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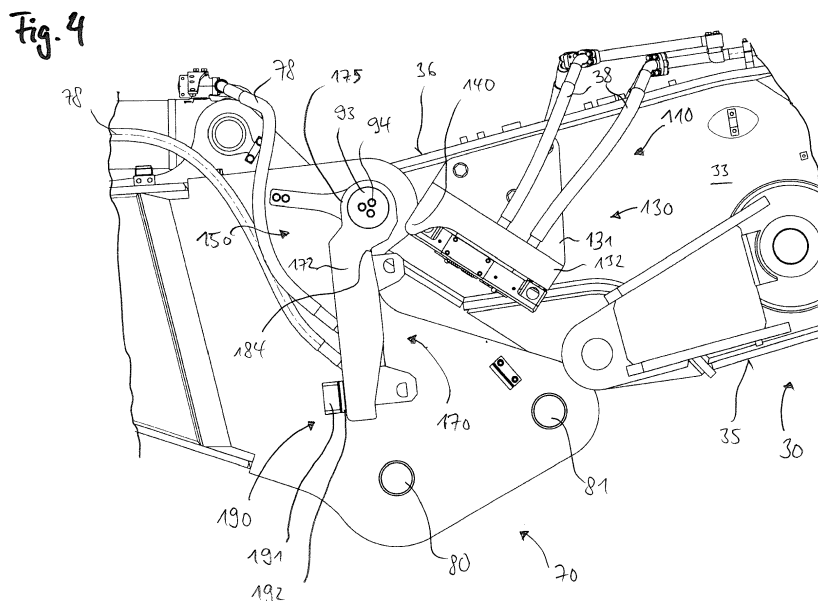
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(54) **WORK EQUIPMENT FOR A WORK VEHICLE AND WORK VEHICLE**

(57) The present invention relates to a work equipment for a work vehicle. The work equipment comprises a first boom, a second boom attachable to the first boom, a plurality of first service lines provided on the first boom, a plurality of second service lines provided on the second boom, and a quick coupling device for coupling the plurality of first service lines with the plurality of second service lines. The quick coupling device comprises a first coupling unit and a second coupling unit. The first coupling unit includes a first coupling block wherein the first service lines are connected to the first coupling block and wherein

the first coupling block is fixedly mounted to a side surface of the first boom. Further, the second coupling unit includes a second coupling block wherein the second service lines are connected to the second coupling block and wherein the second coupling block is arranged laterally to a side surface of the second boom such that the second coupling block is rotatable relative to the first coupling block between a connection position in which the first and second coupling blocks are connected to each other and a release position in which the first and second coupling blocks are disconnected from each other.



Description

Field of the Invention

5 **[0001]** The present invention relates to a work equipment for a work vehicle. The work equipment comprises a first boom and a second boom attachable to the first boom. Further, a plurality of first service lines is provided on the first boom and a plurality of second service lines is provided on the second boom. The work equipment further includes a quick coupling device for coupling the plurality of first service lines with the plurality of second service lines. Moreover, the present invention relates to a work vehicle comprising such a work equipment.

Summary of the Invention

Background

15 **[0002]** For work vehicles, such as excavators, it is known to provide the service lines for hydraulic oil, water, lubricant along the booms and/or arms of the work equipment assembly. For example, it is necessary to transmit the hydraulic oil from the hydraulic system located at the work vehicle body to the hydraulic boom cylinder for moving the boom, to the hydraulic arm cylinder for moving the arm and to the hydraulic bucket cylinder for moving the bucket. To this end, it is necessary to provide hydraulic service lines along the work equipment. Moreover, it is further necessary to provide other service lines, e.g. electric lines and/or lubricant lines for the work equipment components. In many cases, each service line is divided in several line sections which are connected to each other. In particular, in the area of the hinges between the work equipment components, i.e. between boom and arm, boom and boom or arm and bucket, the line section shall be long enough so that the service line is flexible enough for allowing the rotational movement of the work equipment parts relative to each other. For connecting the service line sections of a service line to each other commonly a coupling piece, e.g. a pin-like coupling member is used. Thus, there is high number of service lines and a high number of coupling pieces for connecting the service line sections to each other.

Technical Problem

30 **[0003]** Further, for such kind of work vehicle there is a need to change the configuration of the work equipment. Often it is necessary to change the work equipment configuration by changing not the overall work equipment but to change only a part or component of it, e.g. replacing the arm of an excavation boom by a longer demolition boom to exchange the excavation work equipment into a demolition work equipment. In such a situation, commonly it is necessary to manually disconnect a plurality of single coupling pieces at every single service line. This takes a lot of time and access to the coupling system needs to be provided.

35 **[0004]** Thus, it is an object of the present invention to improve a work equipment having a first and second boom to achieve an easy and quick change of the service lines of the work equipment. Further, it is an object to provide a work vehicle having such an improved work equipment.

Solution to the Problem

40 **[0005]** The object is solved by the work equipment according to claim 1 and by the work vehicle according to claim 15.

[0006] The dependent claims describe preferred embodiments of the invention.

45 **[0007]** According to the present invention, the work equipment comprises a first boom, a second boom attachable to the first boom, a plurality of first service lines provided on the first boom, a plurality of second service lines provided on the second boom and a quick coupling device for coupling the plurality of first service lines with the plurality of second service lines, wherein the quick coupling device comprises a first coupling unit and a second coupling unit. The first coupling unit includes a first coupling block wherein the first service lines are connected to the first coupling block and wherein the first coupling block is rigidly mounted to a side surface of the first boom. The second coupling unit includes a second coupling block wherein the second service lines are connected to the second coupling block and wherein the second coupling block is arranged laterally to a side surface of the second boom such that the second coupling block is rotatable relative to the first coupling block between a connection position in which the first and second coupling blocks are connected to each other and a release position in which the first and second coupling blocks are disconnected from each other.

55 **[0008]** As to the general understanding of the present invention, the work equipment can also be designated as work equipment assembly or work implement assembly. Further, the first or second boom can also be designated as arm. Generally, such a work equipment comprises a first side surface or first lateral surface, a second side surface or second lateral surface, an upper surface and a lower surface. The work equipment usually has a box-shape in a cross-sectional

view. Preferably, the work equipment comprises a first boom, a second boom (or arm) and a work attachment. Regarding the general understanding, the first boom can be designated as a first boom part and the second boom can be designated as a second boom part and the two boom parts can build the boom of the work equipment. Preferably, the first boom is rotatably mounted to the vehicle body of a work vehicle such that the first boom can rotate around a horizontal axis. At least for the mounting of the boom and/or the coupling of the quick coupling device, the second boom can be pivotably attached to the first boom to pivot around a horizontal axis relative to the first boom. Further, the work attachment, e.g. a bucket or demolition tool, can be rotatably attached to the second boom (or arm). Further, the work equipment comprises several hydraulic cylinders for moving the booms, arm and/or work attachment.

[0009] Regarding the position of the second coupling block which is rotatably mounted to the first coupling block, the second coupling block is arranged laterally to the side surface of the second boom preferably at a distance from the second boom and/or substantially parallel to the second boom. Thus, it is possible that the second coupling block does not contact the side surface of the second boom during rotational movement of the second coupling block. Preferably, the second coupling block is rotatable relative to the second boom and rotatable relative to the first boom. Further, it is preferred that the rotation axis of the second coupling block extends substantially in the horizontal direction and/or extends substantially perpendicular with regard to the longitudinal axis or path of the first and/or second boom.

[0010] Further, in the connection position the first and second coupling blocks are connected to each other such that the first and second service lines are operatively connected and in the release position the first and second coupling blocks are disconnected from each other such that the first and second service lines are disconnected. The release position can also be designated as disconnected position.

[0011] In the present invention, the first and second coupling block preferably comprises a (solid) block body, e.g. shaped like a cuboid. The block body can include a plurality of recesses. Preferably, each recess passes through the block body from a coupling connection side to a service line side. The recess can be formed in a step-like manner. Preferably, the recess has a first end related to the coupling connection side and a second end related to the service line side. The first end and/or the second end can receive and hold a connection port or valve. For example, in a first group of recesses the one end of the recess receives an electric connector or plug and the other end of the recess receives an end of the first or second service line. In a second group of recesses the first end of each recess may receive a fluid line connector, e.g. a valve, and the second end receives an end of the first or second service line.

[0012] In a preferred embodiment, the first coupling unit comprises a first bracket, wherein the first coupling block is fixedly mounted to the first bracket and the first bracket is fixedly mounted to the first boom. Further, the second coupling unit comprises a second bracket, wherein the second coupling block is fixedly mounted to the second bracket and the second bracket is rotatably mounted to the second boom. It is preferred that each coupling block is directly mounted to the bracket and/or that each bracket is directly mounted to the boom, e.g. by usual fastening means like bolts and/or screws etc.

[0013] Preferably, the first coupling unit, the first coupling block and/or the first bracket is/are mounted at the front end (or tip) of the first boom. The rear end of the first boom is configured to be pivotably mounted to the vehicle body of the work vehicle. Further, preferably the second coupling unit, the second coupling block and/or the second bracket is/are mounted at the rear end of the second boom. The front end of the second boom is configured for connecting a further boom, an arm or a work attachment like a bucket or a demolition tool.

[0014] Preferably, each of the first and second bracket include at least two side plates, a base plate and an end plate. Preferably, there are two side plates which are arranged at a distance to each other and substantially parallel to each other and further substantially parallel to the side surface of the first and/or second boom. The first bracket and the second bracket may comprise a first end portion related to the connection area between the front end of the first boom and the rear end of the second boom and may comprise a second end portion opposite to the first end portion. At the second end portion, the end plate may extend substantially perpendicular to the two side plates to connect the two side plates. The base plate also extends substantially perpendicular to the two side plates and is mounted between the two side plates to support the coupling block.

[0015] In a preferred embodiment, the first or second boom includes a connection pin for coupling the first boom to the second boom, wherein the connection pin extends substantially perpendicular to the longitudinal axis of the first boom and/or the second boom. In other words, the connection pin preferably extends in a horizontal direction. Preferably, the second boom comprises the connection pin.

[0016] In a preferred embodiment, the first or second boom comprises a pick-up cup for receiving the connection pin. Preferably, the first boom comprises the pick-up cup. The pick-up cup can extend substantially perpendicular to the longitudinal axis of the first boom and/or the second boom. In other words, the pick-up cup preferably extends in a horizontal direction. In a cross-sectional view, the pick-up cup is substantially C-shaped. Preferably, the pick-up cup is arranged at the front end of the first boom.

[0017] Preferably, the second coupling unit comprises a coupling sleeve for receiving an end portion of the connection pin such that the second coupling unit is rotatably mounted to the connection pin such that the second coupling block is rotatable around the connection pin. Preferably, the second bracket comprises the coupling sleeve. Preferably, the

coupling sleeve is arranged at the first end portion of the second bracket. The coupling sleeve can include an opening, e.g. a through hole, for receiving the connection pin and an outer surface for rotatably mounting the first bracket to the second bracket.

[0018] In a preferred embodiment, the first coupling unit comprises at least one projection for actuating the second coupling unit such that the second coupling block is rotated in a mounting position before the first and second coupling blocks are connected to each other. Preferably, the first bracket comprises the at least one projection. In a preferred embodiment, the first bracket comprises two projections which can be provided at or integrated in side plates of the first bracket. Preferably, the outer end of the projection has a curved shape.

[0019] In a further preferred embodiment, the second coupling unit comprises at least one recess for receiving the projection of the first coupling unit. Preferably, the second bracket comprises the at least one recess. In a preferred embodiment, the second bracket comprises two recesses which can be provided at or integrated in side plates of the second bracket. Preferably, the recess has a curved shape.

[0020] It is preferred that the projection and the recess extend in the same plane. More preferably, this plane extends parallel to a side surface of the first boom and/or second boom. Thus, the projection and the recess can move relative to each other during the mounting procedure for connecting the first coupling block to the second coupling block. In case that the first and second coupling units or first and second coupling blocks are not in the correct position to each other during the mounting procedure, that means in a misaligned position where the first and second coupling blocks can not be connected or where the first and second coupling blocks could collide against each other, then the projection of the first coupling unit can push or rotate away the second coupling block such that the first and second coupling blocks get into the correct position to each other for being connected into the connection position. In the connection position, in which the first and second coupling blocks are connected to each other, the at least one projection is aligned with the recess and can be resided in the at least one recess. The projection can also be designated as a spacer and can be further designated as a spacer formed by a protrusion. The spacer is provided for contacting the second coupling unit, in particular the second bracket, so as to prevent a collision of the first and second coupling units in a misaligned position to each other.

[0021] In another preferred embodiment, the pick-up cup comprises an opening for inserting and extracting the connection pin. Further, the pick-up cup has an inner shape (or inner surface), wherein, when seen in a longitudinal section along the first boom, the inner shape includes a first circular section extending radially around a center axis of the pick-up cup over more than 180° and wherein an outer shape of the connection pin includes a second circular section having a radius smaller than the radius of the first circular section and a linear section, such that the connection pin can be inserted into and extracted from the opening only in a state where the pick-up cup and the connection pin are positioned to each other in a predetermined rotational relationship. Thus, the pick-up cup and the connection pin may be engaged and disengaged to couple the first and second boom and to couple the first coupling unit and the second coupling unit in a first step of a mounting procedure. The pick-up cup preferably extends along a longitudinal axis which extends substantially parallel to the longitudinal direction of the connection pin and/or substantially perpendicular to the longitudinal axis of the first boom. The pick-up cup may comprise at least one locking section extending over a portion along the longitudinal axis wherein the locking section has a shape which can be engaged with an outer shape of the connection pin.

[0022] According to a further preferred embodiment, a restricting member is mounted on the second boom for restricting rotational movement of the second coupling block. Preferably, the restricting member is mounted on the side surface of the second boom. The restricting member may include a base plate directly mounted to the side surface of the second boom and a stopper plate connected to the base plate, wherein the stopper plate extends substantially perpendicular away from the base plate.

[0023] It is preferred that each of the first coupling block and the second coupling block comprises a connection surface having a plurality of connection ports, wherein the connection surfaces are arranged radially to the connection pin. Thus, it is possible to connect the first coupling block and the second coupling block at the same time when coupling the first boom with the second boom. Preferably, the connection areas of the connection ports extend in a connection plane which is arranged radially to the connection pin. The connection ports are connected in the connection position and disconnected in the release connection of the quick coupling device.

[0024] According to a preferred embodiment, the quick coupling device comprises a locking device having a first locking unit and a second locking unit, wherein one of the first and second locking unit comprises at least one movable locking pin and the other of the first and second locking unit comprises at least one locking opening into which the locking pin is insertable and wherein the locking device is in a locked state when the locking pin is inserted into the opening and in an unlocked state when the locking pin is retracted from the opening. Preferably, the first locking unit comprises at least one movable locking pin, in particular two or four locking pins. Accordingly, the second locking unit comprises at least one opening, in particular two or four openings. Preferably, the first coupling block comprises the first locking unit and the second bracket comprises the second locking unit. More preferably, the locking pin is a hydraulic pin and can be remotely or automatically controllable from the cab of the work vehicle.

[0025] In a further preferred embodiment, the second boom comprises at least a first and a second mounting opening

wherein the first mounting opening refers to a first mounting position of the first and second boom and the second mounting opening refers to a second mounting position of the first and second boom and wherein the first boom includes at least one mounting pin insertable into one of the first and second mounting openings for mounting the first boom to the second boom in the first mounting position when the mounting pin is inserted into the first mounting opening and in the second mounting position when the mounting pin is inserted into the second mounting opening. For example, the second boom comprises a first and a second mounting opening wherein the first mounting opening refers to a first mounting position which can be designated a cranked position, in which the longitudinal axes of the first and second boom intersect at a certain angle. The second mounting opening refers to a second mounting position which can be designated a straight position, in which the longitudinal axes of the first and second boom extend substantially coincidentally or parallel. The cranked position of the work equipment can be used for a large excavating depth. The straight position of the work equipment can be used for large reach for excavating work or a large reach for demolition work. Preferably, the mounting pin extends substantially perpendicular to the longitudinal axis of the first boom and/or the second boom. In other words, the mounting pin may extend substantially in a horizontal direction and/or substantially parallel to the connection pin. Thus, the connection pin described above and the mounting pin provide a fastening assembly for safely securing the first boom to the second boom, in particular after full connection of the quick coupling device.

[0026] In a preferred embodiment, the quick coupling device may comprise a first coupling assembly and a second coupling assembly, wherein the first coupling assembly includes the first coupling unit and the second coupling unit as defined in any of the claims and wherein the second coupling assembly includes the first coupling unit and the second coupling unit as defined in any of the claims wherein the first and second coupling unit of the first coupling assembly are arranged at a first side surface of the first and second boom and wherein the first and second coupling unit of the second coupling assembly are arranged at a second side surface of the first and second boom opposite to the first side surface. In other words, the first coupling assembly can be arranged at one side of the booms and the second coupling assembly can be arranged at the other side of the booms. Preferably, if there is high number of service lines, a first number of service lines can be coupled by the first coupling assembly and a second number of service lines can be coupled by the second coupling assembly.

[0027] Regarding the service lines, it is preferred that the first and second service lines comprise at least one of hydraulic lines, electric lines, data lines (e.g. CAN data lines), water lines and/or lubricant lines.

[0028] According to a further aspect of the present invention, a work vehicle comprises a vehicle body and a work equipment according to any one of claims 1 to 14, wherein the first boom is rotatably mounted to the vehicle body.

[0029] According to the invention, the first boom of the work equipment can be permanently mounted to the vehicle body. However, the work equipment configuration can be changed by means of the work equipment as defined above according to the first aspect in an easy and quick manner. In particular, the second boom and possible further boom, arm and work attachment parts attached to the second boom can be easily changed due to the coupling assembly configured between the first and second boom.

[0030] As to the general understanding of the work vehicle according to the present invention, the work vehicle preferably comprises a lower travelling structure, an upper swing structure rotatably arranged on the travelling structure so as to rotate around a vertical axis. The lower travelling structure is configured for travelling of the work vehicle and could be also designated as a drive unit. The lower travelling structure can comprise crawler belts or alternatively wheels having tires. The upper swing structure comprises a vehicle body and an operator's cab arranged on the vehicle body. Thus, the vehicle body is rotatably arranged on the lower travelling structure. The work equipment as described according to the first aspect of the invention is rotatably mounted to the vehicle body such that the work equipment can rotate around a horizontal axis. As to the general understanding of the work equipment is referred to the above explanations.

[0031] The work vehicle of the invention preferably is an excavator, more preferably a wheeled excavator or a crawler excavator. The work vehicle preferably comprises one or all of the above-mentioned features, advantages and preferred embodiments.

Effects of the Invention

[0032] According to the present invention, it is possible to automatically change the configuration of a work equipment for a work vehicle, i.e. the operator must not leave the cab for coupling the first and second coupling units of the quick coupling device. In other words, the operator does not need to manually disconnect the plurality of single coupling pieces at every single service line. This saves a lot of time and oil leakage is reduced or prevented.

Brief Description of the Drawings

[0033]

Fig. 1 is a side view of a work vehicle including a work equipment according to one embodiment of the invention in a first position;

Fig. 2 is a side view of the work vehicle including the work equipment of Fig. 1 in a second position;

Fig. 3 is a side view of the work vehicle including the work equipment of Fig. 1 and 2 in a third position;

Fig. 4 shows an enlarged detail of Fig. 2 referred IV in Fig. 2;

Fig. 5 is a cross-sectional view of the enlarged detail shown in Fig. 4;

Fig. 6 shows a perspective enlarged partial view of a length section taken along the longitudinal center axis of the first and second boom of Fig. 4, 5;

Fig. 7 shows an enlarged detail of Fig. 3 referred VII in Fig. 3;

Fig. 8 is a cross-sectional view of the enlarged detail shown in Fig. 7;

Fig. 9 is an exploded perspective view of the first coupling unit and its mounting to the first boom;

Fig. 10 is an exploded perspective view of the second coupling unit and its mounting to the connection pin;

Fig. 11 is a side view of the work vehicle including the work equipment in the first position corresponding to Fig. 1;

Fig. 12 is an enlarged detail of Fig. 11 shown as a length sectional view and showing an intermediate position in dashed lines;

Fig. 13 is a side view of the work vehicle including the work equipment in the second position corresponding to Fig. 2;

Fig. 14 is an enlarged detail of Fig. 13 shown as a length sectional view;

Fig. 15 is a side view of the work vehicle including the work equipment in the third position corresponding to Fig. 3;

Fig. 16 is an enlarged detail of Fig. 15 shown as a length sectional view;

Fig. 17 is a side view of the work vehicle including the work equipment in a further position alternative to the position of Fig. 15;

Fig. 18 is an enlarged detail of Fig. 17 shown as a length sectional view;

Fig. 19 shows a side view of the quick coupling device in its release position similar to Fig. 4 and with a locking device shown in a unlocked state;

Fig. 20 shows another side view of the quick coupling device in its release position and with the locking device shown of Fig. 19 in the unlocked state;

Fig. 21 shows a side view of the quick coupling device of Fig. 19 to 20 in its connection position and with the locking device shown in a locked state;

Fig. 22 shows another side view of the quick coupling device as shown in Fig. 21 in its connection position and with the locking device in the locked state ;

Fig. 23 is a enlarged cross-sectional view of a detail shown in Fig. 12;

Fig. 24 is a enlarged cross-sectional view of a detail shown in Fig. 14;

Fig. 25 is a enlarged cross-sectional view of a detail shown in Fig. 16;

Fig. 26 is an enlarged detail similar to Fig. 11 shown as a length sectional view and showing an intermediate position;

Fig. 27 is an enlarged detail similar to Fig. 26 shown as a length sectional view and showing a further intermediate position;

Fig. 28 an enlarged detail similar to Fig. 27 showing the quick coupling device in the release position;

Fig. 29 an enlarged detail similar to Fig. 28 showing the quick coupling device in the connection position;

Description of the Embodiments

[0034] Figures 1 to 3 are side views of a work vehicle 300, which is a crawler excavator according to a preferred embodiment of the present invention. In the following, the directions "front", "rear", "side", "lateral", "upper" and "lower" indicate directions based on a front view seen from the cab, in particular seen from the operator's seat. Thus, the work vehicle 300 has a forward-rearward-direction X and a vehicle width direction substantially perpendicular to the forward-rearward-direction X.

[0035] The work vehicle 300 basically includes a lower travelling structure 310, an upper swing structure 320 and a work equipment 10 according to the invention.

[0036] The lower travelling structure 310 comprises at least two crawler belts 311 each having at least two wheels, in particular a front wheel 312 and a rear wheel 313. In the present embodiment, the rear wheel 312 is a drive wheel and the front wheel is an idler wheel. Additional wheels and/or rollers can be provided. The rear wheels 312 of the crawler belts 311 are actuated by an engine (not shown) arranged in the work vehicle 300. By the actuation of the rear wheels 312, the work vehicle 300 is accelerated to travel.

[0037] The upper swing structure 320 comprises a vehicle body 321 having a supporting frame 322 which is arranged rotatably on the lower travelling structure 310 such that the supporting frame 322 can rotate with respect to the lower travelling structure 310 around a vertical axis. The vehicle body 321 further comprises an operator's cab 323. Further components of the work vehicle 300 can be supported on the supporting frame 322, like the engine, the at least one tank, at least one hydraulic pump, an exhaust gas aftertreatment unit and/or a counterweight and so forth. These

components are not shown in the Figures.

[0038] Further, the work vehicle 300 comprises a work equipment 10 according to the invention. The work equipment 10 is attached to a front portion of the vehicle body 321. In particular, the work equipment 10 is mounted to the vehicle body 321 in a pivotally manner, in particular is pivotable around a horizontal axis which is perpendicular to the forward-rearward-direction X. Thus, the work equipment 10 is rotatable within a working plane which extends in a vertical direction and which is substantially perpendicular to the supporting frame 322 or to the ground on which the work vehicle 300 travels.

[0039] In Fig. 1, the work equipment 10 is in a first position, namely in a disconnected state. There, the left part of the work equipment 10 is supported on a work equipment stand 330. In Fig. 2, the work equipment 10 is in a second position, namely in a pre-assembled state, and in Fig. 3 the work equipment 10 is in a third position, namely in an assembled state.

[0040] As to the general structure, the work equipment 10 has a first side surface or first lateral surface, a second side surface or second lateral surface, an upper surface and a lower surface. The work equipment 10 preferably extends along a longitudinal path and preferably has a box-shape in a cross-sectional view. It may comprise several work equipment components movable with respect to each other.

[0041] In the embodiment shown, the work equipment 10 comprises a first boom 30, a second boom 70 and an arm 100. The second boom 70 can also be designated as an arm. A work attachment (not shown) can be connected to the arm 100. In the assembled state of the work equipment 10, as shown for example in Fig. 3, the first boom 30 is fixed to the second boom 70 such that the first boom 30 and second boom 70 can not move relative to each other. However, the assembled configuration of first and second boom 30, 70 is pivotable relative to the vehicle body 321 and is also pivotable relative to the arm 100.

[0042] The first boom 30 preferably extends along a longitudinal path and preferably has a box-shape in a cross-sectional view. The first boom 30 has a side surface 33, a further side surface 34, a lower surface 35 and an upper surface 36. Preferably, the side surfaces 33, 34 extend substantially parallel to each other and/or in a vertical direction. Further, the first boom 30 has a rear end 31 and a front end 32, wherein the rear end 31 (not shown) is pivotally attached to the vehicle body 321 such that the first boom 30 can rotate around a pivot axis which extends substantially perpendicular to the working plane and which extends in a horizontal direction as mentioned above.

[0043] The second boom 70 preferably extends along a longitudinal path and preferably has a box-shape in a cross-sectional view. The second boom 70 has a side surface 73, a further side surface 74, a lower surface 75 and an upper surface 76. Preferably, the side surfaces 73, 74 extend substantially parallel to each other and/or in a vertical direction. Further, the second boom 70 has a rear end 71 and a front end 72.

[0044] Starting from the first position shown in Fig. 1 the rear end 71 of the second boom 70 is attachable to the front end 32 of the first boom 30 by advancing the work vehicle 300 slowly in the forward-rearward-direction X towards the second boom 70 to reach the second position shown in Fig. 2. In the second position, the front end 32 of the first boom 30 is engaged with the rear end 71 of the second boom 70 such that the second boom 70 can rotate relative to the first boom 30 around a pivot axis which extends in a substantially horizontal direction. In the second position, the first boom 30 and the second boom 70 are in a pre-assembled state. In this regard, as indicated in Fig. 1 and 2, the second boom 70 includes a connection pin 90 and the first boom 30 includes a pick-up cup 60 for receiving the connection pin 90 for coupling the first boom 30 to the second boom 70 to reach the pre-assembled state. Preferably, the connection pin 90 is arranged at the rear end 71 of second boom 70 and extends through an opening of the side surface 73 and an opening of the side surface 74 as shown more detailed in Fig. 4 to 6 and 10. Preferably, the connection pin 90 and the pick-up cup 60 extend substantially perpendicular to the longitudinal axis of the first boom 30 and/or the second boom 70. The interaction of connection pin 90 and pick-up cup 60 is used for the first mounting step when the first boom 30 is positioned at the second boom 70 as shown in Fig. 2 and from Fig. 11 to 14.

[0045] As shown best in Figures 9, 10 to 18, 23 to 25, the pick-up cup 60 is provided at the front end 32 of the first boom 30 and comprises an opening 61 for inserting and extracting the connection pin 90. The pick-up cup 60 extends along a center axis 64 and has an inner shape 62. When seen in a longitudinal section along the first boom 30, as shown in Fig. 6 and 12, 14, 16, 18 and more detailed in Fig. 23 to 25, the inner shape 62 includes a first circular section 63 extending radially around the center axis 64 over an angle α of more than 180° . As shown in Fig. 23 to 25, the inner shape 62 further includes a linear section 65 following the first circular section 63 at one end thereof and a linear section 66 following the first circular section 63 at the other end thereof.

[0046] As best shown in Fig. 5, 6, 23 to 25, the connection pin 90 includes a middle portion 91 extending between the side surfaces 73, 74 of the second boom 70 and at least one end portion 92 extending outside the side surface 73. An outer shape 95 of the connection pin 90 includes a second circular section 96 having a radius slightly smaller than the radius of the first circular section 63. The second circular section 96 includes a linear section 97, such that the connection pin 90 can be inserted into and extracted from the opening 61 of the pick-up cup 60 only in a state where the pick-up cup 60 and the connection pin 90 are positioned to each other in a predetermined rotational relationship as can be seen from Figures 11 to 18 and more detailed in Figures 23 to 25. As can be taken from Fig. 23 to 25, the dimensions of the circular sections 63, 96 and linear sections 65, 66, 97 and angle α are configured such that the connection pin 90 can be inserted via opening 61 into the pick-up cup 60 in the first position as shown in Fig. 12, 14 and more detailed in Fig.

23, 24. The dashed lines in Fig. 12 show an intermediate position shortly before the pick-up cup 60 engages with the connection pin 90. After full insertion of the connection pin 90 into the pick-up cup 60, the position as shown for example in Fig. 2, 14 and 23 is reached. As a next step, the first boom 30 is lifted by actuation of the boom cylinder 37. Thus, the front end 32 is lifted until the position shown in Fig. 3, 15, 16 is reached. There, the pick-up cup 60 and the connection pin 90 are rotated to each other due to the lifting operation of the first boom 30 such that the linear section 97 of the connection pin 90 is drawn away from the opening 61 such that the connection pin 90 is engaged within the pick-up cup 60 and can not be withdrawn. This situation is shown in Fig. 16 and in more detail in Fig. 25.

[0047] For finally securing the first boom 30 to the second boom 70 such that the booms 30, 70 can no more rotate to each other around the connection pin 90, a first mounting opening 80, a second mounting opening 81 and a mounting pin 40 are provided. The first mounting opening 80 and the second mounting opening 81 are positioned at the rear end 71 of the second boom 70. The first mounting opening 80 refers to a first mounting position of the boom assembly including the first and second boom 30, 70 and is shown in Fig. 3, 15, 16. The second mounting opening 81 refers to a second mounting position of the boom assembly including the first and second boom 30, 70 and is shown in Fig. 17, 18. The first mounting position of the boom assembly can also be designated as cranked position and the second mounting position of the boom assembly can also be designated as straight position.

[0048] For secure fixation of the first boom 30 to the second boom 70 in the desired first or second mounting position (cranked or straight position) at least one mounting pin 40 is used. Preferably, one mounting pin 40 is used at each side of the work equipment 10. The mounting pin 40 can be provided at the first boom 30 and is insertable into the first mounting opening 80 or into the second mounting opening 81. Preferably, the mounting pin 40 is a movable hydraulic pin which can be remotely controlled from the operator's cab.

[0049] In order to secure the first boom 30 to the second boom 70 in the cranked position, the first boom 30 is lifted until the longitudinal axis of the mounting pin 40 matches with the longitudinal axis of the first mounting opening 80. In this manner, the work equipment 10 can be raised from the work equipment stand 330. Then, the mounting pin 40 can be inserted into the first mounting opening 80 as shown in Fig. 7, 8, 15, 16. Now, the connection pin 90 is engaged with the pick-up cup 60 and the mounting pin 40 is inserted into the first mounting opening 80 such that first boom 30 and second boom 70 can no more rotate relative to each other.

[0050] For securing the first boom 30 to the second boom 70 in the straight position, the first boom 30 is lifted and/or lowered until the longitudinal axis of the mounting pin 40 matches with the longitudinal axis of the second mounting opening 81. Then, the mounting pin 40 can be inserted into the second mounting opening 81 as shown in Fig. 17 and 18. Now, the connection pin 90 is engaged with the pick-up cup 60 and the mounting pin 40 is inserted into the second mounting opening 81 such that first boom 30 and second boom 70 can no more rotate relative to each other.

[0051] Next, the arm 100 will be described in more detail. The arm 100 generally extends along a longitudinal path and preferably has a box-shape in a cross-sectional view. The arm 100 has a side surface 103, a further side surface 104, a lower surface 105 and an upper surface 106. Preferably, the side surfaces 103, 104 extend substantially parallel to each other and/or in a vertical direction. The arm 100 is pivotally mounted to the second boom 70. In more detail, the arm 100 has a rear end 102 and a front end 101, wherein the rear end 102 is pivotally attached to the front end 72 of the second boom 70 such that the arm 100 can rotate relative to the second boom 70 around a pivot axis which extends substantially perpendicular to the working plane and which extends in a horizontal direction. The work attachment already mentioned above but not shown in the Figures can be connected to the front end 102 of the arm 100, preferably by a coupler and more preferably by a quick coupler device. For example, the work attachment can be a bucket or demolition tool.

[0052] Further, the work equipment 10 comprises several hydraulic cylinders for moving the booms 30, 70, the arm 100 and/or the work attachment. In order to pivot the boom assembly including the first boom 30 and second boom 70 with regard to the vehicle body 321, the above-mentioned boom cylinder 37 is provided. The base end of the boom cylinder 37 is supported on the vehicle body 321 and the tip end of the boom cylinder 37 is mounted in the area of the front end 32 of the first boom 70. Preferably, the boom cylinder 37 extends laterally to the first boom 30 and the tip end of the boom cylinder 37 is mounted to the side surface 33 of the first boom 30. Preferably, a further boom cylinder 37 (not shown) is provided at the opposite side of the first boom 30 in a similar manner in order to provide a symmetric configuration. In order to pivot the arm 100 with regard to the boom assembly including the first boom 30 and second boom 70, an arm cylinder 77 is provided. Preferably, the base end of the arm cylinder 77 is supported on the rear end 71 of the second boom 70 and the tip end of the arm cylinder 77 is mounted to the rear end 71 of the arm 100. Preferably, the arm cylinder 77 extends along the upper surface 76 of the second boom 70 and is mounted to the upper surface 76 of the second boom 70. For moving the work attachment relative to the arm 100, a work attachment cylinder 107 is provided. Preferably, the base end of the work attachment cylinder 107 is supported on the rear end 102 of the arm 100 and the tip end of the work attachment cylinder 107 is mounted in the area of the front end 101 of the arm 100. Preferably, the work attachment cylinder 107 extends along the upper surface 106 of the arm 100 and is mounted to the upper surface 106 of the arm 100.

[0053] The cylinders 37, 77, 107 are hydraulic cylinders and the hydraulic fluid for moving the cylinders 37, 77, 107

is supplied by a hydraulic pump (not shown) located on the vehicle body 321. The hydraulic fluid is supplied from the hydraulic pump to the hydraulic cylinders by a plurality of service lines. The service lines can also be designated as conduits, piping or pipework and will be described in more detail below.

[0054] In the present invention, the service lines comprise two groups of service lines, namely first service lines 38 which can be also designated as a first group of service lines and second service lines 78 which can be also designated a second group of service lines. The first service lines 38 are related to the first boom 30 and the second service lines 78 are related to the second boom 70. Further, the first service lines 38 are provided on the first boom 30 and the second service lines 78 are provided on the second boom 70. Additionally, the second service lines 78 can be provided on or extend to the arm 100. As shown in Fig. 1 to 3, the first service lines 38 are preferably arranged on the upper surface 36 of the first boom 30 and the second service lines 78 are preferably arranged on the upper surface 76 of the second boom 70. The first and second service lines 38, 78 comprise at least one of a hydraulic line, electric line, data line (e.g. CAN data line), water line and/or lubricant line. In the present embodiment and for clarity in the drawings, the first service lines 38 and the second service lines 78 each comprise only two separate service lines, but it is clear that there can be a higher number of service lines for the first service lines 38 and the second service lines 78.

[0055] According to the present invention, the work equipment 10 comprises a quick coupling device 20 for coupling the plurality of the first service lines 38 with the plurality of the second service lines 78.

[0056] Basically, the quick coupling device 20 comprises a first coupling unit 110 and a second coupling unit 150 for coupling the plurality of first service lines 38 with the plurality of second service lines 78. The first coupling unit 110 includes a first coupling block 120 wherein the first service lines 38 are connected to the first coupling block 120 and wherein the first coupling block 120 is fixedly mounted to the side surface 33 of the first boom 30. Further, the second coupling unit 150 includes a second coupling block 160 wherein the second service lines 78 are connected to the second coupling block 160 and wherein the second coupling block 160 is arranged laterally to the side surface 73 of the second boom 70 such that the second coupling block 160 is rotatable relative to the first coupling block 120 between a connection position in which the first and second coupling blocks 120, 160 are connected to each other (see Fig. 3, 7, 8) and a release position in which the first and second coupling blocks 120, 160 are disconnected from each other (see Fig. 2, 4, 5).

[0057] The first coupling unit 110 comprises a first bracket 130, wherein the first coupling block 120 is fixedly mounted to the first bracket 130 and the first bracket 130 is fixedly mounted to the first boom 30. The second coupling unit 150 comprises a second bracket 170, wherein the second coupling block 160 is fixedly mounted to the second bracket 170 and the second bracket 170 is rotatably mounted to the second boom 70.

[0058] The preferred configuration of the first and second brackets 130, 170 is best shown in Fig. 4 to 10 and 19 to 22 and will be described in more detail below.

[0059] The first bracket 130 preferably includes at least two side plates, namely a first side plate 131 and a second side plate 132, a base plate 133, and two end plates 134. The two side plates 131, 132 are arranged at a distance and substantially parallel to each other and parallel to the side surface 33. The first bracket 130 is mounted to the first boom 30 via the first side plate 131. In more detail, the first side plate 131 is mounted by means of bolts 51 and washers 52 to connection members 50 connected to the side surface 33 of the first boom 30 and, as shown in Fig. 6 and 9, preferably there are three connection members 50 formed as pins protruding perpendicular from the side surface 33 and having threads for receiving the bolts 51. Of course, alternative configurations are possible for mounting the first bracket 130 to the first boom 30. The first bracket 130 is preferably mounted in such a manner to extend substantially parallel to the side surface 33 of the first boom 30. Further, the first bracket 130 comprise a first end portion 135 located in the area of the connection pin 90 or in other words related to the joint formed by connection pin 90 and pick-up cup 60. Further, a second end portion 136 is located opposite to the first end portion 135 at the free lower end of the first bracket 130. At the first end portion 135 and the second end portion 136, the end plates 134 extends substantially perpendicular between the two side plates 131, 132 respectively and connect the two side plates 131, 132. The base plate 133 also extends substantially perpendicular to the two side plates 131, 132 and is mounted between the two side plates 131, 132 to support the first coupling block 120. The first coupling block 120 is fixed by bolts 137 to the base plate 133.

[0060] The second bracket 170 preferably includes at least two side plates, namely a first side plate 171 and a second side plate 172, and two base plates 173, 174. The two side plates 171, 172 are arranged at a distance and substantially parallel to each other and parallel to the side surface 73 of the second boom 70. The second bracket 170 is rotatably mounted to the connection pin 90 to be pivotable relative to the second boom 70 and relative to the first bracket 30. The second bracket 170 comprise a first end portion 175 located in the area of the connection pin 90 or in other words related to the joint formed by connection pin 90 and pick-up cup 60. Further, a second end portion 176 is located opposite to the first end portion 175 at the free lower end of the second bracket 170. At the second end portion 176, the base plate 174 extends substantially perpendicular between the two side plates 171, 172 and connects the two side plates 171, 172 and supports the second coupling block 160. At the first end portion 175, the base plate 173 also extends substantially perpendicular to the two side plates 171, 172 and is mounted between the two side plates 171, 172 to support the second coupling block 160. The second coupling block 160 is fixed by bolts 177 to the base plates 173, 174 which are mounted to the side plates 173, 174. Of course, alternative configurations are possible for mounting the second bracket 170 to

the second boom 70. The second bracket 170 is preferably mounted in such a manner to extend substantially parallel to the side surface 73 of the second boom 70.

[0061] As best shown in Fig. 10, the second bracket 170 is rotatably mounted to the connection pin 90 to be rotatable around the extension axis of the connection pin 90 relative to the connection pin 90 and the second bracket 170 is also rotatable relative to the first bracket 130. In this regard, a coupling sleeve 180 is provided at the second bracket 170. As mentioned above, the connection pin 90 includes an end portion 92 extending outside from the side surface 73 and for receiving the second bracket 170 such that the second bracket 170 is rotatable around the connection 90. To this end, the second bracket 170 comprises the coupling sleeve 180 which extends between the side plates 171, 172 at the first end portion 175. The coupling sleeve 180 has an opening 181 for rotatably mounting the second bracket 170 to the connection pin 90. Also, the side plates 171, 172 include a bore, e.g. a through-hole, aligned with the opening 181 for receiving the connection pin 90. In order to mount the second bracket 170 to the connection pin 90, the coupling sleeve 180 is pushed onto the connection pin 90 and then a cover plate 93 is mounted to the outer end of the connection pin 90 by bolts 94. Further, for rotatably mounting the second bracket 170 to the first bracket 130 the first bracket 130 is mounted to the first boom 30 such that coupling sleeve 180 does not contact the first end portion 135 of the first bracket 130 when the connection pin 90 is resided in the pickup-up cup 60.

[0062] As to the configuration of the coupling blocks 120, 160 as best shown in Fig. 4, 5, 7, 8, 9, 10 and 19 to 22, the first coupling block 120 comprises a coupling connection surface 121 having a plurality of connection ports 122 with valves 123. At the opposite side the first coupling block 120 comprises a service line surface 124 having a plurality of service line connection ports 125. The second coupling block 160 comprises a coupling connection surface 161 having a plurality of connection ports 162 with valves 163. At the opposite side the second coupling block 160 comprises a service line surface 164 having a plurality of service line connection ports 165. Preferably, the coupling connection surfaces 121, 161 and the service line surfaces 124, 164 are arranged radially to the connection pin 90. In the connected position of the coupling blocks 120, 160, the coupling connection surface 121 is directly connected to the coupling connection surface 161 such that these surfaces 121, 161 are parallel to each other (see Fig. 8). Preferably, the coupling blocks 120, 160 each are formed as a solid block body, in particular cuboid-shaped. The block body can include a plurality of recesses. Preferably, the recess passes through the block body from the coupling connection surface 121, 161 at the connection side to a service line surface 124, 164 at the service line side. The recess can be formed in a step-like manner. Preferably, the recess has a first end related to the coupling connection surface 121, 161 and a second end related to the service line surface 124, 164. The first end can receive and hold the connection port 122, 162 and the second end can receive and hold the connection port 125, 165. For example, in a first group of ports the one end of the recess receives an electric connector or plug and the other end receives an end of the first or second service line. In a second group of ports the one end of each recess receives a fluid line connector, e.g. a valve, and the other end receives an end of the first or second service line.

[0063] It is preferred that the quick coupling device 20 also includes a restricting member 190 mounted on the second boom 70 for restricting rotational movement of the second coupling block 160. The restricting member 190 is supported on the second boom 70 by a mounting plate 191 extending parallel to the side surface 73. A stop member 192 extends away from the mounting plate 191 to form an abutment member for the second coupling unit 150. Thus, the range of rotation of the second coupling unit 150 shall be limited.

[0064] Referring to Figures 7 to 10 and 19 to 22, the quick coupling device 20 further can comprise a locking device 200 having a first locking unit 210 and a second locking unit 220, wherein one of the first and second locking unit 210, 220 comprises at least one movable locking pin 214 and the other one of first and second locking unit 210, 220 comprises at least one locking opening 224 into which the locking pin is insertable. The locking device 200 is in a locked state when the locking pin 214 is inserted into the opening 224 and in an unlocked state when the locking pin 214 is retracted from the opening 224. Preferably, the first locking unit 210 comprises four movable locking pins 214 as shown in Fig. 7 to 10 and 19 to 22. Accordingly, the second locking unit 220 comprises four openings 224. Preferably, the first locking unit 210 is block-shaped and directly mounted to the first coupling block 120 or is integrated into the first coupling block 120. As shown in Fig. 9, the first locking unit 210 preferably comprises two first locking unit sections 211, 212. Each locking unit section 211, 212 includes two locking pins 214. The first locking unit section 211 is provided at the first end portion 135 of the first bracket 130 and the second locking unit section 212 is provided at the second end portion 136 of the first bracket 130. The first coupling block 120 supports the two locking unit sections 211, 212 and the valves 123 are located between the two locking unit sections 211, 212. As can be seen from Fig. 10, the second locking unit 220 preferably comprises two second locking unit sections 221, 222. Each locking unit section 221, 222 includes two locking openings 224. To this end, four side plates 223 are provided. Each side plate 223 comprises one locking opening 224 for receiving one locking pin 214. These side plates 223 preferably are mounted to the second coupling block 160, preferably parallel to the outer side surfaces of the second coupling block 160. Alternatively, the openings 224 can be integrated in the side plates 171, 172. The locking pins 214 are provided in the unlocked state within the first locking unit 210 (Fig. 19, 20) and can be moved in a direction towards the outside of the first locking unit 210 to come into the locked state (Fig. 21, 22). In the locked state, the locking pins 214 engage with the locking openings 224. Preferably, the locking pins 214

are hydraulic pins and can be remotely or automatically actuated from the cab of the work vehicle.

[0065] Based on the above explained configuration of the quick coupling device 20 with the first coupling unit 110 and the second coupling unit 150, the mounting procedure will be described. As mentioned above, in the second position (pre-assembled state) as shown in Fig. 2 the first boom 30 is positioned at the second boom 70 and the connection pin 90 is engaged within the pick-up cup 60. Subsequently, the front end 31 of the first boom 30 is lifted by actuation of the boom cylinder 37 until the third position as shown in Fig. 3, 15, 16 is reached. During the rotation of the first boom 30, the second bracket 70 and/or the first bracket 30 is rotated around the connection pin 90 until the first and second coupling units 110, 150 are in the connected state, in which the first coupling block 120 and the second coupling block 150 are connected to each other (see Fig. 7, 8). This means that the coupling connection surface 121 connects the coupling connection surface 161 such that the connection ports 122, 162 can communicate with each other. In other words, the valves 123, 163 are then in a connected state. This applies also for all other connection ports of all other service lines. Subsequently, the first locking unit 210 and the second locking unit 220 can be brought into the locked state such that the first coupling unit 110 and the second coupling unit 150 are safely connected to each other. Afterwards, the mounting pin 40 can be inserted into the first mounting opening 80 to fix the boom assembly of first and second booms 30, 70 in the cranked position.

[0066] In case that the straight position is desired, the first boom 30 can be lowered starting from the position shown in Fig. 15 by actuating the boom cylinder 37 until the straight position in Fig. 17 is reached. Afterwards, the mounting pin 40 can be inserted into the second mounting opening 81 to fix the boom assembly of first and second booms 30, 70 in the straight position.

[0067] As indicated in Fig. 4, 7, 9, 10 and in Fig. 26 to 29, the first coupling unit 110 comprises at least one projection 140 for actuating the second coupling unit 150 such that the second coupling block 160 is rotated in a mounting position before the first coupling block 120 and second coupling block 160 are connected to each other. In the preferred embodiment, the first bracket 130 comprises two projections 140 (see Fig. 9). In detail, it is preferred that each side plate 131, 132 of the first bracket 130 comprises one projection 140 in the area of the first end portion 135. The outer end or tip of the projection 140 can have a curved shape. The second coupling unit 150 comprises at least one recess 184 for receiving the at least one projection 140 of the first coupling unit 110. In the preferred embodiment, the second bracket 170 comprises two recesses 184 (see Fig. 10). In detail, it is preferred that each side plate 171, 172 of the second bracket 170 comprises one recess 184 in the area of the first end portion 175. Preferably, each recess 184 has a curved shape mating which the curved tip end of the corresponding projection 140.

[0068] It is preferred, that the projection 140 of the first side plate 131 interacts with the recess 184 of the first side plate 171 and that the projection 140 of the second side plate 132 interacts with the recess 184 of the second side plate 172 (see Fig. 9, 10). To this end, the projection 140 of the first side plate 131 and the recess 184 of the first side plate 171 extend in the same plane and the projection 140 of the second side plate 132 and the recess 184 of the second side plate 172 extend in the same plane. Preferably, the planes extend substantially parallel to each other and/or to the side surface 33 of the first boom 30. Thus, the interacting pairs of projection 140 and recess 184 can move relative to each other during the mounting procedure for connecting the first coupling block 120 to the second coupling block 160. The main purpose of the projection 140 and the recess 184 is to bring the first coupling unit 110 and the second coupling unit 150 and in particular the first coupling block 120 and the second coupling block 160 in the desired mounting positions providing a suitable posture relative to each other. This can protect the coupling blocks 120, 160 from engaging when not aligned.

[0069] In the following, this is further described referring to Fig. 26 to 29 in which less relevant parts or features which are already shown in other figures are shown in dashed lines. In the situation as shown in Fig. 26, the work vehicle comprising the first boom 30 approaches along direction X towards the second boom 70 supported on the work equipment stand 330 (see also Fig. 1). Thus, the pick-up cup 60 approaches towards the connection pin 90 as already explained in connection with Fig. 11, 12. In case that the first coupling unit 110 and second coupling unit 150 are not in the correct mounting position to each other, that means in a misaligned position, e.g. when the first boom 30 is positioned not high enough, then the first and second coupling units 110, 150 could collide against each other. To bring the second coupling unit 150 in the desired mounting position, when the first boom 30 further approaches to the second boom 70, then the two projections 140 of the first coupling unit 110 pushes and rotates away the second coupling unit 150 (see arrow in Fig. 27) around the axis of the connection pin 90 such that the first coupling unit 110 reaches the desired position. Afterwards, the boom 30 can be raised until the pick-up cup 60 engages with the connection pin 90 as shown in Fig. 28. In this position, the projection 140 of the side plate 131 is aligned with the recess 184 of the side plate 171 and the projection 140 of the side plate 132 is aligned with the recess 184 of the side plate 172. Subsequently, after further raising the first boom 30 until the position shown in Fig. 29 (shown also in Fig. 17, 18), the first and second coupling units 110, 150 rotate relative to each other around the axis of the connection pin 90 until the first and second coupling blocks 120, 160 are connected into the connection position. In this connected position, the projection 140 of the side plate 131 is resided in the recess 184 of the side plate 171 and the projection 140 of the side plate 132 is resided in the recess 184 of the side plate 172 (see Fig. 29). In other words, the projections 140 at the first coupling unit 110 are

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provided for contacting the second coupling unit 150, in particular for contacting the second bracket 170, in case that the first and second coupling units 110, 150 are in a misaligned position before connecting the pick-up cup 60 with the connection pin 90.

[0070] In another preferred embodiment, a work equipment comprises the quick coupling device 20 of the above embodiment as a first coupling assembly and the quick coupling device 20 of the above embodiment a second coupling assembly. Thus, the first coupling assembly includes the first coupling unit 110 and the second coupling unit 150 as defined above and the second coupling assembly includes the first coupling unit 110 and the second coupling unit 150 as defined above. The first and second coupling units 110, 150 of the first coupling assembly are arranged at the first side surface 33, 73 of the first and second boom 30, 70 and the first and second coupling units 110, 150 of the second coupling assembly are arranged at the second side surfaces 34, 74 of the first and second boom 30, 70 opposite to the first side surface 33, 73. The configuration of the first and second coupling units 110, 150 of the first and second coupling assemblies can be adapted to be symmetrical relative to the longitudinal axes of the first and second boom 30, 70 and/or to be symmetrical relative to the longitudinal axis of the connection pin 90.

List of Reference Signs

10	work equipment	70	second boom
		71	rear end
20	quick coupling device	72	front end
		73	side surface
30	first boom	74	side surface
31	rear end	75	lower surface
32	front end	76	upper surface
33	side surface	77	arm cylinder
34	side surface	78	second service lines
35	lower surface		
36	upper surface	80	first mounting opening
37	boom cylinder	81	second mounting opening
38	first service lines		
40		90	connection pin
40	mounting pin	91	middle portion
		92	end portion
50	connection member	93	cover plate
51	bolts	94	bolts
52	washers	95	outer shape
		96	second circular section
60	pick-up cup	97	linear section
61	opening		
62	inner shape	100	arm
63	first circular section	101	front end
64	cup center axis	102	rear end
65	linear section	103	side surface
66	linear section	104	side surface
		105	lower surface
		106	upper surface
		107	work attachment cylinder
110	first coupling unit	174	base plate
		175	first end portion
120	first coupling block	176	second end portion
121	coupling connection surface	177	bolt
122	coupling connection ports		
123	valve	180	coupling sleeve
124	service line surface	181	bore
125	service line connection port		

(continued)

			184	recess
5	130	first bracket		
	131	first side plate	190	restricting member
	132	second side plate	191	mounting plate
	133	base plate	192	stop member
	134	end plate		
10	135	first end portion	200	locking device
	136	second end portion	210	first locking unit
	137	bolt	211	first locking unit section
			212	first locking unit section
15	140	projection	214	locking pin
			220	second locking unit
	150	second coupling unit	221	second locking unit section
			222	second locking unit section
	160	second coupling block	223	side plate
20	161	coupling connection surface	224	locking opening
	162	connection ports		
	163	valve	300	work vehicle
	164	service line surface		
	165	service line connection port	310	lower travelling structure
25	170	second bracket	311	crawler belt
	171	side plate	312	front wheel
	172	side plate	313	rear wheel
	173	base plate		
30	320	upper swing structure		
	321	vehicle body		
	322	supporting frame		
	323	operator's cab		
35	330	work equipment stand		
	X	forward-rearward-direction		
	α	angle		

Claims

1. Work equipment for a work vehicle, wherein the work equipment comprises:

a first boom,
a second boom attachable to the first boom,
a plurality of first service lines provided on the first boom,
a plurality of second service lines provided on the second boom, and
a quick coupling device for coupling the plurality of first service lines with the plurality of second service lines,
wherein the quick coupling device comprises a first coupling unit and a second coupling unit,
wherein the first coupling unit includes a first coupling block wherein the first service lines are connected to the
first coupling block and wherein the first coupling block is fixedly mounted to a side surface of the first boom and,
wherein the second coupling unit includes a second coupling block wherein the second service lines are con-
nected to the second coupling block and wherein the second coupling block is rotatable relative to a side surface
of the second boom such that the second coupling block is rotatable relative to the first coupling block between
a connection position in which the first and second coupling blocks are connected to each other and a release
position in which the first and second coupling blocks are disconnected from each other.

2. Work equipment according to claim 1, **characterised in that**
the first coupling unit comprises a first bracket, wherein the first coupling block is fixedly mounted to the first bracket and the first bracket is fixedly mounted to the first boom and
the second coupling unit comprises a second bracket, wherein the second coupling block is fixedly mounted to the
second bracket and the second bracket is rotatably mounted to the second boom.
3. Work equipment according to any of claims 1 or 2, **characterised in that** the first or second boom includes a
connection pin for coupling the first boom to the second boom, wherein the connection pin extends substantially
perpendicular to the longitudinal axis of the first boom and/or the second boom.
4. Work equipment according to claim 3, **characterised in that** the first or second boom comprises a pick up cup for
receiving the connection pin.
5. Work equipment according to any of claims 3 to 4, **characterised in that** the second coupling unit comprises a
coupling sleeve for receiving an end portion of the connection pin such that the second coupling unit is rotatably
mounted to the connection pin such that the second coupling block is rotatable around the connection pin.
6. Work equipment according to any of claims 1 to 5, **characterised in that** the first coupling unit comprises at least
one projection for actuating the second coupling unit such that the second coupling block is rotated in a mounting
position before the first and second coupling blocks are connected to each other.
7. Work equipment according to claim 6, wherein the second coupling unit comprises at least one recess for receiving
the projection of the first coupling unit.
8. Work equipment according to any of claims 3 to 7, **characterised in that** the pick-up cup comprises an opening for
inserting and extracting the connection pin and wherein the pick-up cup has an inner shape, wherein, when seen
in a longitudinal section along the first boom, the inner shape includes a first circular section extending radially
around a center axis of the pick-up cup over more than 180° and wherein an outer shape of the connection pin
includes a second circular section having a radius smaller than the radius of the first circular section and a linear
section, such that the connection pin can be inserted into and extracted from the opening only in a state where the
pick-up cup and the connection pin are positioned to each other in a predetermined rotational relationship.
9. Work equipment according to any of the preceding claims, **characterised by** a restricting member mounted on the
second boom for restricting rotational movement of the second coupling block.
10. Work equipment according to any of claims 3 to 9, **characterised in that** each of the first coupling block and the
second coupling block comprises a connection surface having a plurality of connection ports, wherein the connection
surfaces are arranged radially to the connection pin.
11. Work equipment according to any of the preceding claims, **characterised in that** the quick coupling device comprises
a locking device having a first locking unit and a second locking unit, wherein one of the first and second locking
unit comprises at least one movable locking pin and the other one of first and second locking unit comprises at least
one locking opening into which the locking pin is insertable and wherein the locking device is in a locked state when
the locking pin is inserted into the opening and in an unlocked state when the locking pin is retracted from the opening.
12. Work equipment according to any of the preceding claims, **characterised in that** the second boom comprises at
least a first and a second mounting opening wherein the first mounting opening refers to a first mounting position
of the first and second boom and the second mounting opening refers to a second mounting position of the first and
second boom and wherein the first boom includes at least one mounting pin insertable into one of the first and
second mounting openings for mounting the first boom to the second boom in the first mounting position when the
mounting pin is inserted into the first mounting opening and in the second mounting position when the mounting pin
is inserted into the second mounting opening.
13. Work equipment according to any of the preceding claims, **characterised in that** the quick coupling device comprises
a first coupling assembly and a second coupling assembly, wherein the first coupling assembly includes the first
coupling unit and the second coupling unit as defined in any of the preceding claims and wherein the second coupling
assembly includes the first coupling unit and the second coupling unit as defined in any of the preceding claims
wherein the first and second coupling unit of the first coupling assembly are arranged at a first side surface of the

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first and second boom and wherein the first and second coupling unit of the second coupling assembly are arranged at a second side surface of the first and second boom opposite to the first side surface.

5 **14.** Work equipment according to any of the preceding claims, **characterised in that** the first and second service lines comprise at least one of hydraulic lines, electric lines, data lines, water lines and/or lubricant lines.

15. Work vehicle comprising a vehicle body and a work equipment according to any one of claims 1 to 14, wherein the first boom is rotatably mounted to the vehicle body.

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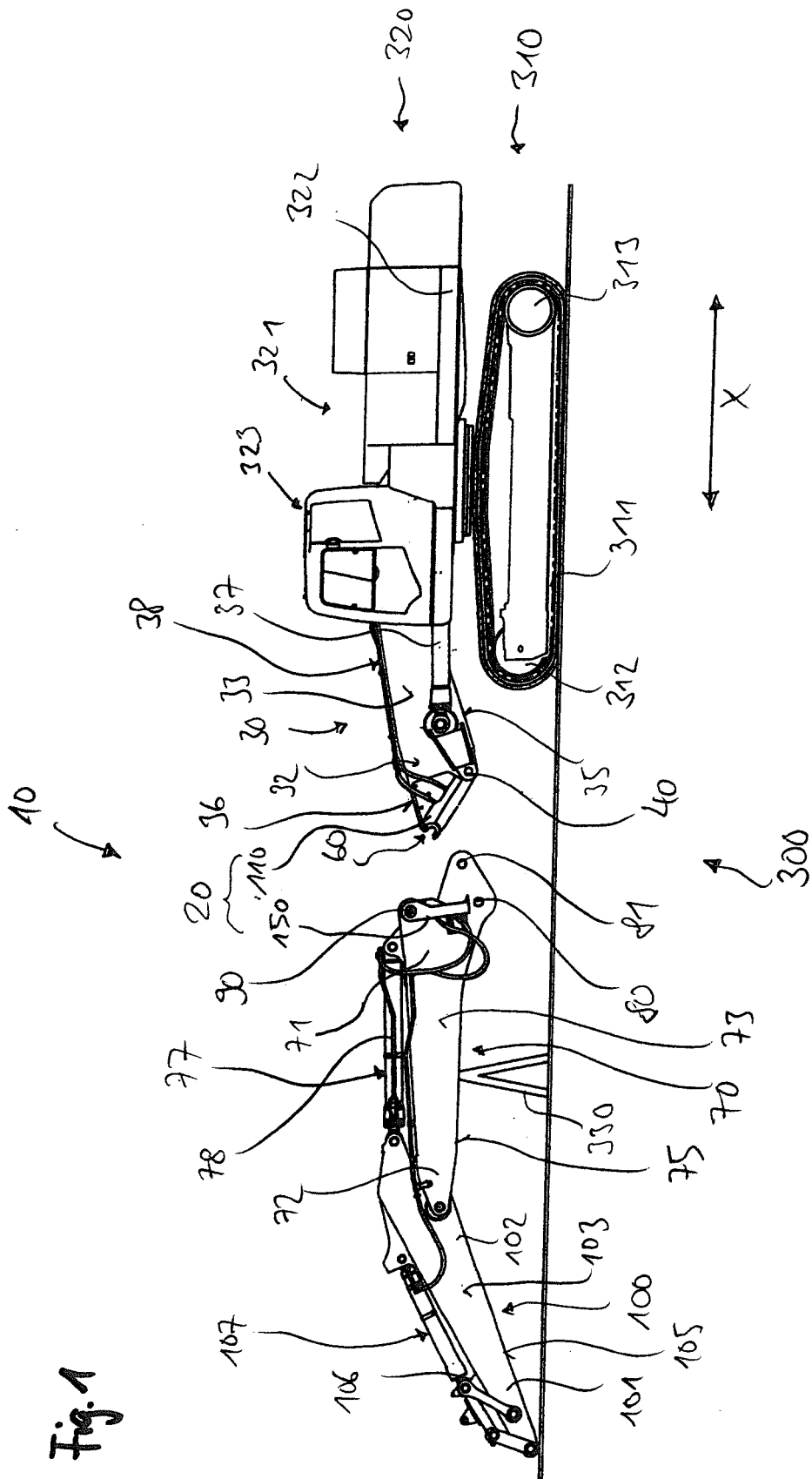
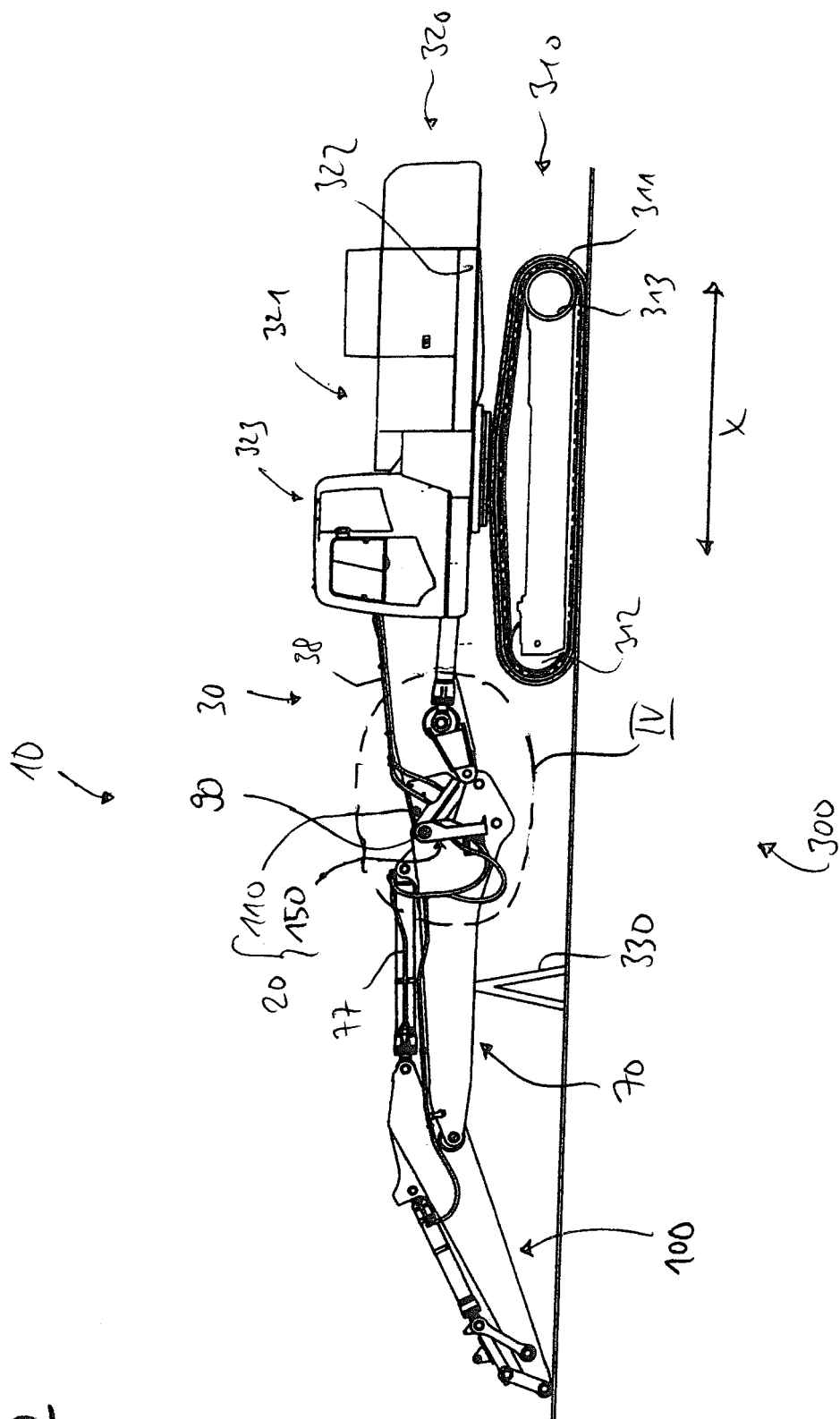


Fig. 2



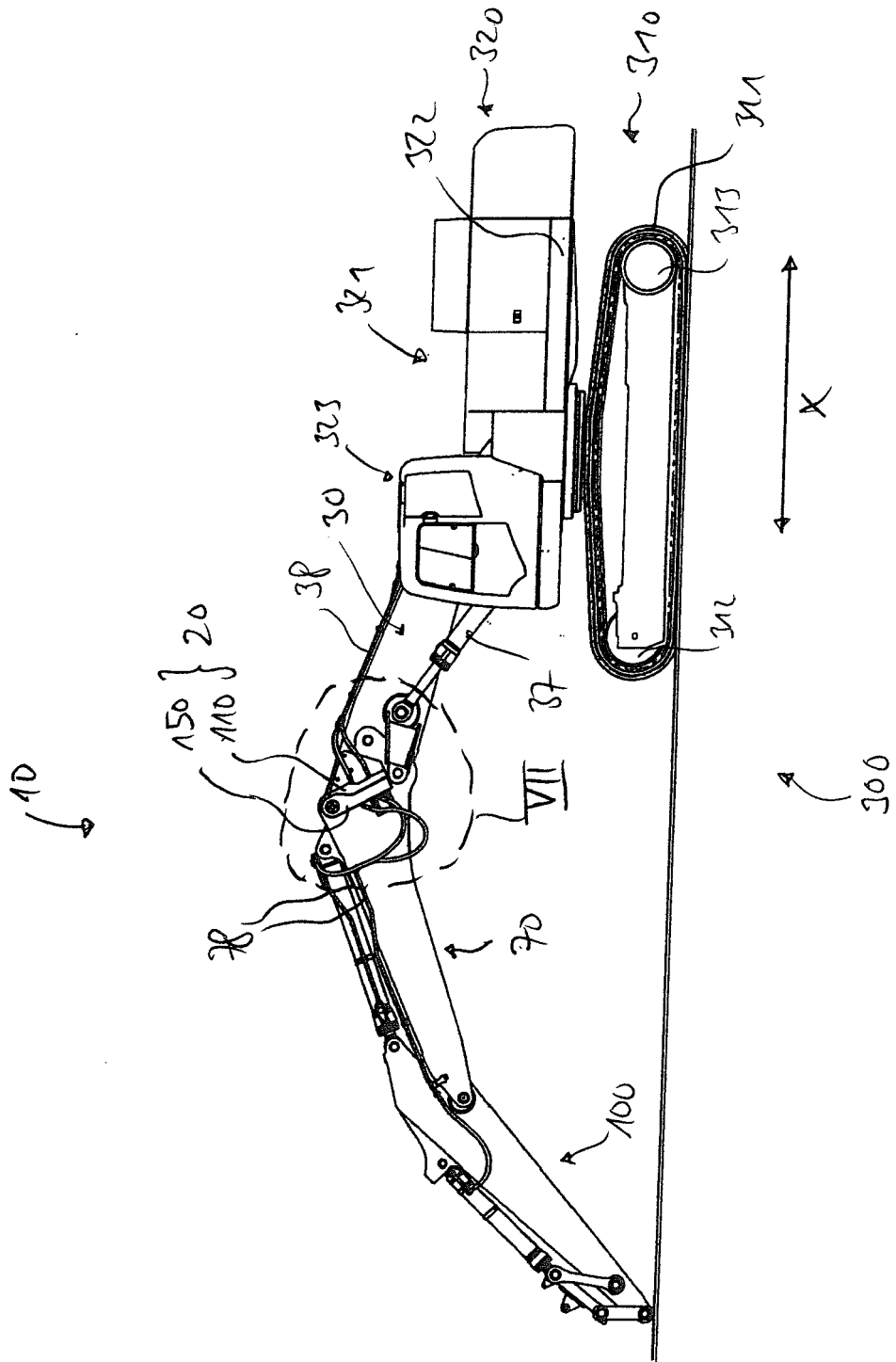
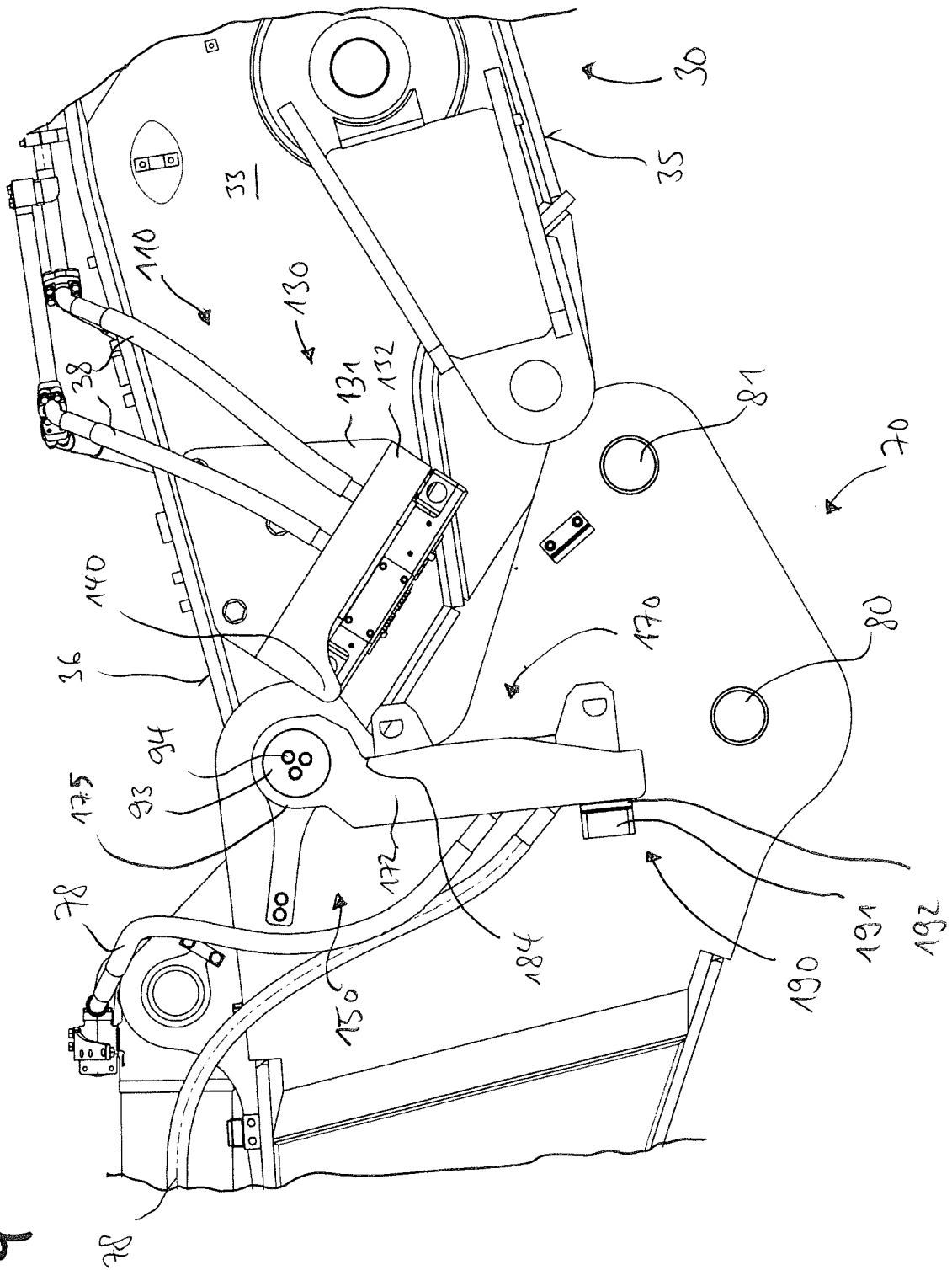


Fig. 3

Fig. 4



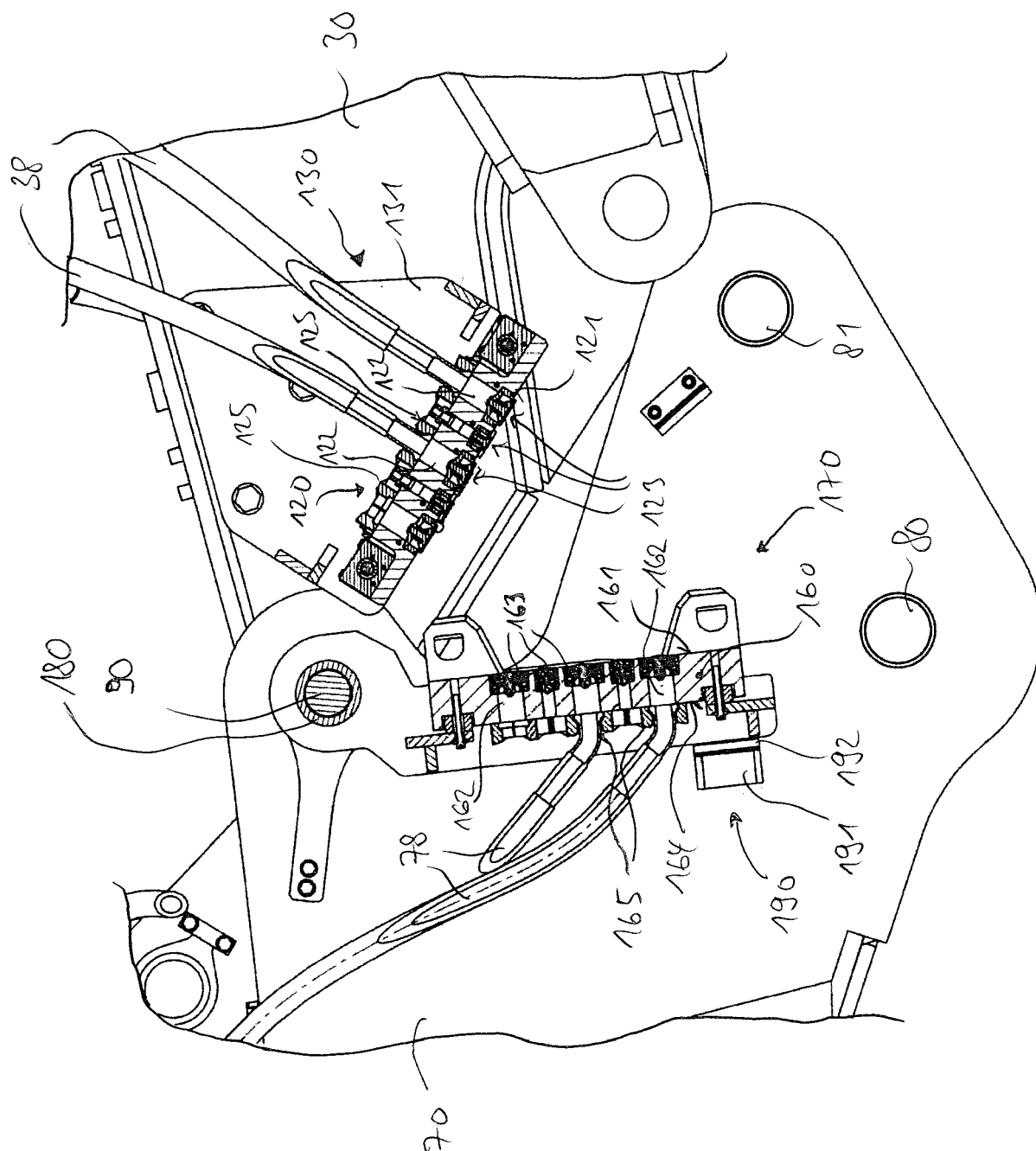


Fig. 5

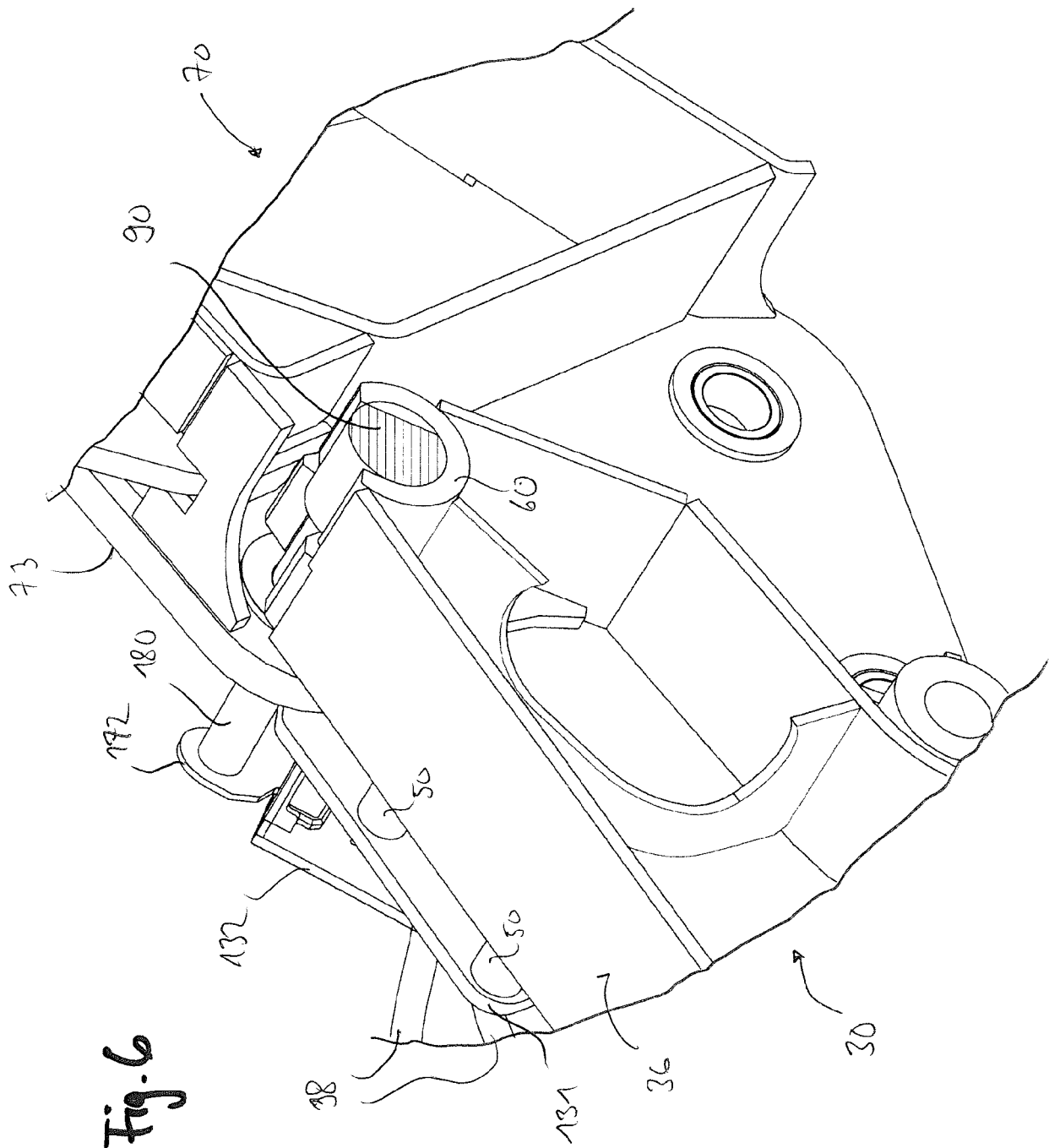
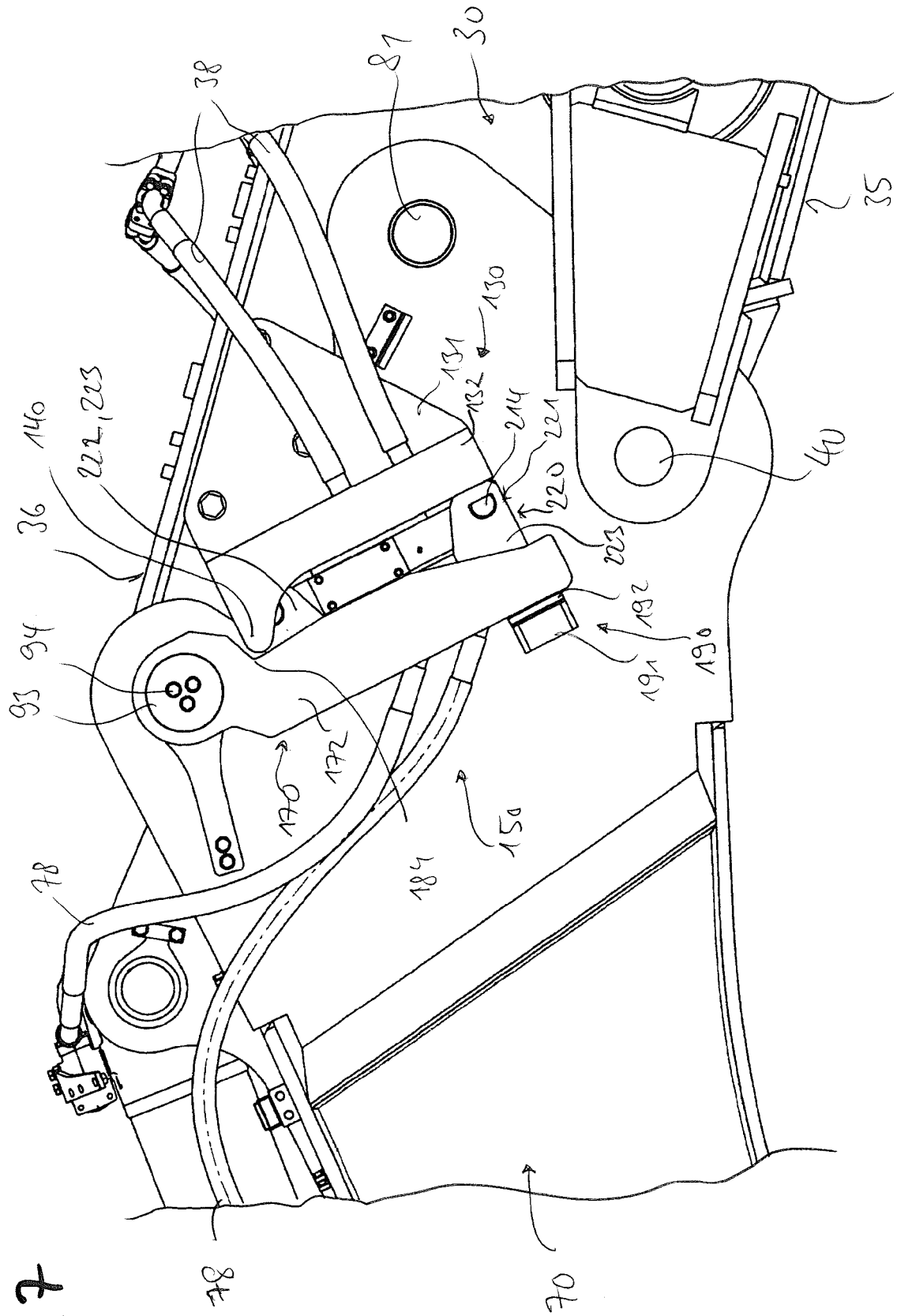


Fig. 6

Fig. 7



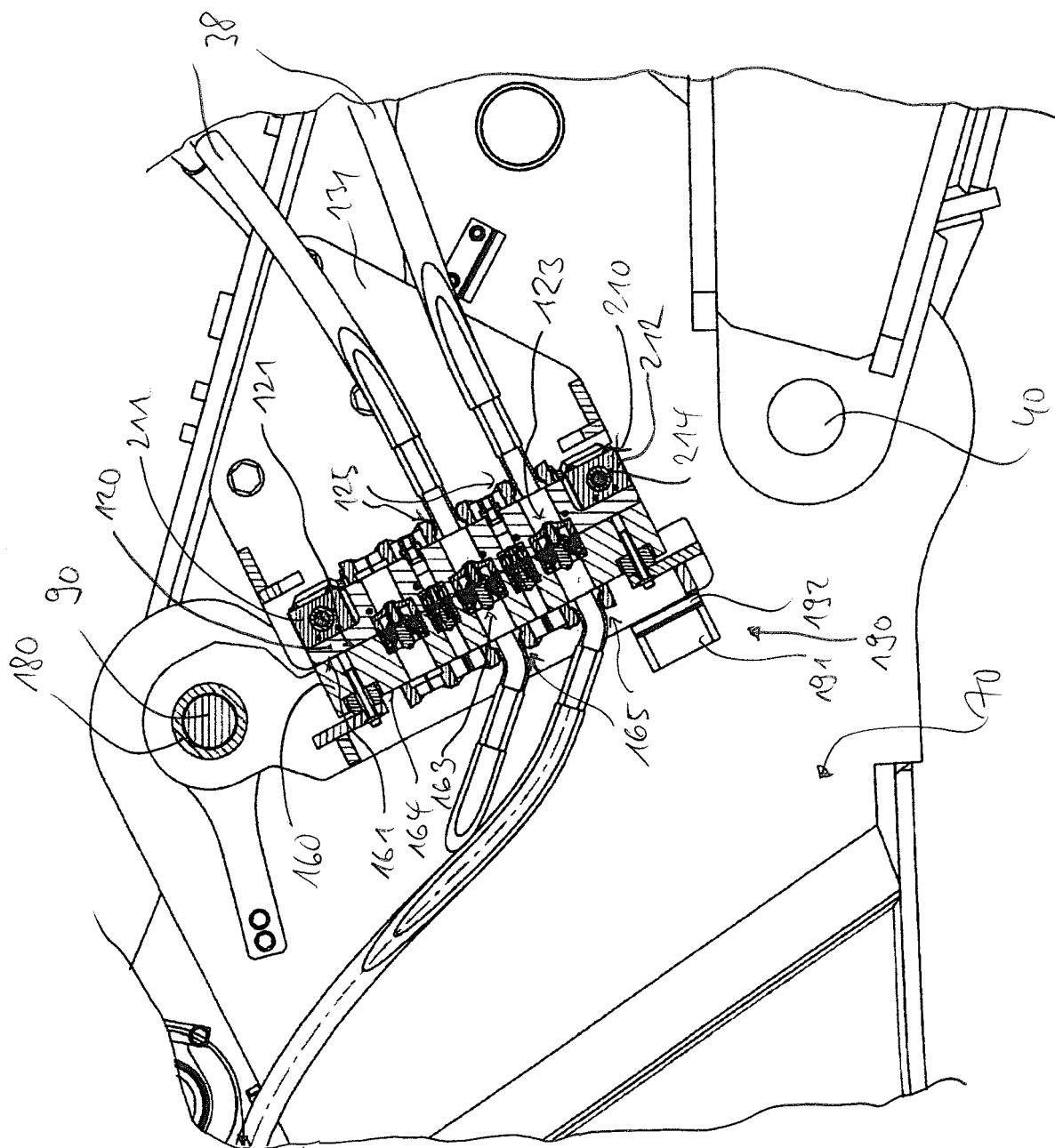
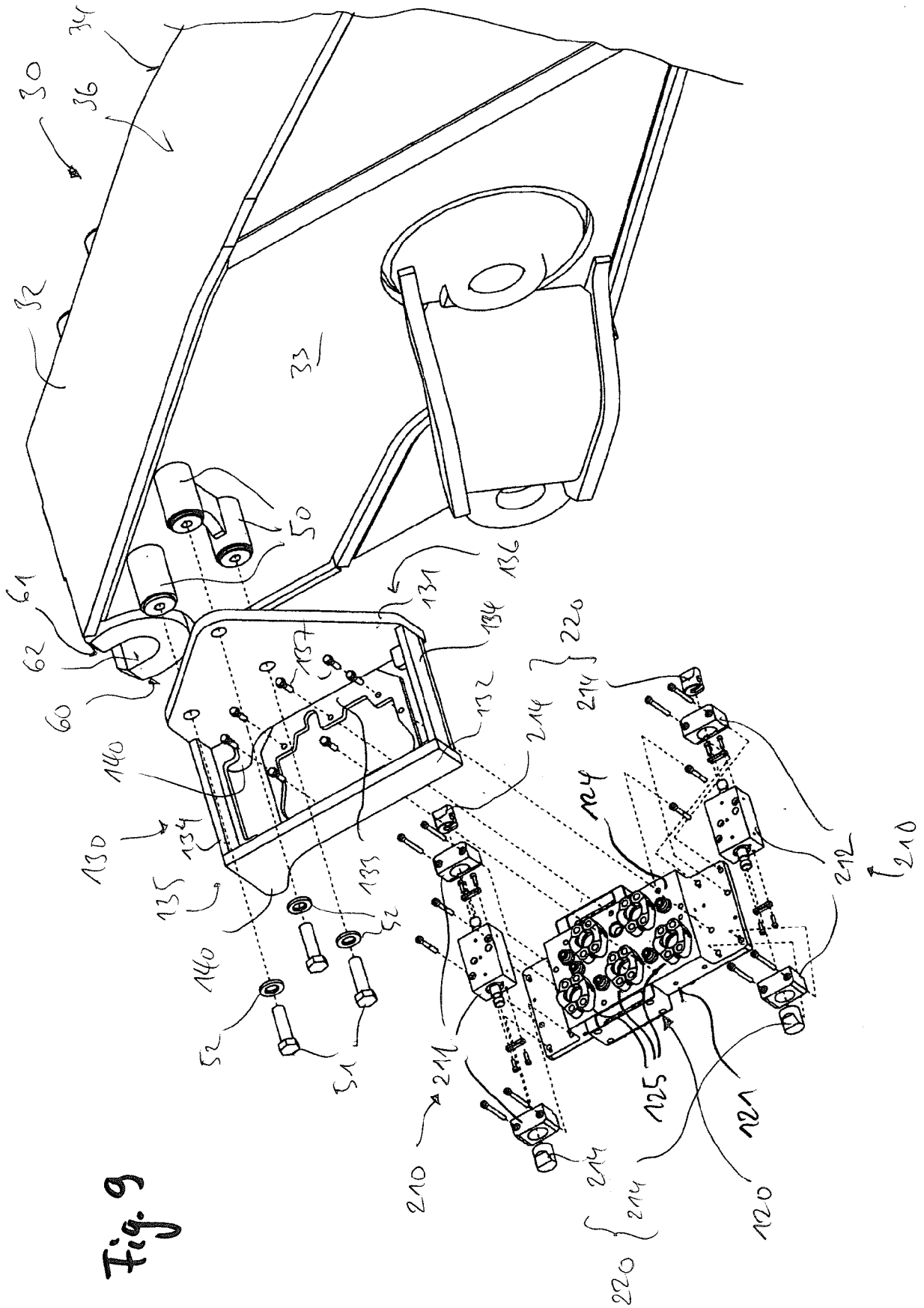


Fig. 8



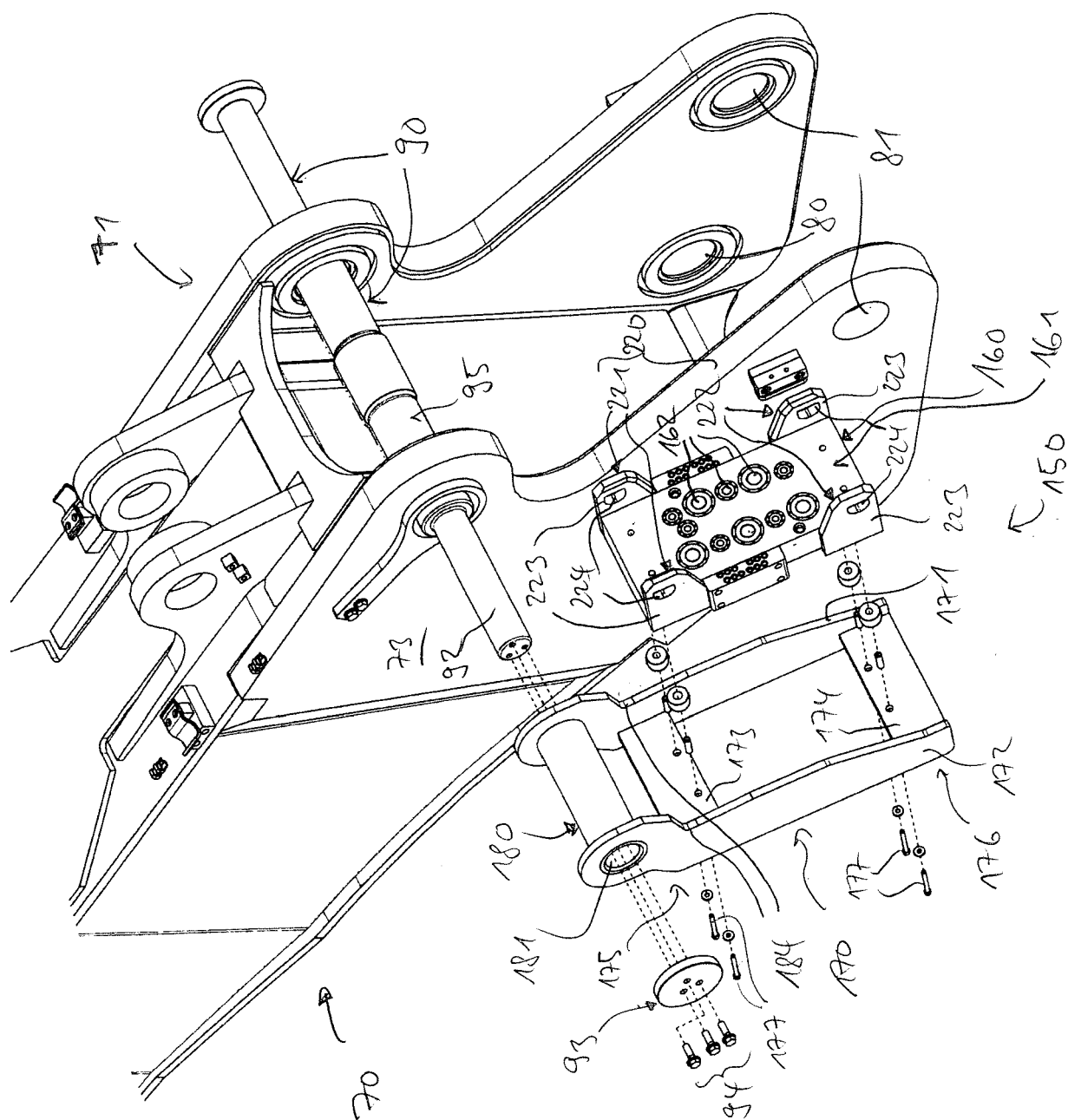


Fig. 10

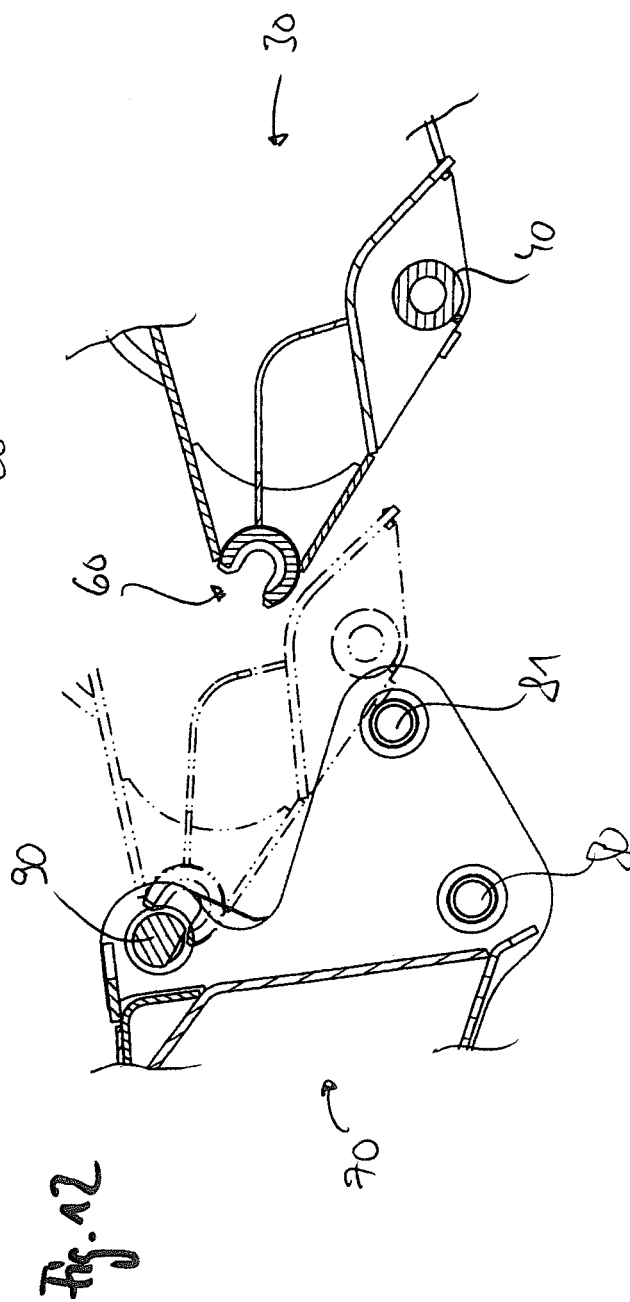
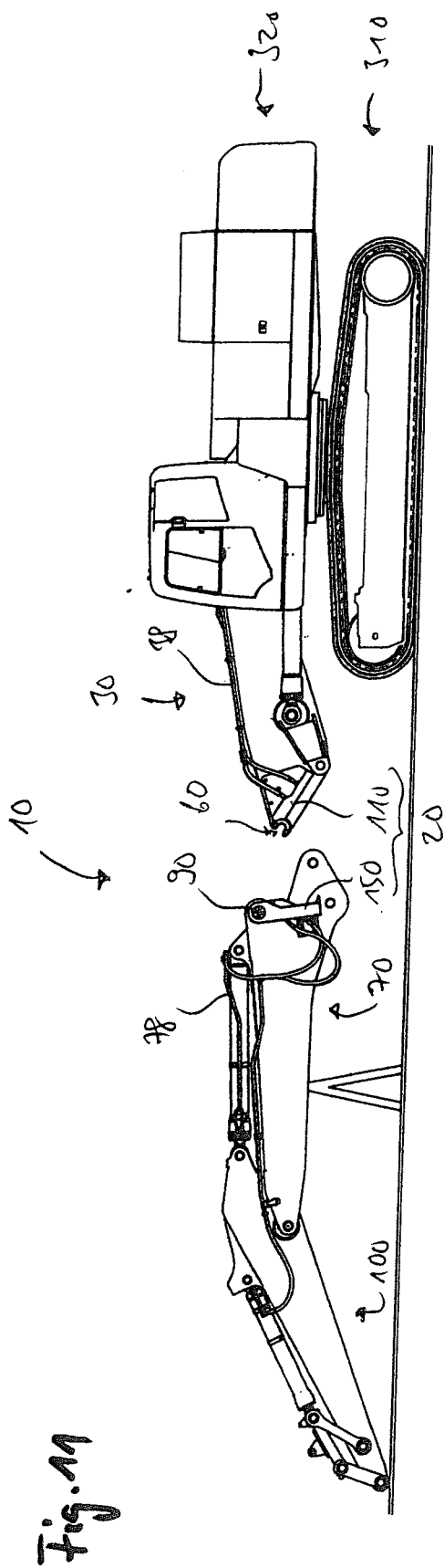


Fig. 13

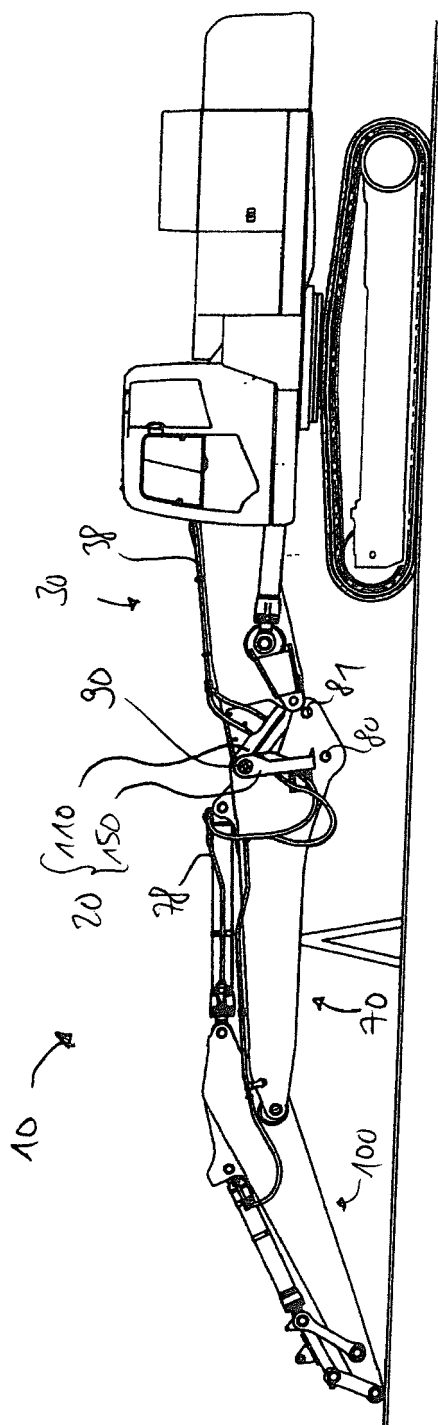
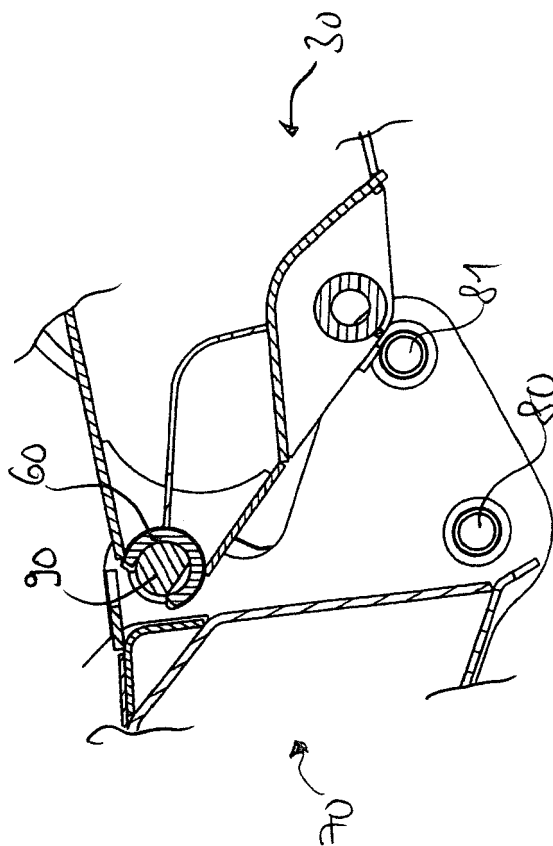


Fig. 14



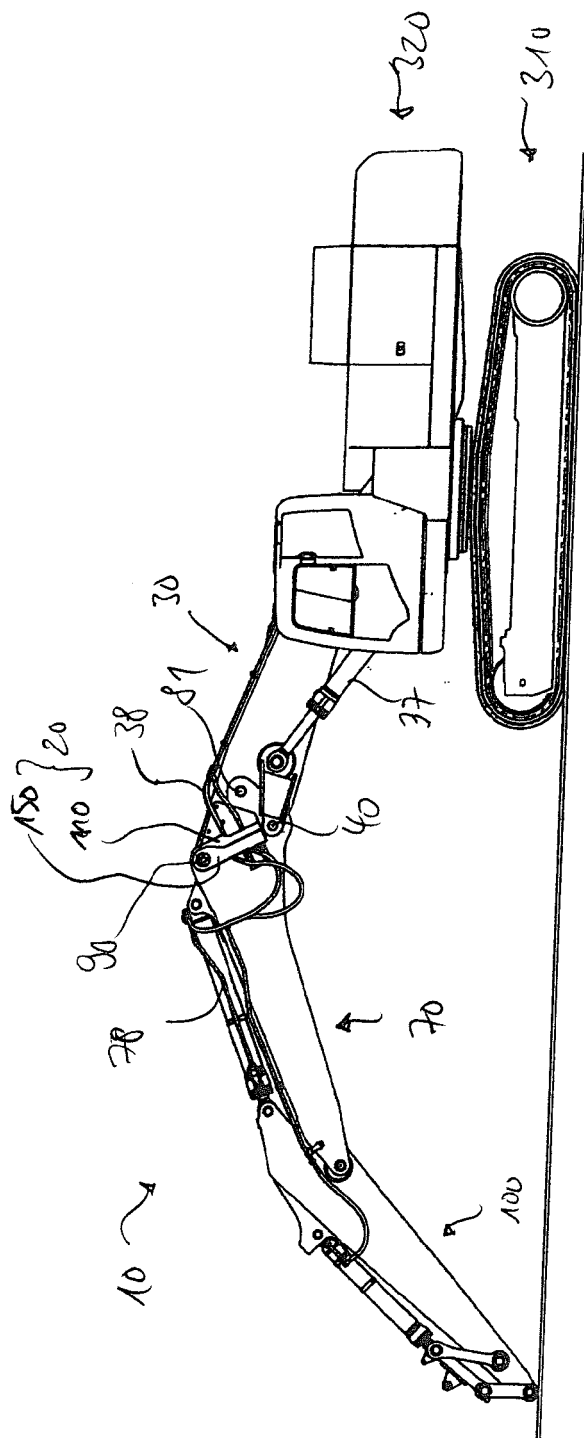


Fig. 15

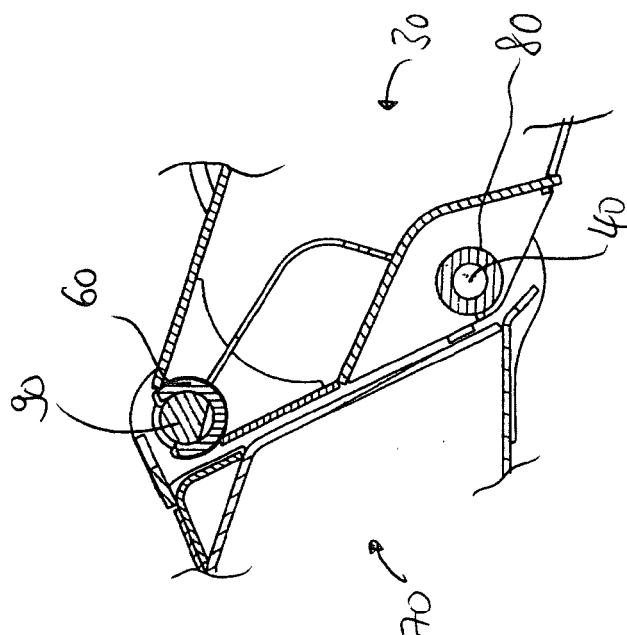


Fig. 16

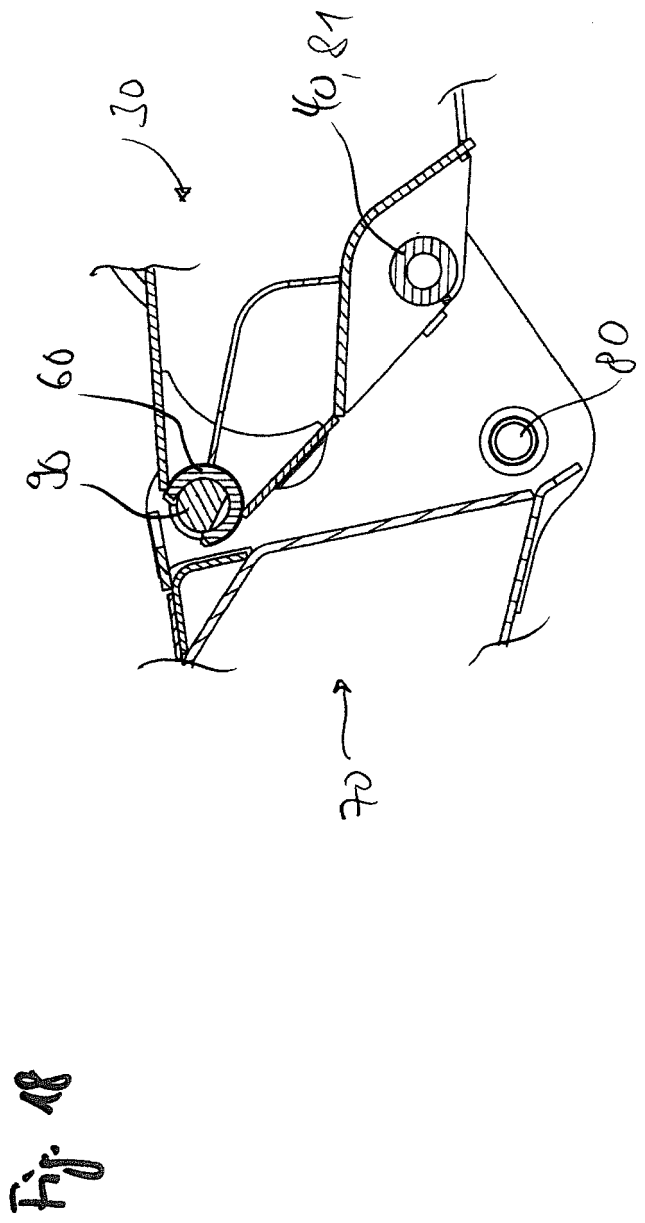
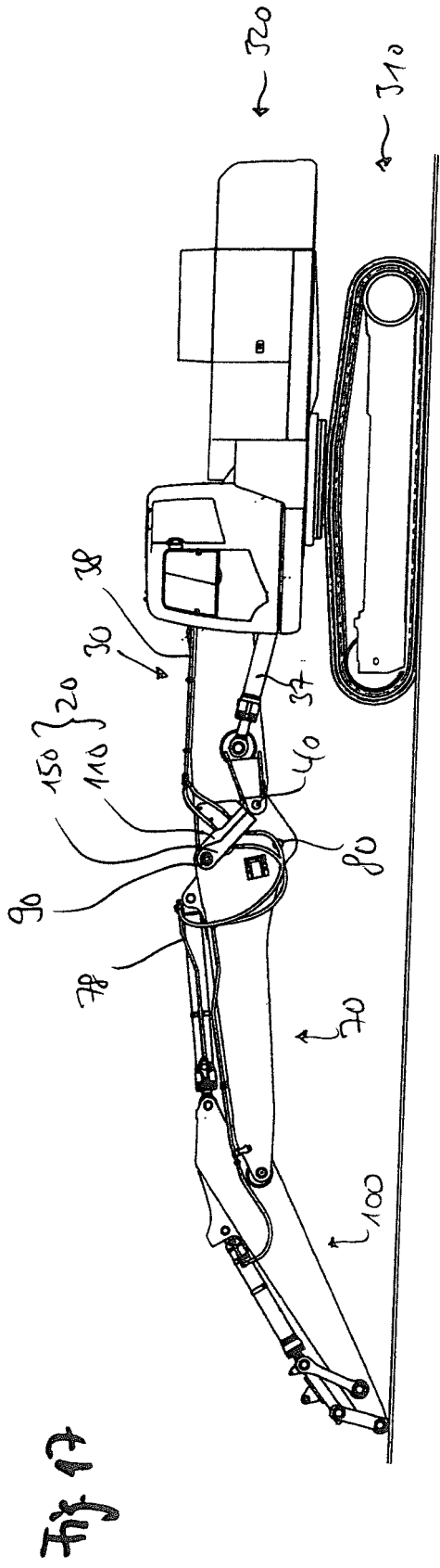


Fig. 19

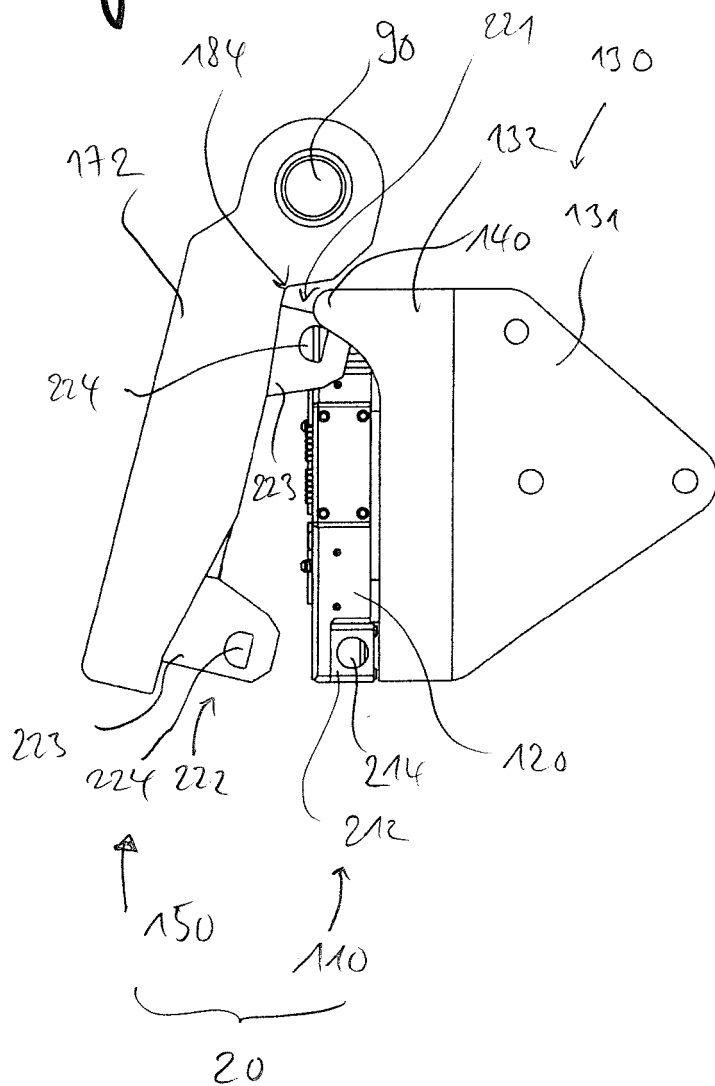


Fig. 20

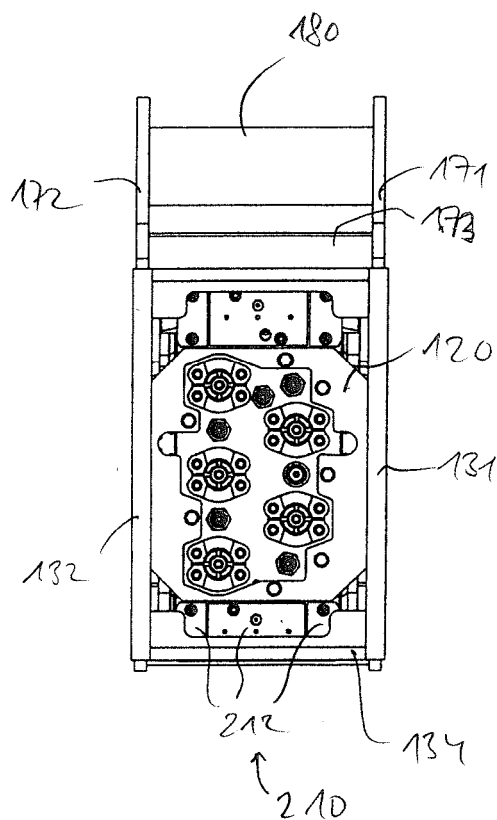


Fig. 2.1

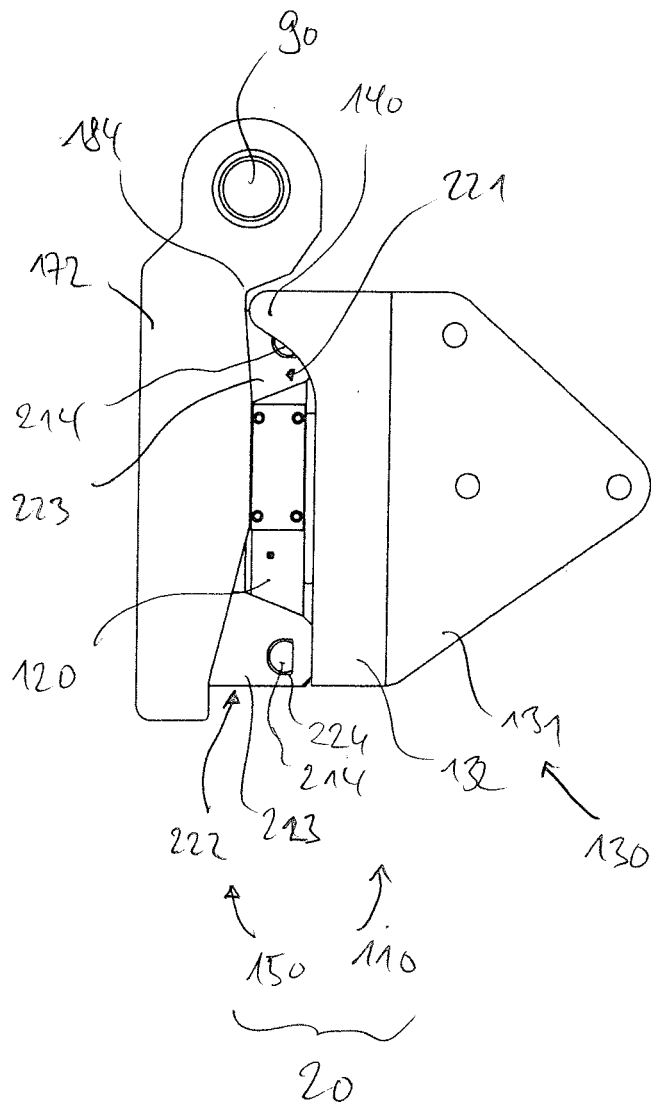


Fig. 22

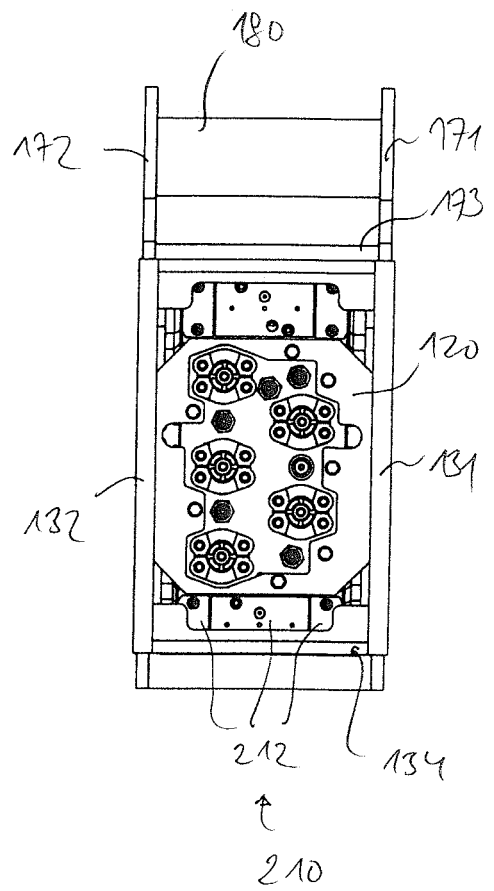


Fig. 23

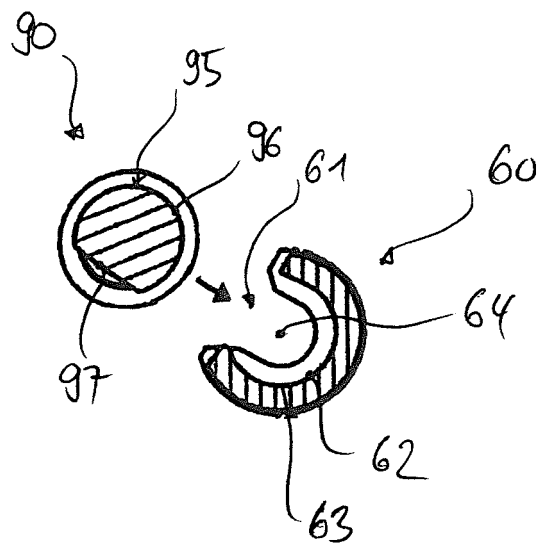


Fig. 24

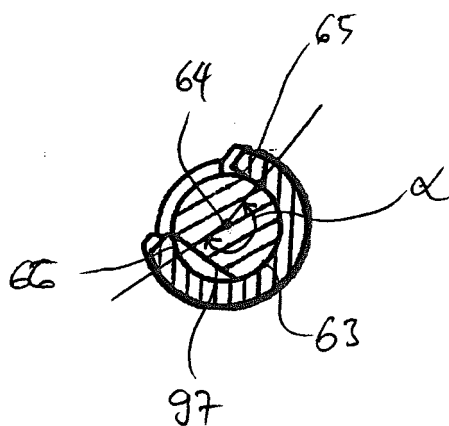


Fig. 25

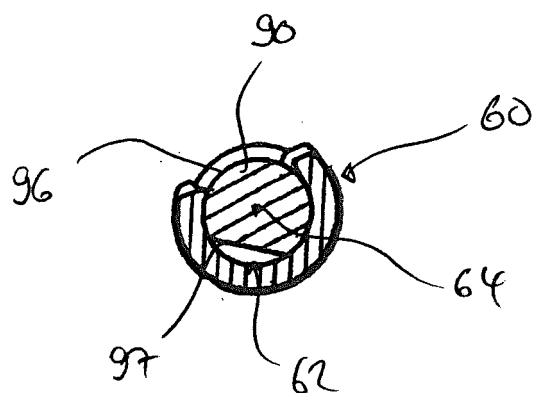


Fig. 26

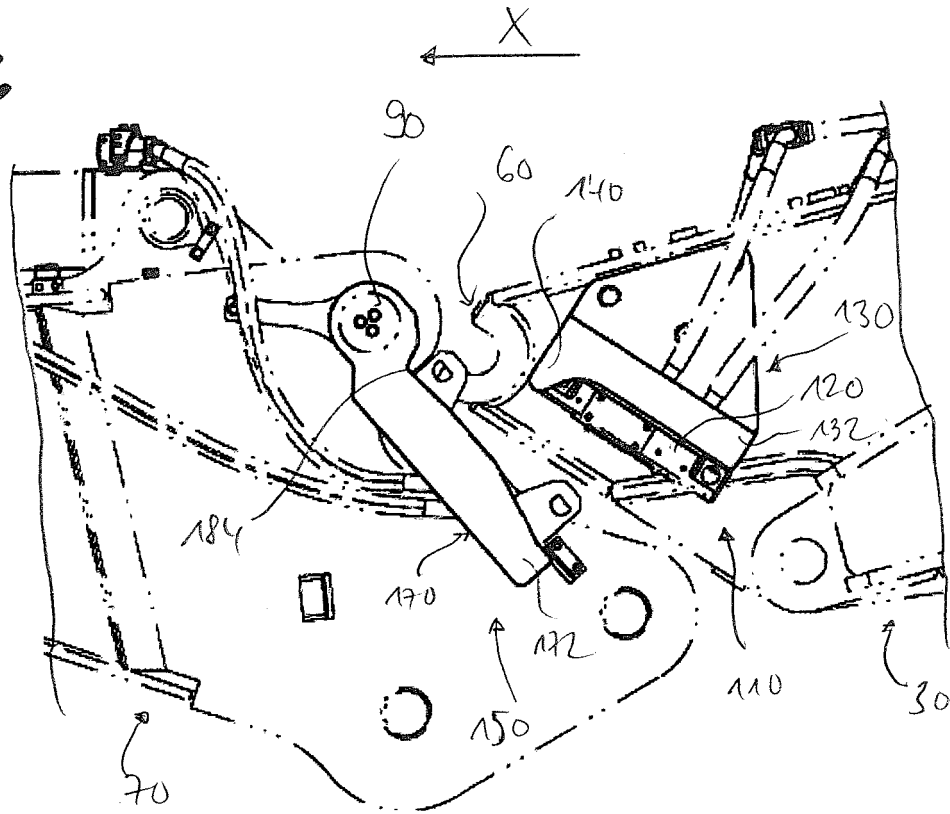


Fig. 27

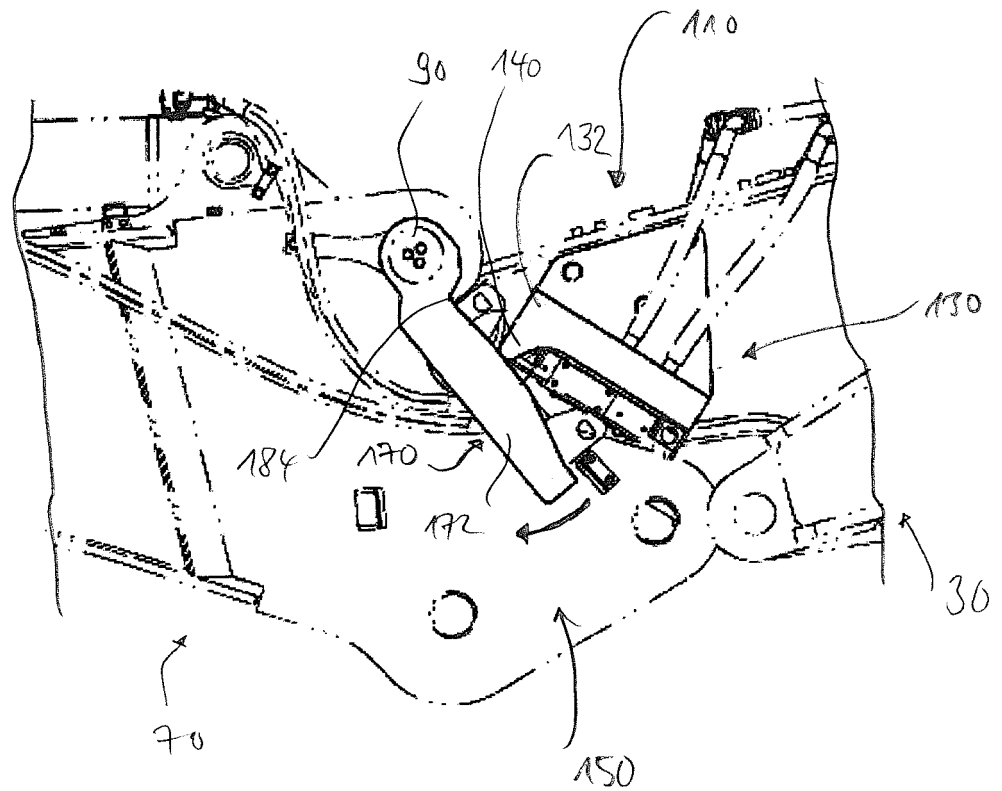


Fig. 28

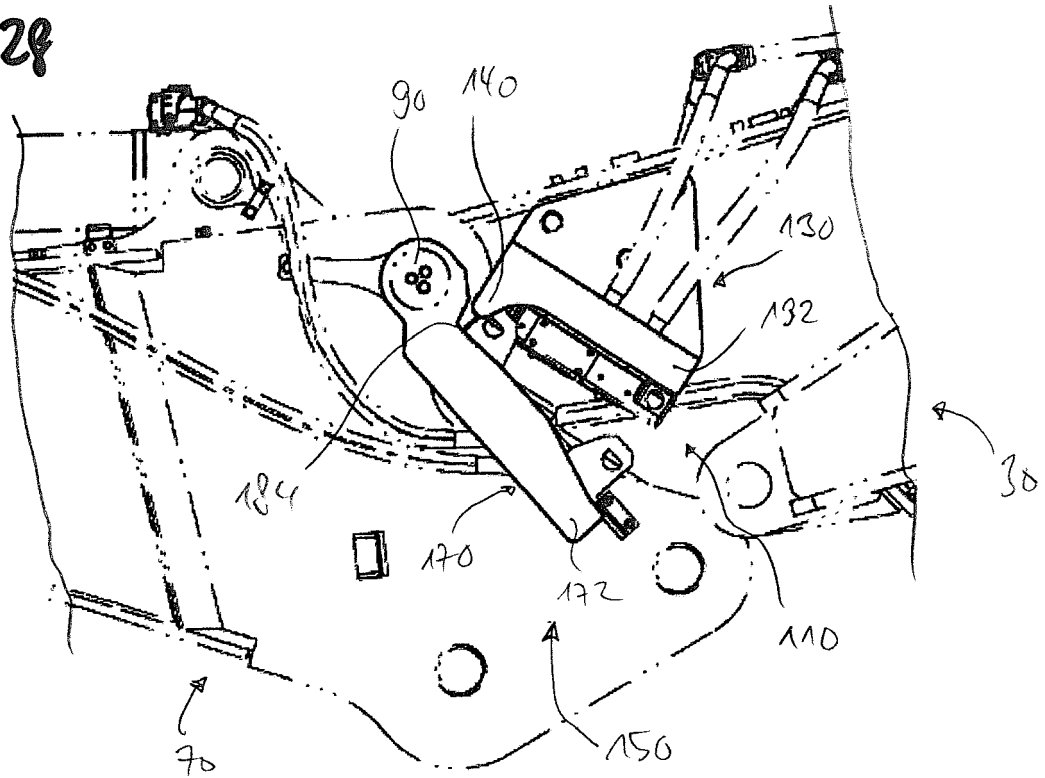
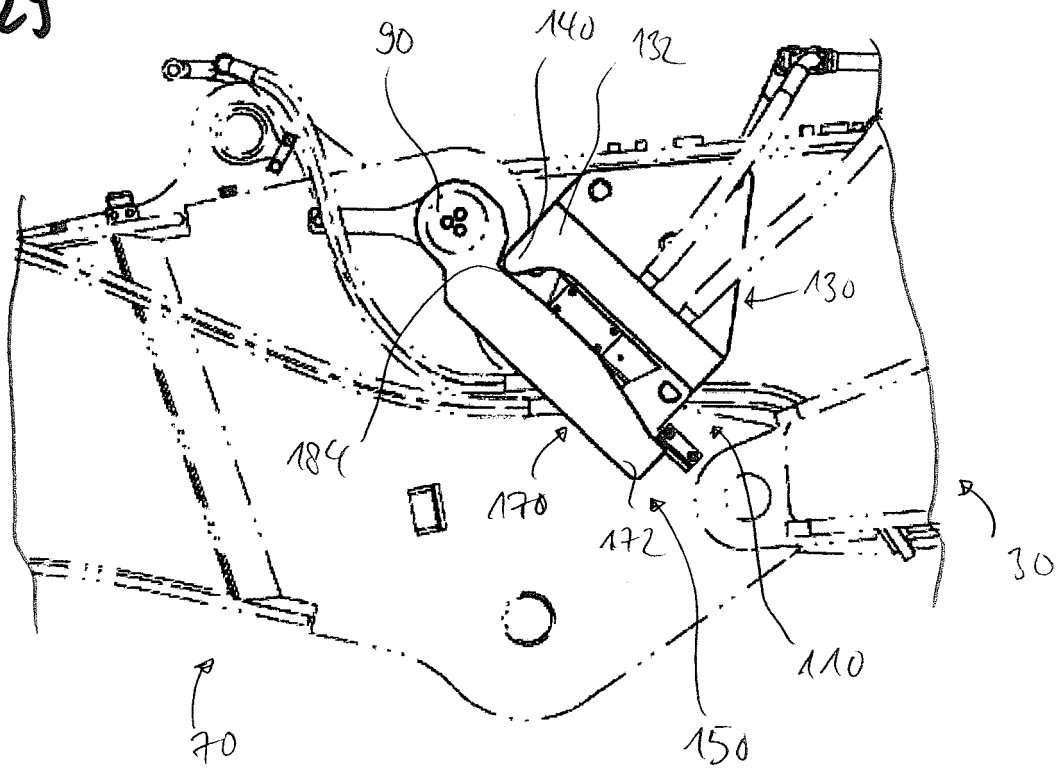


Fig. 29





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Place of search Munich		Date of completion of the search 18 January 2018	Examiner Kühn, Thomas
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