frame (6) of the arrangement (100).

14. Method for changing an operational mode of a construction machine (1), wherein the construction machine (1) comprises a machine frame (6) and an articulated boom (2), wherein the articulated boom (2) is arranged on the machine frame (6); **characterized in that** the method comprises at least the step of mechanically interlocking or unlocking a proximal arm (62) of the articulated boom (2) with or from the machine frame (6) for switching from an excavator mode to a loader mode or vice versa of the construction machine (1).

15. Method for retro-fitting a construction machine with an arrangement according to any one of claims 1 to 10, wherein the method comprises the step of adding the arrangement (100) according to any one of claims 1 to 10 to the construction machine (1).

Fig. 1

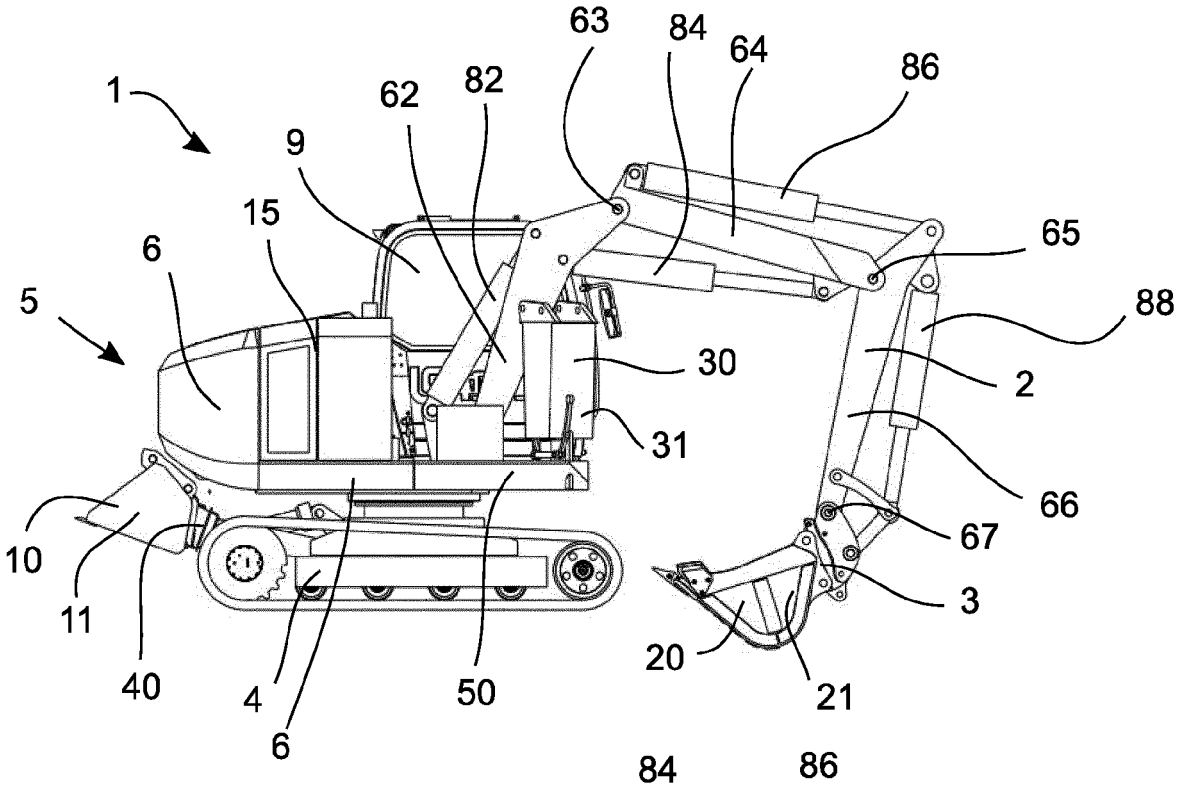
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Fig. 2

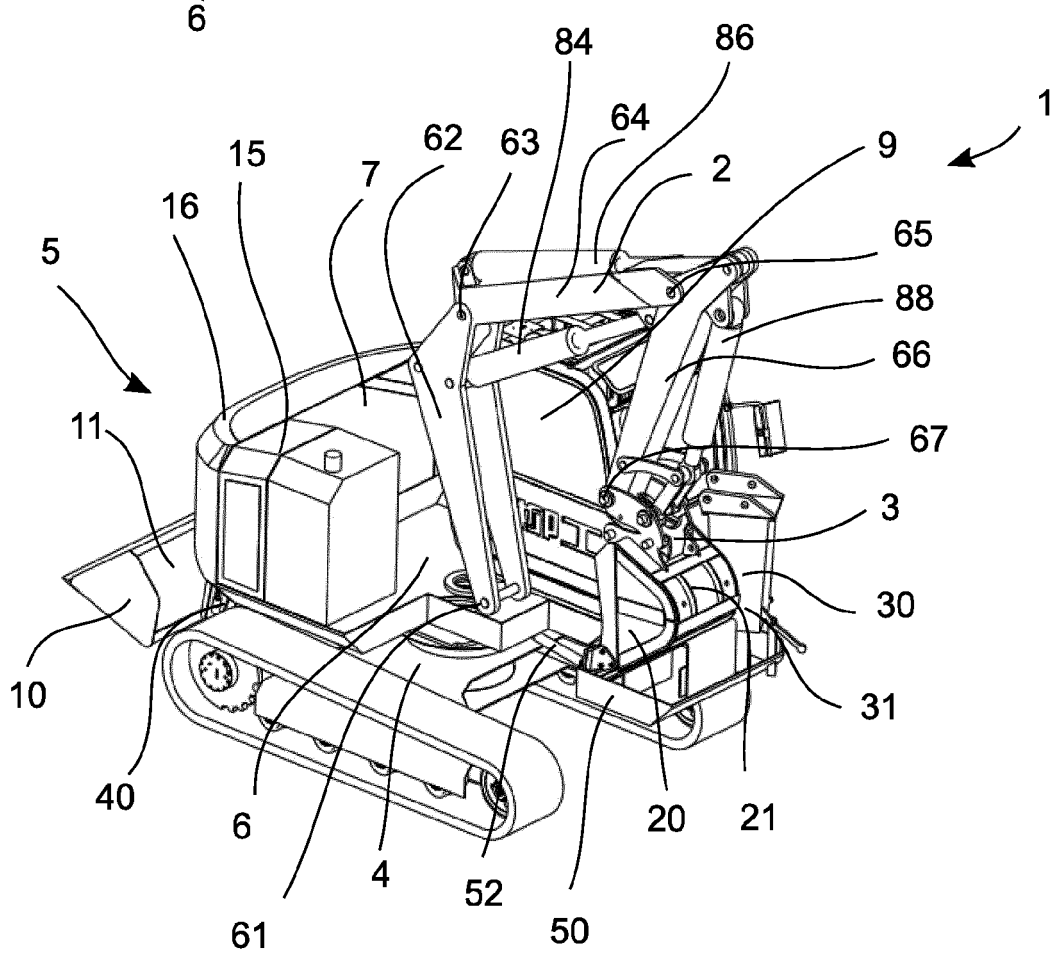
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Fig. 3

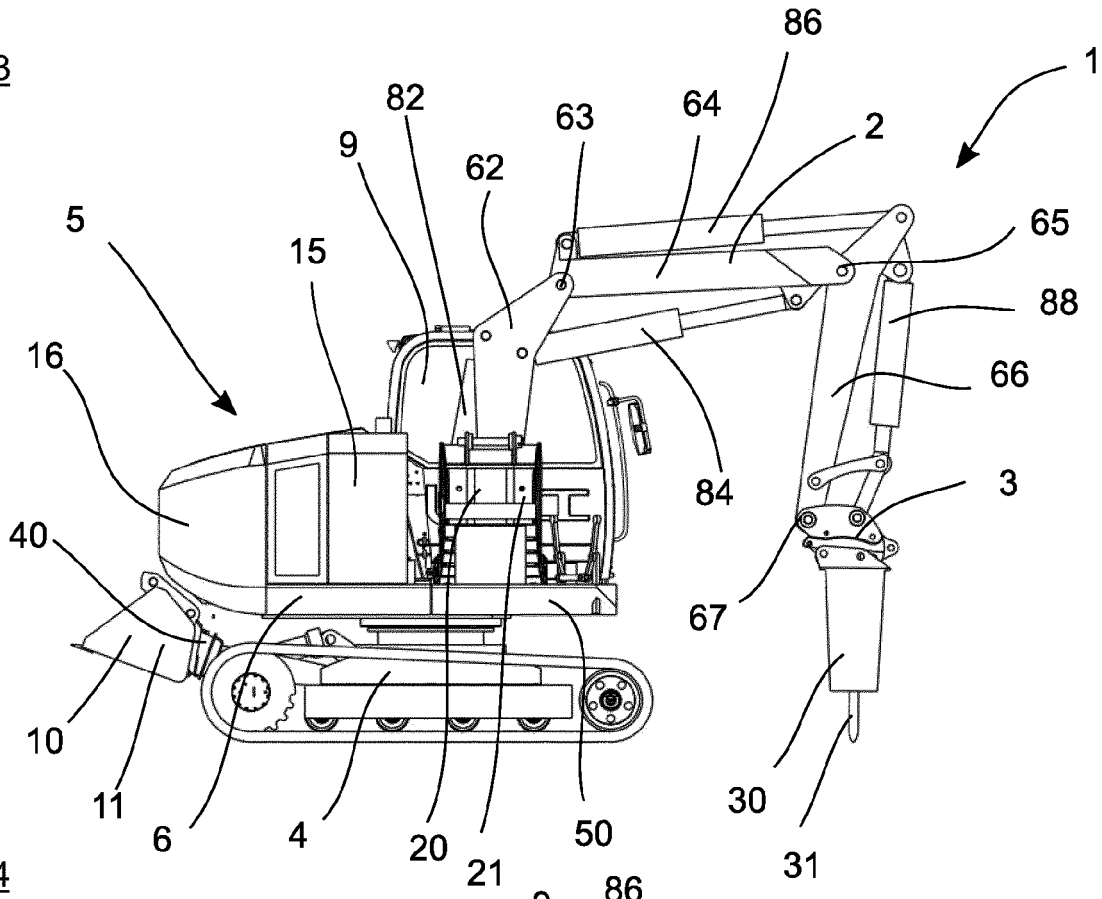
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Fig. 4

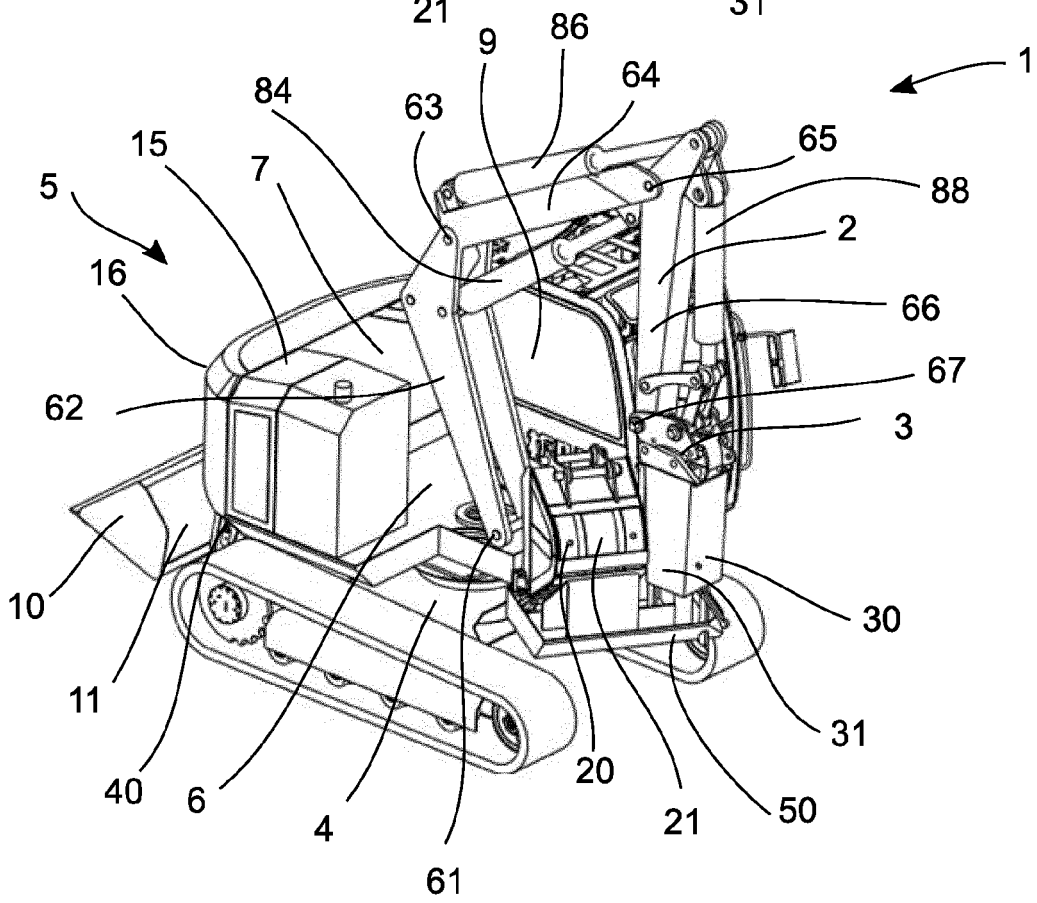
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Fig. 5

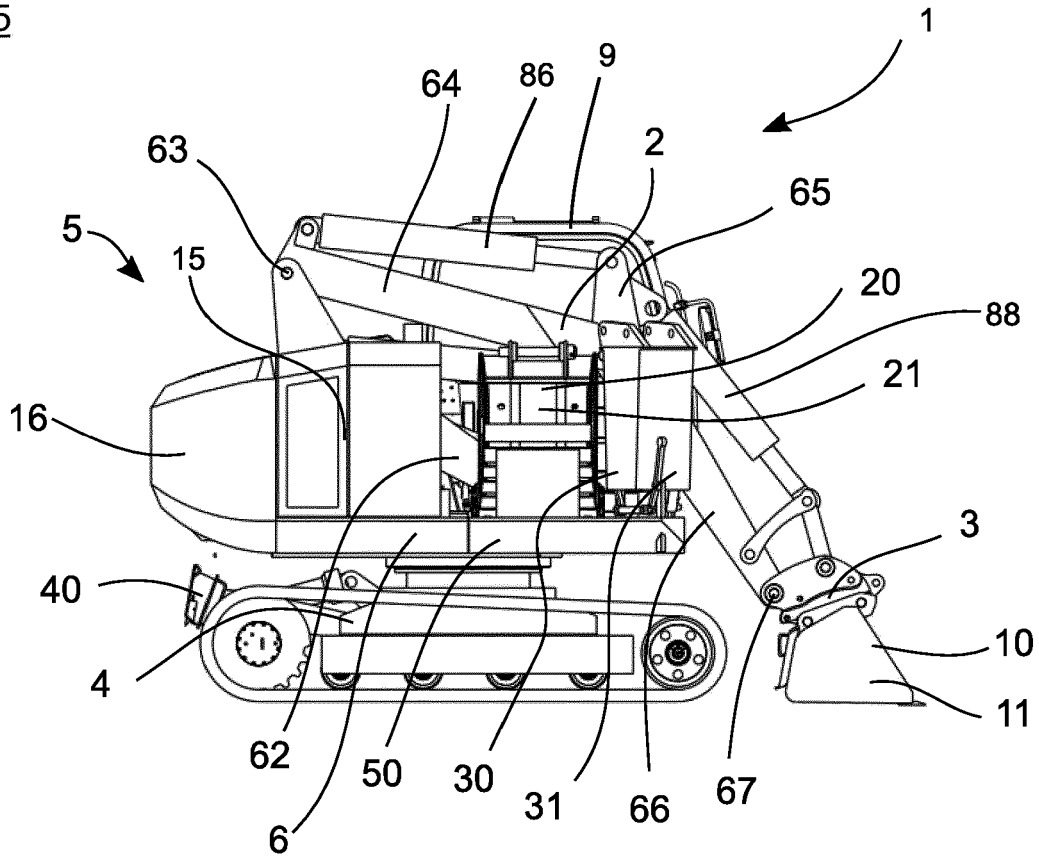
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Fig. 6

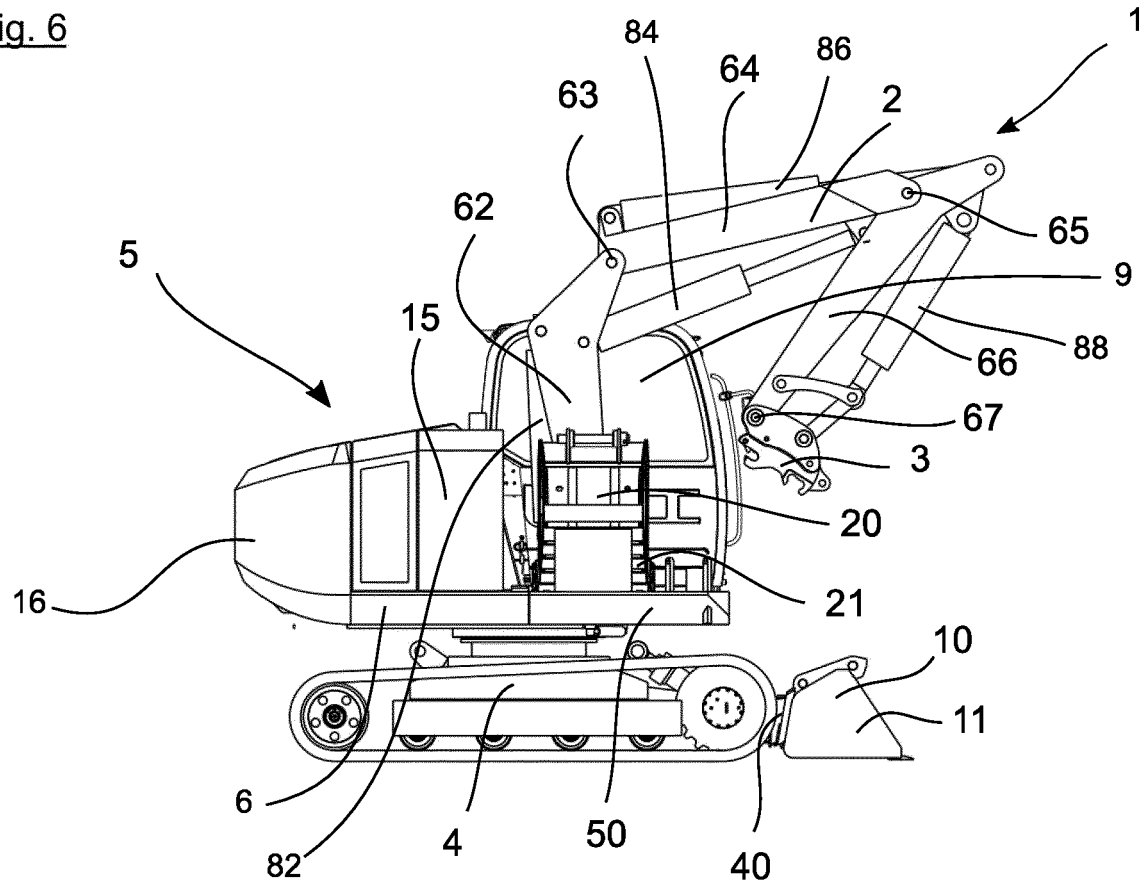
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Fig. 7

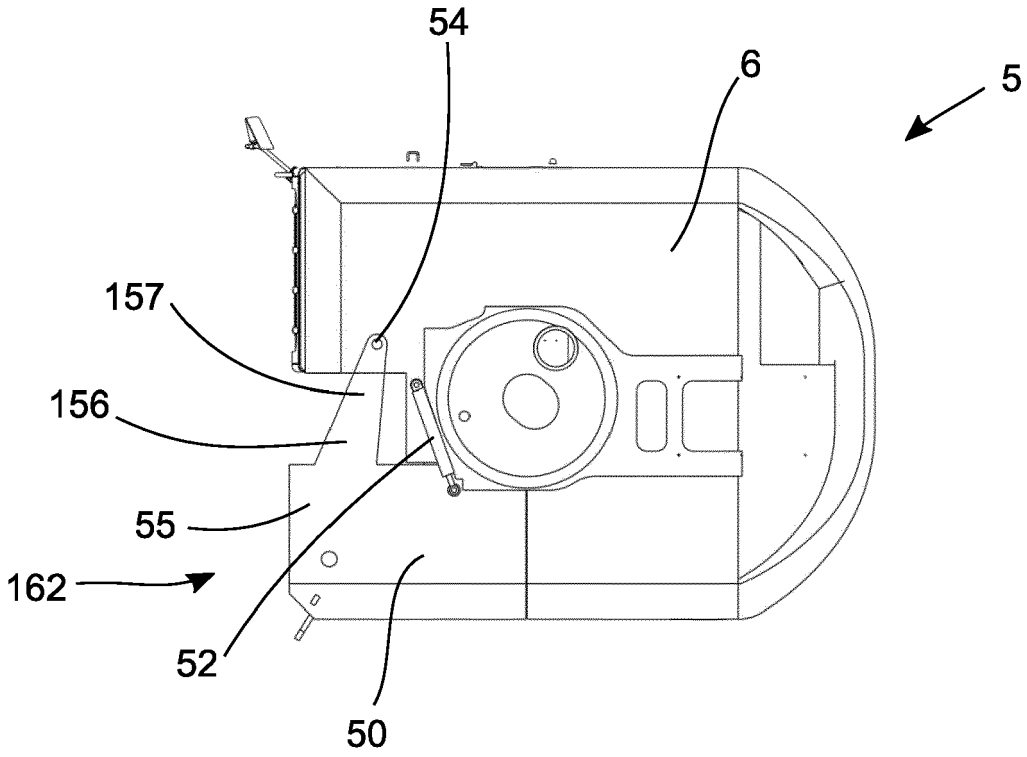

Fig. 8

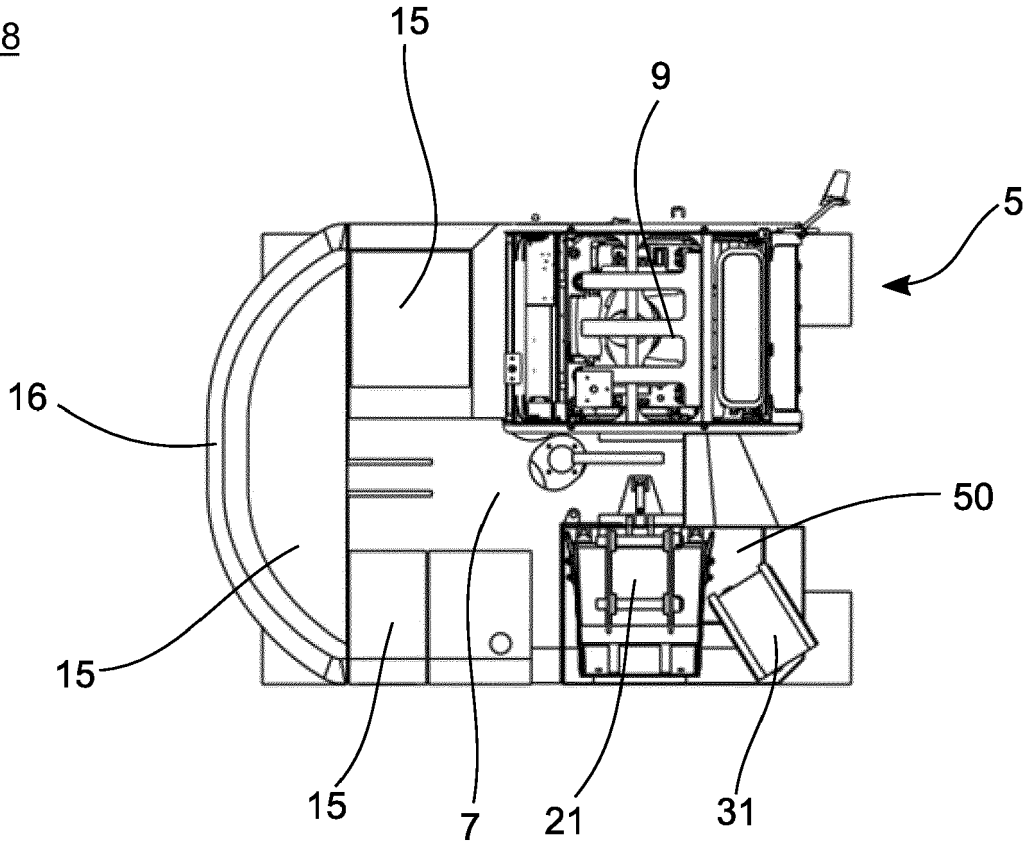

Fig. 9

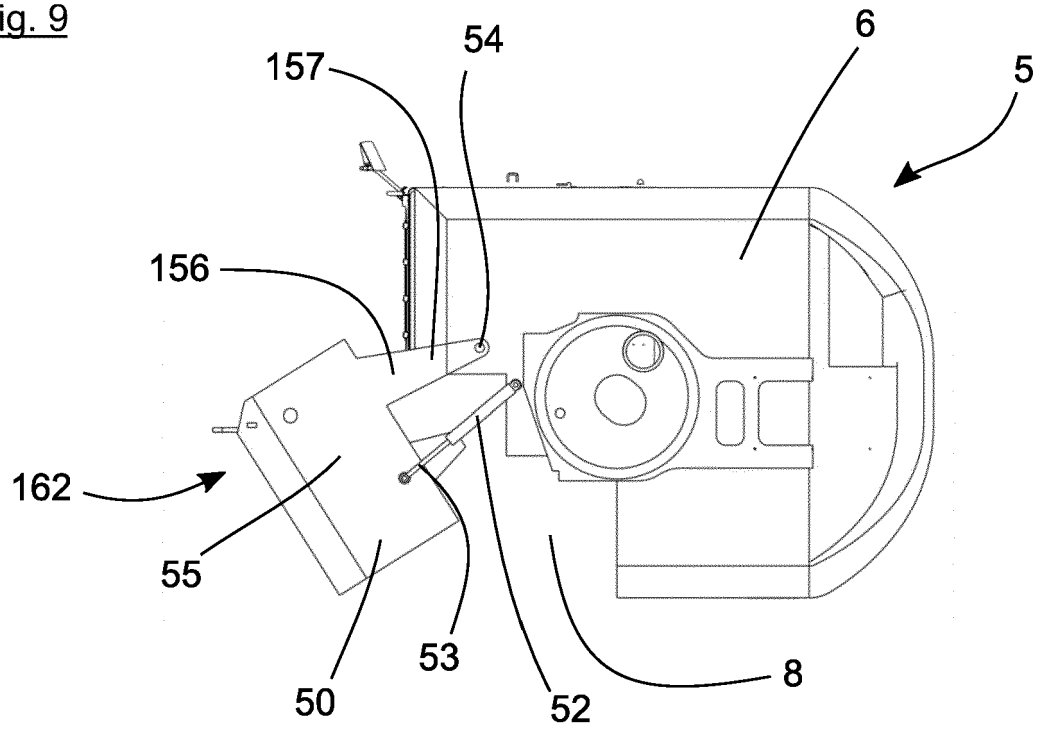

Fig. 10

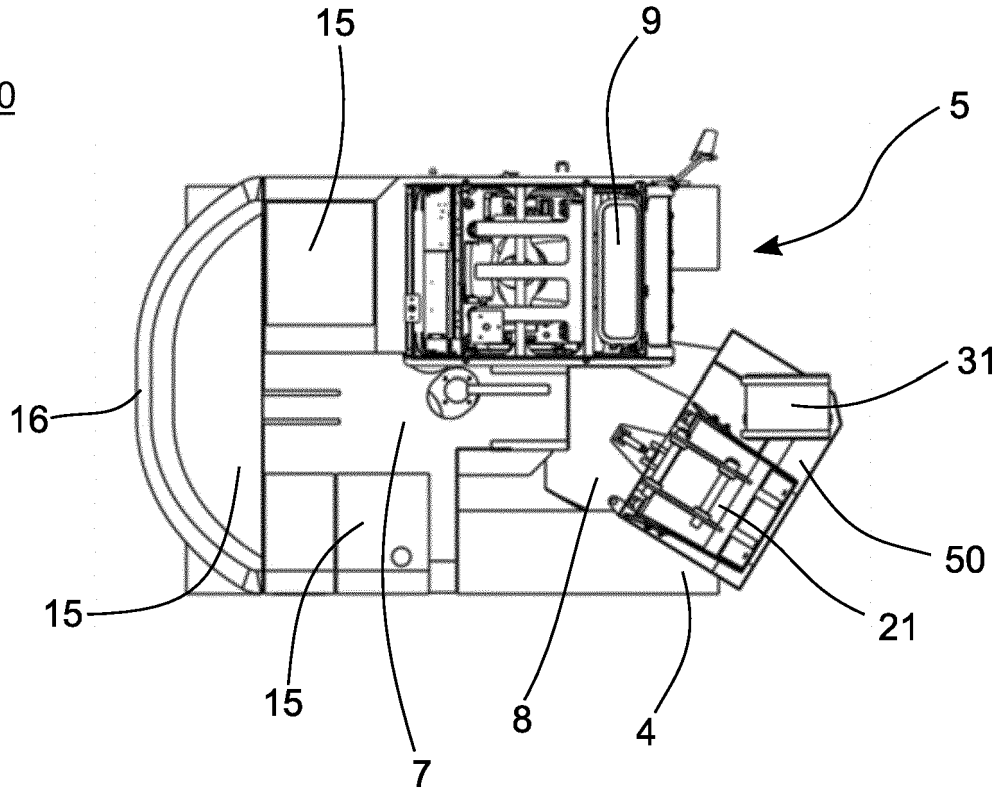

Fig. 11

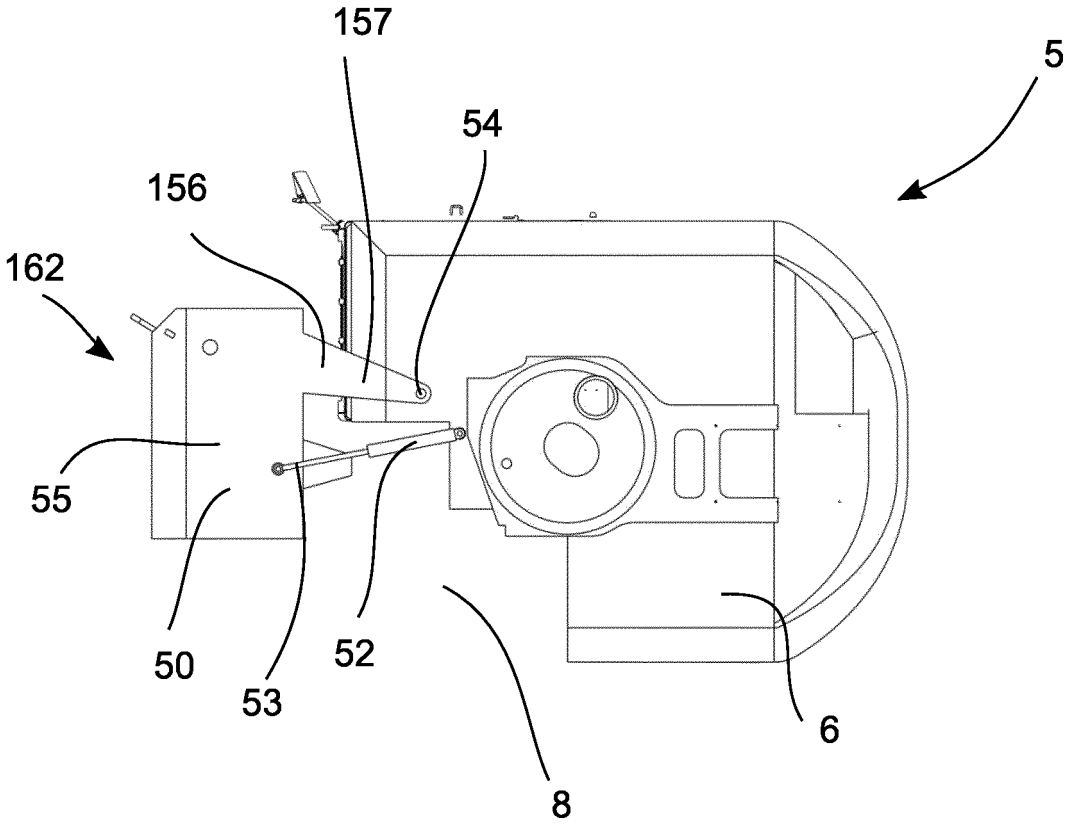

Fig. 12

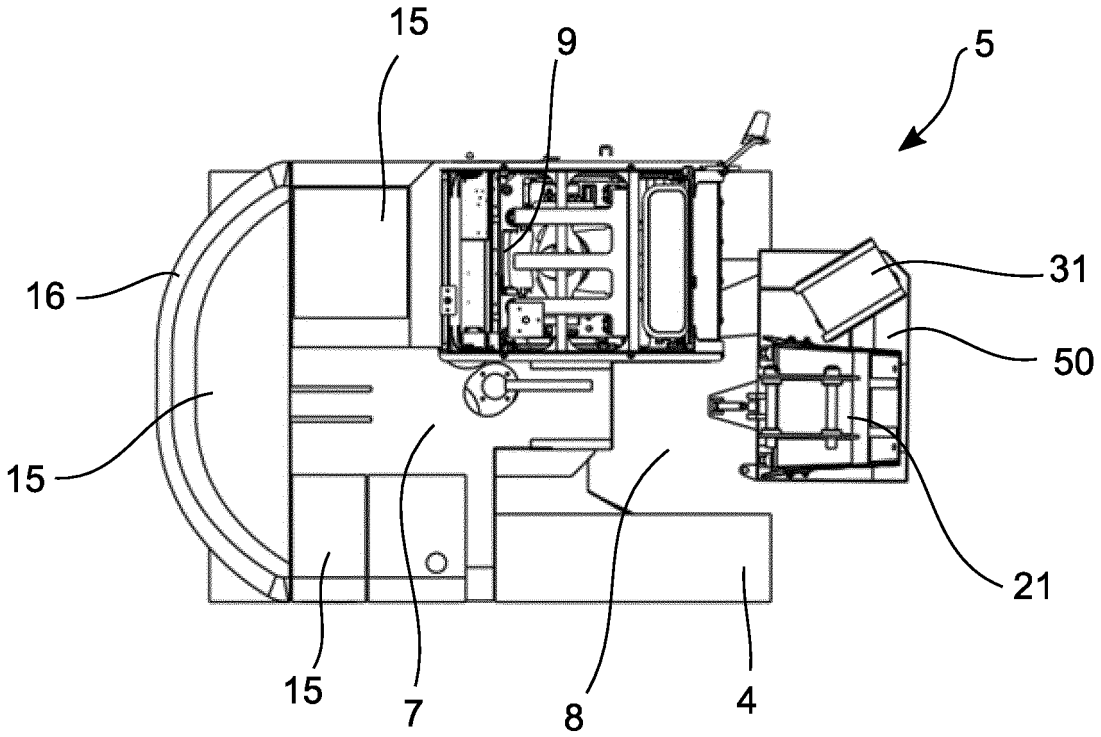

Fig. 13

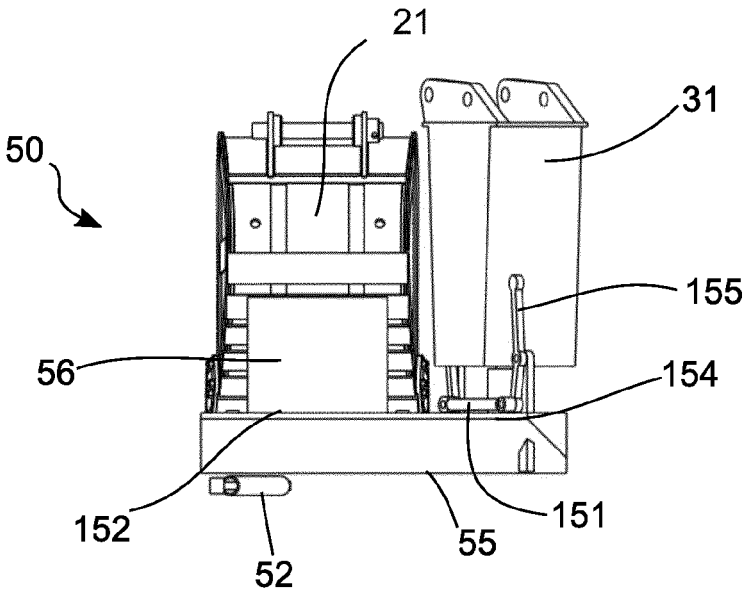

Fig. 14

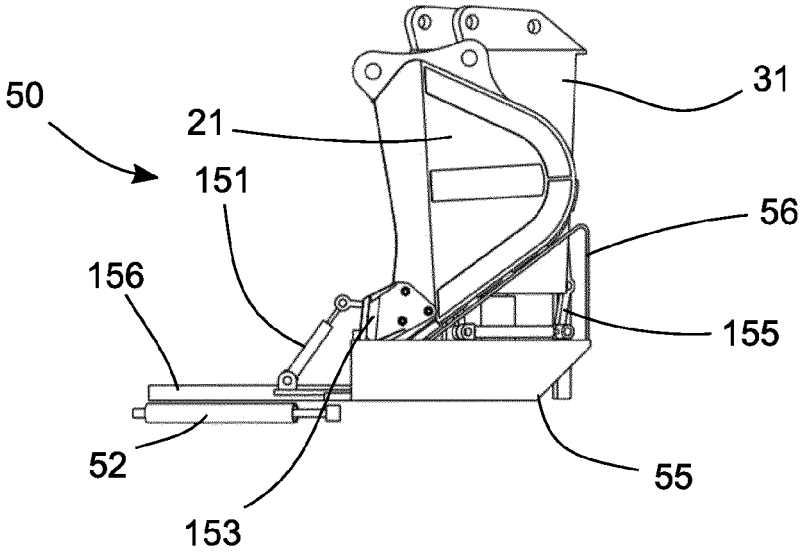

Fig. 15

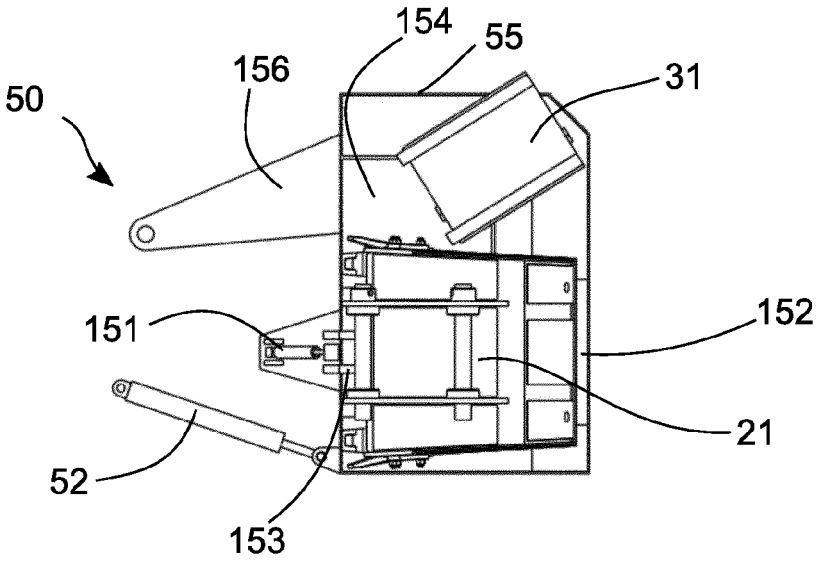

Fig. 16

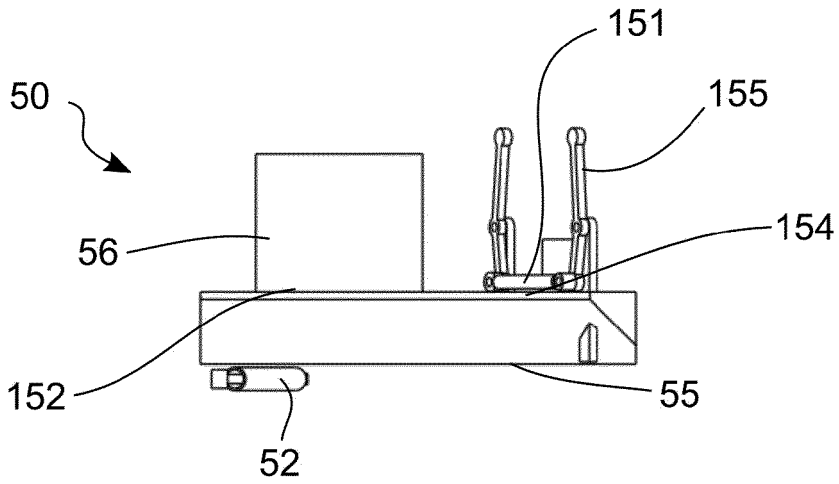

Fig. 17

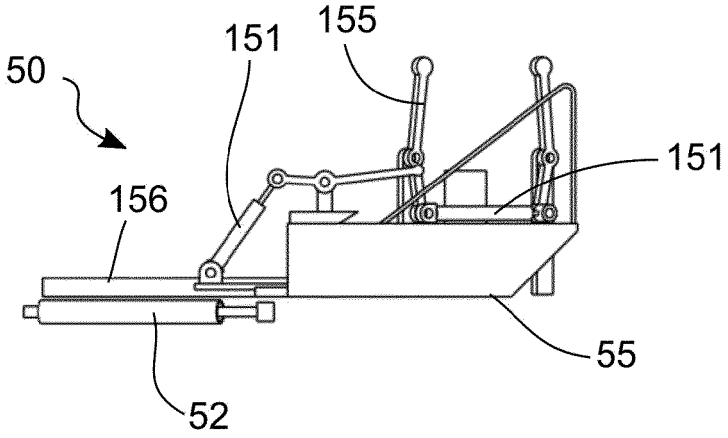

Fig. 18

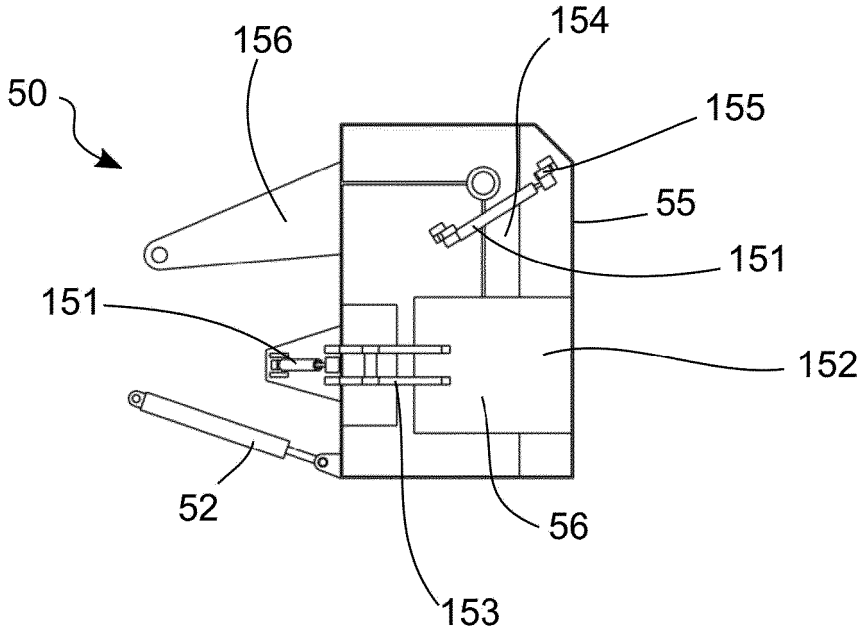

Fig. 19

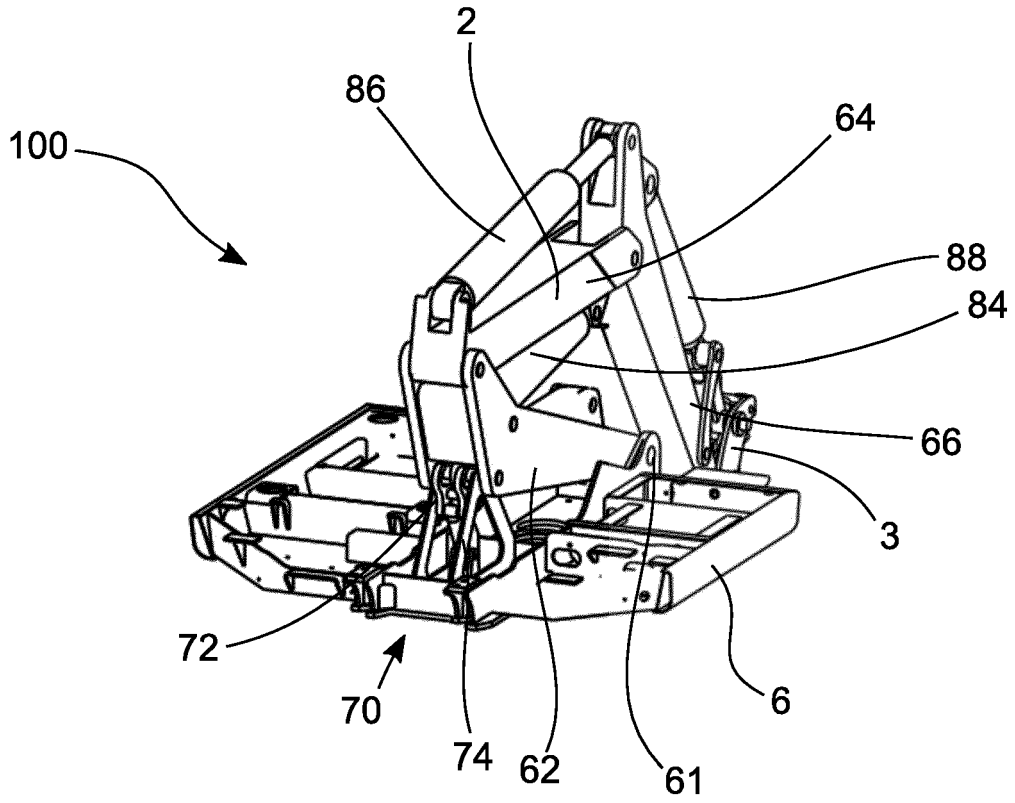
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Fig. 20

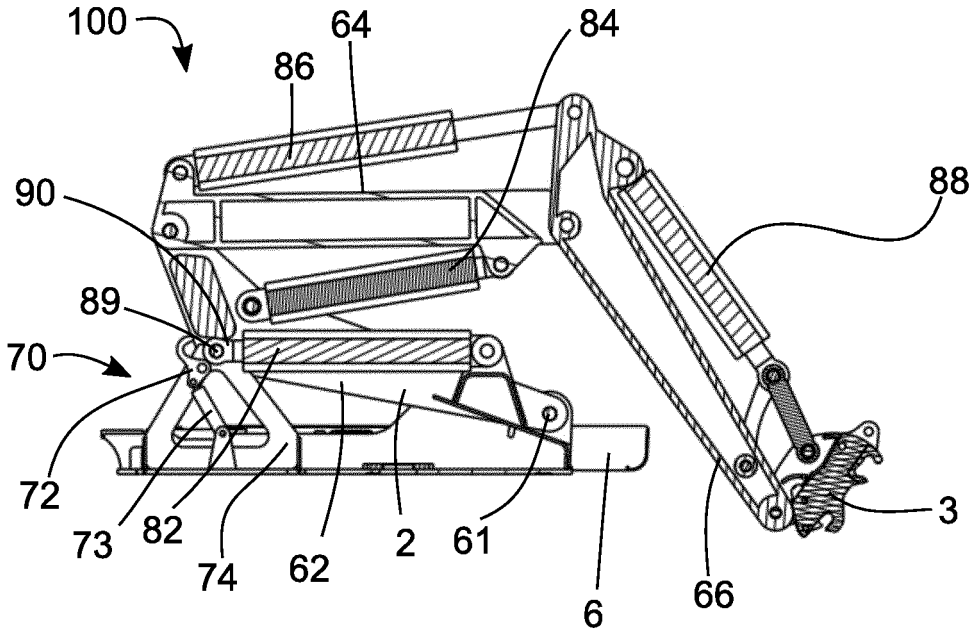
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Fig. 21

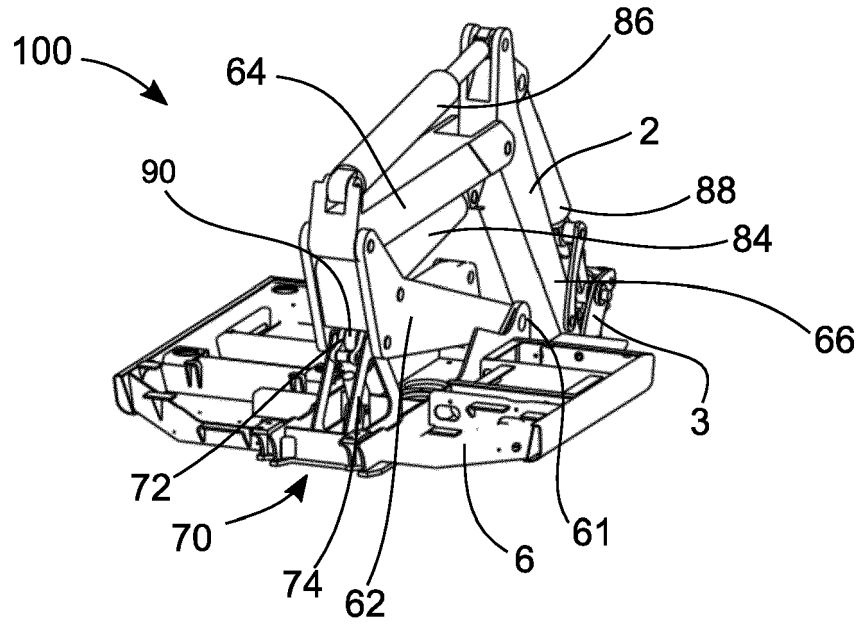
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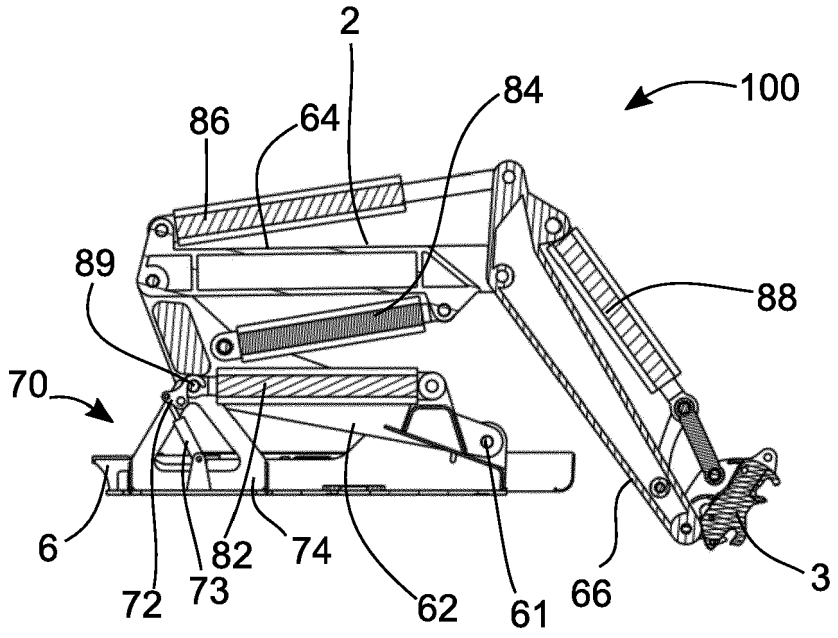
Fig. 22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Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 18 7269

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	US 4 227 852 A (SCHMITZ FLOYD A ET AL) 14 October 1980 (1980-10-14) * column 3, line 20 - column 4, line 11; figures 2,4 *	1-7,10, 14,15	INV. E02F3/96 E02F3/32 E02F3/38
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Place of search	Date of completion of the search	Examiner
Munich	10 January 2019	Papadimitriou, S

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EUROPEAN SEARCH REPORT

Application Number
EP 18 18 7269

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