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(54) Cabin arrangement

(57) The invention relates to an arrangement for adapting a steering cab (9) movably, in relation to a working machine, at the end of a boom arm (10). Said boom arm (10) is made up of several successive parallelogram shaped trapezoidal knuckle boom portions (16, 25) between which there is, respectively, an interconnecting piece (22) comprising at least three spaced boom link joints. A power means acts within each of said trapezoidal knuckle boom portions (16, 25) for changing the geometry of the respective trapezoidal knuckle boom portion (16, 25) with respect to its link joints.

The invention also relates to a method for extending the range of the path of a steering cab (9), wherein the altitude of the cab can be adjusted, said steering cab (9) being arranged innsuch a manner at an outer end (11) of a trapezoidal knuckle boom (16) attached to a working machine that the shape of said trapezoidal knuckle boom is adjustable by means of a power means (32). At least one further parallelogram shaped trapezoidal knuckle boom portion (25) is attached between the inner end of said trapezoidal knuckle boom and said working machine by means of a separate piece (22), said further parallelogram shaped trapezoidal knuckle boom portion being separately movable by means of a second power means (33).

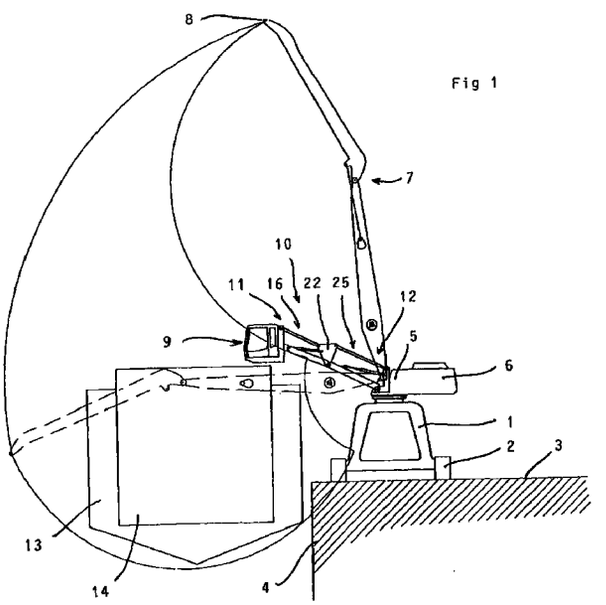

Fig 1

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Description

[0001] The invention relates to an arrangement for adapting a working machine steering cab in a movable manner, in relation said working machine, at the end of a boom arm, said working machine and, correspondingly, said steering cab having, respectively, two link joints spaced apart from each other, said boom arm extending from at least one of said link joints, the direction of said boom arm being adjustable by means of a power means. The invention also relates to a method for extending the range of the path of a working machine steering cab, wherein the altitude of the cab can be adjusted, said cab being arranged in such a manner at one end of a trapezoidal knuckle boom attached to said working machine that the shape of the trapezoidal knuckle boom can be varied by means of a power means.

[0002] In conventional working machines such as cranes, excavators or the like the cab is usually arranged at the machine in such a manner that the driver, while staying in the cab, is able to watch the function of the machine, If the machine comprises a body which can be turned in relation to the earth the steering cab is usually arranged to said body in such a manner that the cab will turn along with the body. For the driver there is sometimes even arranged a separate steering seat which is located nearer the place of work or higher up so that the driver will have a better sight over the place of work.

[0003] In some newer working machines the cab is arranged movably so that the complete cab together with its control equipment can be elevated or driven out from the machine body and closer to the place of work. Thus, EP-publication No. 0 102 123 discloses a harbor crane where the cab can be driven diagonally outwards-upwards along the crane boom. Finnish patent No. 71538, on the other hand, discloses a crane cab arrangement where the cab is arranged at the end of a telescopic boom.

[0004] Digger and crane arrangements are also known wherein the machine's cab is arranged at the end of a trapezoidal boom in such a manner that the cab can be elevated upwards from the level of the machine body. A solution is also known wherein such a trapezoidal boom is arranged at the end of an arm which is turnable in relation to the body in such a manner that the attachment point for said arm can be moved slightly forwards by means of a somewhat complicated guiding arrangement.

[0005] Especially in ship loading functions it would be an advantage if the crane cab could be driven to such a position where the driver would have a direct and as good a view as possible over the whole deck of the ship's hold, as this would render the use of a guiding man or a camera control superfluous. With cab designs known until today this would, however, be technically extremely difficult to arrange and, in practice, usually impossible. The object of the present invention is to provide a simple solution to this problem and even so that the invention can be utilized also as a retrofitting for already existing cab arrangements. The arrangement according to the invention can be applied, besides for actual material handlings equipment such as harbor cranes, wood handling devices, excavators and the like, also for other such working machinery where a temporary and guidable disposition of the driver/cab at a greater distance from the working machine would be favorable.

[0006] The characteristics of the invention are evident from the appended claims. Thus, the arrangement according to the invention is characterized in that the boom arm for the cab is constituted of several successive trapezoidal knuckle boom portions having the shape of a parallelogram, between which boom portions there is, respectively, an interconnecting piece comprising at least three spaced boom link joints, a power means acting within each of said trapezoidal knuckle boom portions for changing the geometry of the corresponding boom portion i.e. to turn said booms with respect to their link joints, The arrangement comprises at least two such parallelogram shaped knuckle trapezes, but in certain embodiments their number can also be higher. The method according to the invention is characterized by attaching at least one further parallelogram shaped trapezoidal knuckle boom arrangement, utilizing an interconnecting piece, between the inner end of a trapezoidal knuckle boom and the working machine, said further boom arrangement being separately movable by means of a second power means.

[0007] Several important advantages will be achieved, in comparison to prior art, by arranging the cab of a working machine at the end of one or several parallelogram shaped trapezoidal knuckle boom portions. In general terms such a structure is stable and technically simple, while simultaneously offering possibilities for exact and individual steering of the separate knuckle boom portions so that the cab can be placed exactly at the specific location from which, in each respective situation, in view of the machine's function, the visibility is best. At the same time, however, the cab located at the end of even a long knuckle boom arrangement will all the time and without further adjusting measures be forced to remain in its horizontal disposition, which is important both technically and with respect to working safety. Due to an especially favorable embodiment of the invention the cab can be moved both a long way forwards from the body of the working machine and also even downwards under the basic level of the body, which especially in connection with ships gives the best possible visibility. The arrangement also makes it possible for the driver to enter the cab directly from the ground level.

[0008] Generally, the cab arrangement according to the invention is attached, in a manner according to prior art, to the turnable body of the machine, thus moving

along with the movement of the machine's actual boom, i.e. the boom of the crane or excavator. In the heaviest working machines the total weight of the cab is low in relation to the actual work load, so there will rise no essential balancing problems even in the case where the cab is driven rather far out from the machine body. In another embodiment a separate counter weight is arranged at the machine body, said counter weight suitably moving in an opposite direction in relation to the cab, by means of a boom arrangement according to the invention, thus maintaining the balance.

[0009] The invention will now be described in more detail with reference to the appended drawings which describe some favorable embodiments of the invention, in which drawings

Figure 1 as an explanatory sketch discloses the general layout of an arrangement according to one embodiment of the invention, the drawing showing a material handling machine and its hoist boom,

Figure 2 discloses the body structure of a crane, the cab being in its basic position, where the actual hoist boom has been omitted for clarity reasons,

Figure 3 as a separate figure discloses the cab and boom arrangement of Figure 2 in a hoisted position,

Figure 4 as a separate figure discloses the cab and boom arrangement of Figure 2 in a position where two booms have been driven into successive horizontal positions, and

Figure 5 discloses the cab and boom arrangement of Figure 2 where the cab has been lowered down under the level of the machine body.

[0010] According to Figure 1 a working machine like a crane, an excavator or the like comprises a lower body 1 usually having transportation means 2 for moving the machine e.g. along the edge 4 of a quay 3. Usually, an upper body 5 is attached to the machine's lower body 1 favorably so that said upper body 5 can turn around a vertical axis in relation to said lower body 1, said upper body usually comprising the working machine's driving motor (not shown) and a counterbalance weight 6 for balancing a boom, indicated by reference 7, and a load at the end thereof (not shown). Said boom 7, which in the case disclosed in the figure has multiple parts, is favorably arranged to said upper body 5 in such a manner that it turns along with said upper body 5 and can be tilted in relation thereto so that its end 8 extends in the manner indicated in Figure 1. A loading means like a clamshell bucket, a lifting hook, an excavator's scoop or the like (not shown) is arranged at the end 8 of said boom 7 in a manner known per se.

[0011] According to the invention the working machine's steering cab 9 is arranged at the outer end 11 of a multi-arm trapezoidal knuckle boom arrangement 10 having several parts and being composed of parallelograms, so that the inner end 12 of said boom arrangement 10 is attached to the body of the working machine, in this case to its turnable upper body 5. The steering cab arrangement with its boom arrangement 10 is suitably arranged in a parallel manner at the side of the actual working boom 7 so that the cab 9 and said boom 7 simultaneously will turn along with said upper body 5. The cab 9 is arranged in such a position that it cannot be hit by a load at the end of the boom. According to one embodiment of the invention separate guiding means are arranged which, if necessary, e.g., when a load is suspended in hoisting wires at the end 8 of the boom 7, will prevent the cab 9 from being driven into a dangerous vicinity of the vertical projection of the upper end 8 of the boom 7 and/or, if necessary, drive the cab 9 away from such a position in accordance with the movements of said upper end 8. According to another embodiment the knuckle boom arrangement 10 for the cab 9 and/or said boom 7 is arranged, horizontally, in a slightly skew manner in relation to the upper body 5 of the working machine, whereby the horizontal distance between the cab 9 and the end 8 of the boom 7 will increase when the reach of the cab's 9 boom arrangement 10 increases.

[0012] From Figure 1 it will be evident that the cab 9, provided with a boom arrangement 10 in accordance with the invention, can be driven a relatively long way out over the edge 4 of the quay 3 so that the cab 9 actually will be located above the hatch to the hold 14 of a ship 13 alongside the quay 3, from which position there is a direct visual contact to the bottom of the hold 14, where the actual loading takes place. Thus, the crane operator is well able to observe the functions and precisely guide the end 8 of the boom 7 and the loading means attached thereto, in accordance with the progress of the work. In a corresponding manner the cab arrangement according to the invention renders it possible, when fitted to a heavy excavator, to extend the cab 9, during the work at e.g., a pit at a building site, beyond a provisional piling wall, where otherwise the digging is difficult to control.

[0013] Figure 2 discloses a situation where the cab 9, arranged at the end of a boom arrangement 10, is driven to an idle or basic position where the cab 9 thus is as close to the working machine's body 1, 5 as possible. Usually, this is the position where the machine operator enters the cab and leaves it, since this position can automatically be exactly determined in relation to the body. In other positions the cab is not necessarily located at a suitable distance from the body for enabling passage, and according to one embodiment of the invention a locking of the cab's 9 passage door 15 is arranged so that the door 15 cannot be opened, except in a separately defined emergency situation, when the cab 9 is located in other positions than in said basic position. If the position of the working machine and its

cab, e.g., at harbor work can be otherwise exactly defined in relation to the ground it may, on the other hand, be suitable that the passage takes place when the cab 9 is located, e.g., in a lowered position near the level of the quay 3 as shown in Figure 5, and suitably turned away from the edge 4 of the quay 3, which position also can be easily reached automatically.

[0014] Figure 3 discloses a position where the outermost boom portion 16 of said boom arrangement 10 is directed for hoisting the cab 9 to a higher level, According to the invention said boom portion 16 comprises a generally parallelogram shaped trapezoidal knuckle boom comprising a lower boom 17 and an upper boom 18. Suitably, the outer ends 11 of said booms 17, 18 are attached, via corresponding links 19, 20, to an essentially L-shaped body 21 which carries the cab 9.

[0015] Favorably, the opposite end of the knuckle trapeze is made up of an intermediate interconnecting piece 22, to which said outer boom portion 16 is attached via links 24, 24', and through which the outermost boom portion 16 connects to the next, i.e. a preceding boom portion 25, which in the described embodiment at the same time constitutes the outermost boom portion which connects to the body 5 of the working machine. According to the invention said preceding boom portion 25 is made up, in a corresponding manner, of a generally parallelogram shaped trapezoidal knuckle boom with its lower and upper booms 26 and 27, respectively, The links at one end of said booms 26, 27 are connected to said interconnecting piece 22, suitably so that an inner link shaft 24 of the lower boom 17 of said outer boom portion 16 and an outer link shaft 24' of the lower boom 26 of the preceding boom portion 25 are coaxial, at least one of said lower booms 17, 26 suitably being made up of double booms so that the lower boom of one of said boom portions will be located between said double booms. The outer link 28 of the upper boom 27 of the preceding trapezoidal knuckle boom portion 25 is not concentric with the link 23 of the upper boom 18 of the outer boom portion 16 but is located at some distance therefrom at said interconnecting piece 22. Thus said boom portions 16 and 25 can easily be bent closely against each other so that a compact boom structure is achieved in the resting position, which is best seen in Figure 3.

[0016] Links 29, 30 at the opposite end of said preceding boom 25 are interconnected via another interconnecting piece (not shown) to a boom portion preceding it (not shown) or, in the disclosed case, directly to a link supporting pedestal 31 arranged at the body 5 of the working machine, which pedestal is discussed in more detail below.

[0017] Further, from Figure 3 it is evident that power means 32 and 33, respectively, are connected to each parallelogram shaped trapezoidal knuckle boom portion 16, 25. Said power means suitably comprise pneumatic or hydraulic working cylinders, spindle motors or the like, by means of which the geometry of the respective trapezoidal knuckle boom portion 16, 25 can be forced to change so that the position of the outer link joints 19, 20 and 24, 28, respectively, is changed in the form of a parallel displacement in relation to the inner link joints 23, 24'. Thus, using said power means 32, 33 one can achieve, separately or in group and very exactly, an impact upon the general orientation of said knuckle boom portions 16, 25, while the general inclination of said outer links 19, 20 and thus also the cab 9 automatically remains unchanged.

[0018] Figure 4 gives a better view of the general geometry of the cab 9, said power means 32, 33 and the boom portions 16, 25, said interconnecting piece 22 and said link supporting pedestal 31 connecting to the body 5 of the working machine according to an especially favorable embodiment of the invention. In this embodiment the general arrangement of the different links is slightly inclined, In the embodiment disclosed each end of said boom portions 16, 25 comprises two links, one of which is located higher up and the other one lower down. Due to the inclined arrangement the upper link 19, 23, 28, 29, respectively, is slightly displaced, in the horizontal direction, in relation to the lower link 20, 24, 24', 30, respectively, Thus an interconnecting line A-A running through each lower and, correspondingly, upper link joint at each of said knuckle boom portions 16, 25 slightly deviates from both the vertical and the horizontal directions. With respect to the vertical direction P-P this deviation is favorably 10 to 60°, suitably especially about 15 to 30°.

[0019] The inclination of said link joints, as disclosed above, gives, in combination with the diagonal position of said power means 32, 33 as seen in the Figure and more closely discussed below, especially good turning conditions for said boom portions 16, 25, taking into consideration both the optimal position of the cab 9, with respect to its function, and the torques it causes at the base of each respective boom portion 16, 25. The inclination makes it possible to position the inner boom portion (indicated by the reference numeral 25 in the case disclosed in Figures 3 and 4) on one band essentially vertically; as disclosed in Figures 2 and 3 and, on the other hand, at the same time in a sufficiently sturdy manner also essentially horizontally, as disclosed in Figure 4, in which case the torque which the cab causes at the base of the boom is highest. Thus, an essential feature of the invention can be achieved, namely a stepless mobility of the cab 9 both in the vertical and in the horizontal directions within the whole range of reach which practically can be considered as appropriate. In this manner the arrangement according to the invention essentially differs from the simple trapezoidal boom arrangements known in prior art, wherein corresponding links have been arranged essentially either in a vertical or in a horizontal plane, which arrangements at the extreme ranges of movement technically restrict the stable movement of the cab. With the trapezoidal knuckle booms 16, 25 and their link arrangement, in accordance

with the invention, an especially good stability and establishment of the cab's position in practical extensional situations can be achieved, while at the same time preventing an inclination of the cab even in a possible breakdown situation at the power means.

[0020] Favorably, an interconnecting piece 22 comprising at least three link joints 23, 24, 28 is used as said interconnecting piece between said trapezoidal knuckle boom portions 16, 25. At least for the parallelogram shaped trapezoidal boom arrangement 25 located nearest to the working machine said link joints 24' and 28 at said interconnecting piece 22 are suitably located so that an interconnecting line A-A running from the lower link 24' via the upper link 28 is inclined, in relation to the vertical direction P-P, away from the cab 9 at an angle α which, accordingly, will be in the order of 10 to 60°, most favorably about 15 to 30°.

[0021] Said interconnecting piece 22 comprising said link joints 23, 24, 24', 28 is suitably arranged so that attachment links 23, 24 and, respectively, 24', 28 for the first and second parallelogram shaped trapezoidal knuckle boom portions 16, 25, respectively, will be essentially each others mirror images, in relation to the vertical direction, the lower link joint 24, 24' suitably being common for both boom portions 16 and 25.

[0022] According to Figure 4 the power means 33 at the trapezoidal knuckle boom portions 25 located nearest to the working machine favorably acts between one parallelogram boom 26 of the trapeze and a separate link joint 34 arranged at the link supporting pedestal 31 connected to the body 5 of the working machine, The power means at each following trapezoidal knuckle boom (designated with references 16 and 32, respectively, in Figure 4) acts between another corresponding parallelogram boom and a separate link joint 35 arranged at the respective interconnecting piece 22 preceding the respective trapezoidal knuckle boom. In the embodiment disclosed in the Figures said separate link joints 34, 35 for said power means 32, 33 are located between the link joints 23, 24 and, respectively, 29, 30 for each respective boom portion 16, 25, favorably slightly above the center, but the location can also be another, e.g., in connection with a boom link joint or at opposite ends of the boom portions.

[0023] The Figures mainly disclose embodiments where the number of successive parallelogram shaped trapezoidal knuckle boom portions 16, 25 is two, but the scope of the invention also includes embodiments where the number of such portions is higher. This is possible especially due to the link joints arranged in a manner which is displaced in relation to the vertical line, i.e., inclined. A multi-boom arrangement may be appropriate especially in cases aiming at an especially long reach without increasing the structural height of the boom arrangement especially when it is in its initial position, or where the object is especially versatile guiding properties for the cab 9, e.g, for harbor functions. According to one embodiment of the invention the length of an existing boom structure can be increased, after appropriate reinforcement measures taken, also at a later stage, and one special embodiment is wholly based on a boom arrangement of modular dimensions.

[0024] The scope of the invention also includes embodiments where the above described arrangement comprising at least two successive parallelogram shaped trapezoidal knuckle boom portions is supplemented with cab displacing means know per se. Thus, a favorable embodiment includes the arrangement of the cab 9 at the outermost links 19, 20 of the outermost parallelogram shaped trapezoidal knuckle boom portion 16 via an essentially L-shaped body structure 21 comprising link joints, where telescopic means (not shown) favorably are arranged between said body structure 21 and the steering cab 9 for horizontal displacement of the cab along said body structure 21.

[0025] Above some favorable embodiments of the invention have been disclosed, but for the expert it is clear that the invention can be modified in many other ways within the scope of the appended claims.

Claims

1. An arrangement for adapting a steering cab (9) movably, in relation to a working machine, at the end of a boom arm (10, 17, 26), said working machine and, correspondingly, said steering cab (9) having two link joints (29, 30 and 19, 20, respectively) spaced apart from each other, said boom arm (17, 26) extending from at least one (20) of said link joints, the direction of said boom being adjustable by means of a power means (32, 33), **characterized** in that said boom arm (10, 17, 26) is made up of several successive parallelogram shaped trapezoidal knuckle boom portions (16, 25) between which there is, respectively, an interconnecting piece (22) comprising at least three boom link joints (23, 24, 24', 28) spaced apart from each other, wherein a power means (32, 33) acts within each of said trapezoidal knuckle boom portions (16, 25), for changing the geometry of the respective trapezoidal knuckle boom portion (16, 25) with respect to its link joints.

2. An arrangement as defined in claim 1, **characterized** in that the trapezoidal knuckle boom portion (25) which is closest to the working machine is connected to the working machine, favorably to its suitably turnable body (5), to link joints (29, 30) arranged essentially one above the other at an appropriately separate link support pedestal (31), wherein said link joints favorably are horizontally displaced with respect to each other so that the joint arrangement (29, 30) is slightly inclined (in an angle α) in relation to the vertical line (P-P).

3. An arrangement as defined in claim 2, **character-**

ized in that the superimposed pairs of link joints (19-20, 23-24, 28-24', 29-30) at the ends of each parallelogram shaped trapezoidal knuckle boom portion (16, 25) are arranged, among themselves, in a slightly inclined manner in relation to the vertical line (P-P), suitably so that a connecting line (A-A) running through each respective pair of link joints (19-20, 23-24, 28-24', 29-30) diverges (α) from the vertical direction about 10 to 60°, favorably about 15 to 30°.

4. An arrangement as defined in any one of claims 1 to 3, **characterized** in that said interconnecting piece (22), which comprises said link joints (23, 24, 24', 28), is arranged so that the links (23-24 and 28-24', respectively) for a first and a second parallelogram shaped trapezoidal knuckle boom portion (16, 25) will be the mirror images of each other, with respect to the vertical line, suitably so that a lower link joint (24, 24') is common for lower booms (17, 26) at each boom portion (16, 25), wherein at least one of said booms (17, 26) then suitably is designed as a double boom comprising two parallel booms, and the other one of said booms is arranged between said parallel booms.

5. An arrangement as defined in any one of claims 1 to 4, **characterized** in that the power means (33) at the parallelogram shaped trapezoidal knuckle boom portion (25) which is nearest to the working machine acts between one of the parallelogram booms (26 or 27) of the trapeze and a separate link joint (34) arranged at the body (5) of said working machine, suitably at said link support pedestal (31), and the power means (32) for each subsequent trapezoidal knuckle boom portion (16) acts between the other corresponding parallelogram boom (17, 18) and a separate link joint (35) arranged at the interconnecting piece (22) preceding each respective trapezoidal knuckle boom portion (16).

6. An arrangement as defined in claim 5, **characterized** in that the separate link joint (34, 35) for each respective power means (32, 33) is arranged, at said interconnecting piece (22) and/or at said link support pedestal (31) at said body (1, 5), between said link joints (23, 24 and 29, 30, respectively), favorably slightly above the center.

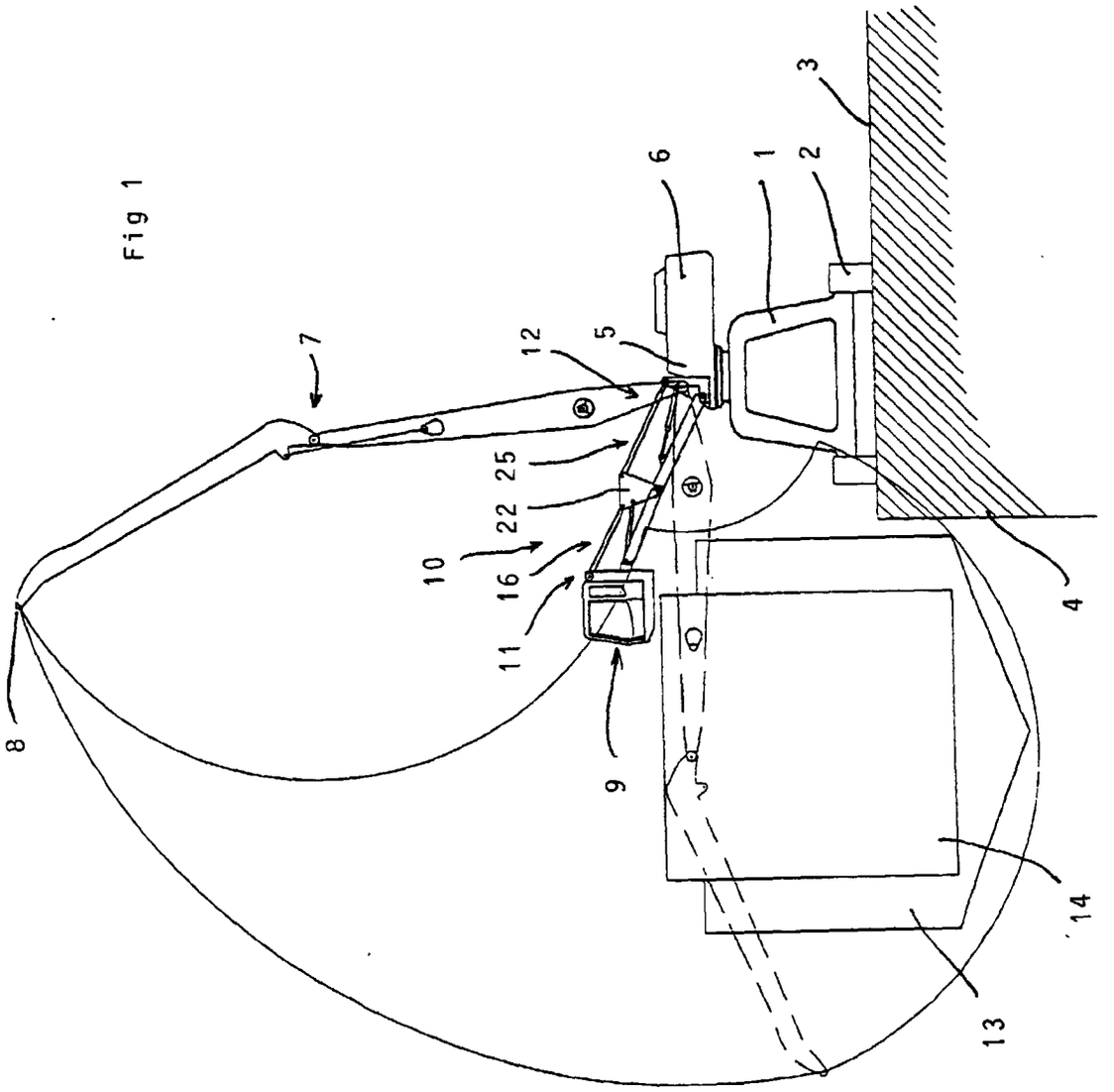
7. An arrangement as defined in any one of claims 1 to 6, **characterized** in that the number of successive parallelogram shaped trapezoidal knuckle boom portions (16, 25) is higher than two.

8. An arrangement as defined in any one of claims 1 to 7, **characterized** in that said steering cab (9) is connected to the outermost links (19-20) of the outermost parallelogram shaped trapezoidal knuckle boom portion (16) via an essentially L-shaped body structure (21) comprising link joints, favorably so that there between said body structure (21) and said steering cab (9) further are telescopic means for horizontal displacement of said steering cab (9) along said body structure (21).

9. A method for extending the range of the path of a steering cab (9), wherein the altitude of the cab can be adjusted, said steering cab (9) being arranged in such a manner at an outer end (11) of a trapezoidal knuckle boom (16) attached to said working machine that the shape of said trapezoidal knuckle boom can be varied by means of a power means (32), **characterized** by attaching at least one further parallelogram shaped trapezoidal knuckle boom portion (25) between the inner end of said trapezoidal knuckle boom and said working machine by means of a separate piece (22), said further parallelogram shaped trapezoidal knuckle boom portion (25) being separately movable by means of a second power means (33).

10. A method as defined in claim 9, **characterized** by using, as a separate connecting piece between said trapezoidal knuckle boom portions (16, 25), an interconnecting piece (22) having favorably at least three link joints (23, 24, 24', 28) which, at least for the parallelogram shaped trapezoidal knuckle boom portion (25) which is located nearest to the working machine, suitably is arranged so that an interconnecting line (A-A) running from a lower link (24, 24', 30) via an upper link (28, 29) is inclined (α), in relation to the vertical line, 10 to 60°, favorably about 15 to 30° away from said steering cab (9).

Fig 1



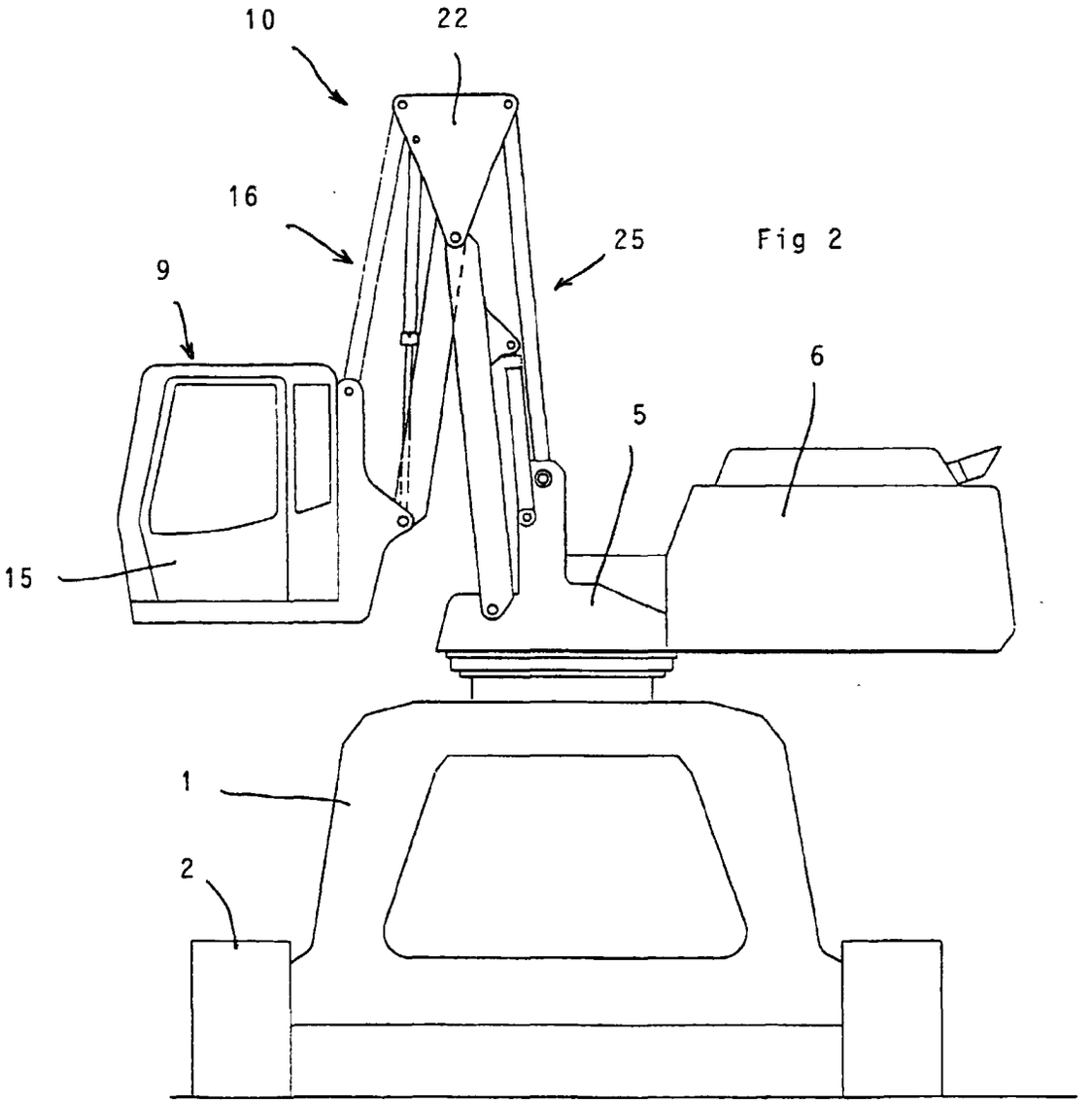


Fig 2

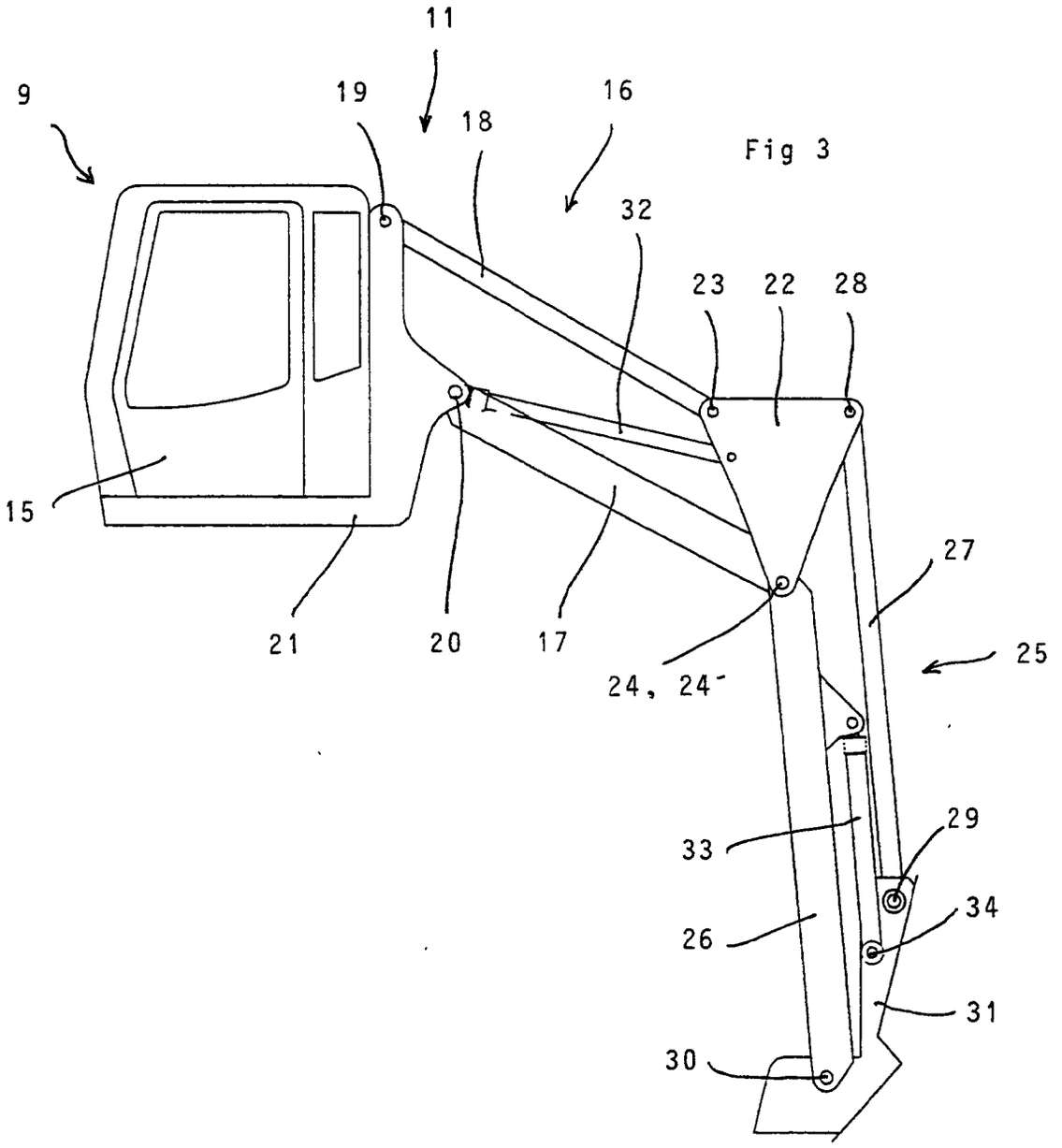


Fig 3

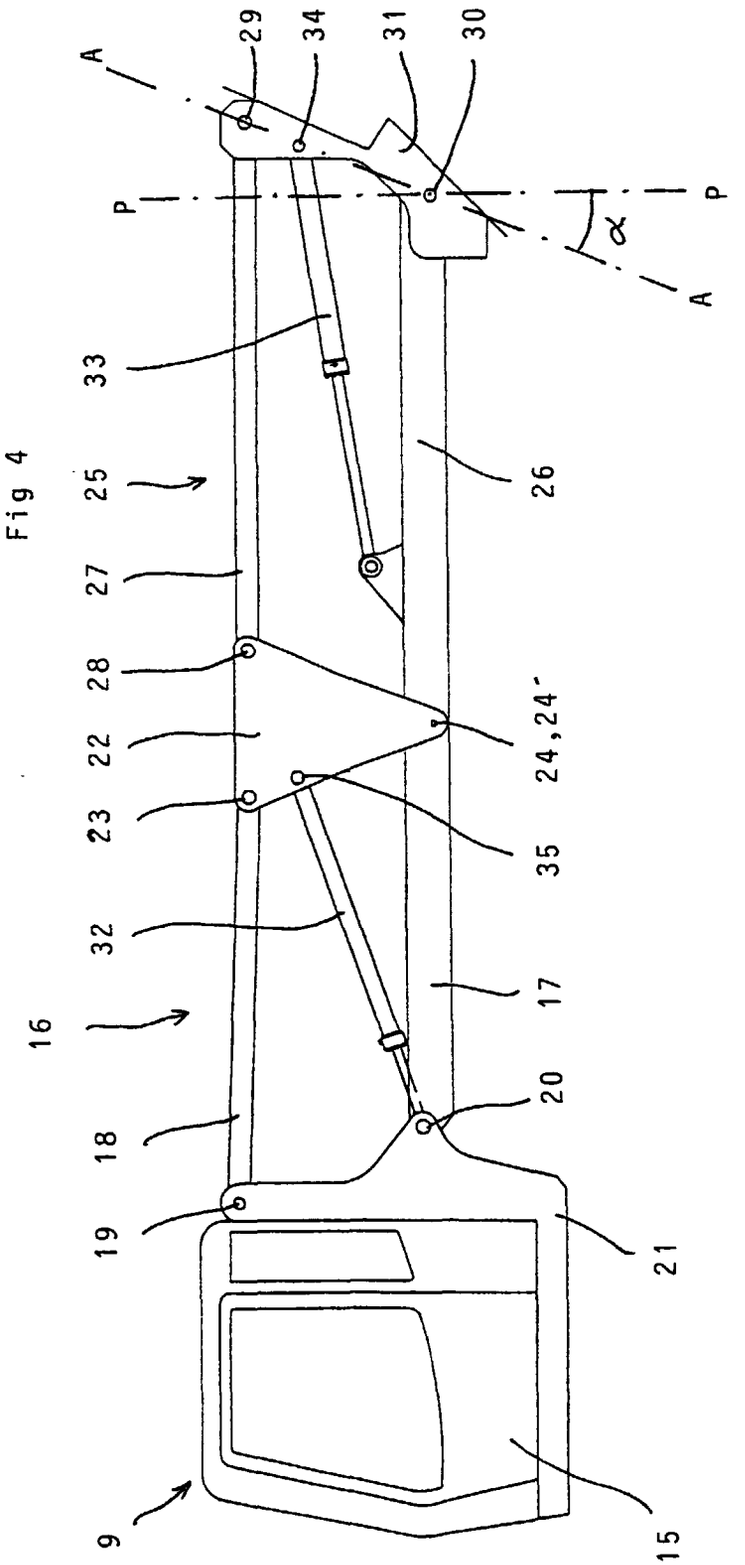

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Fig 4

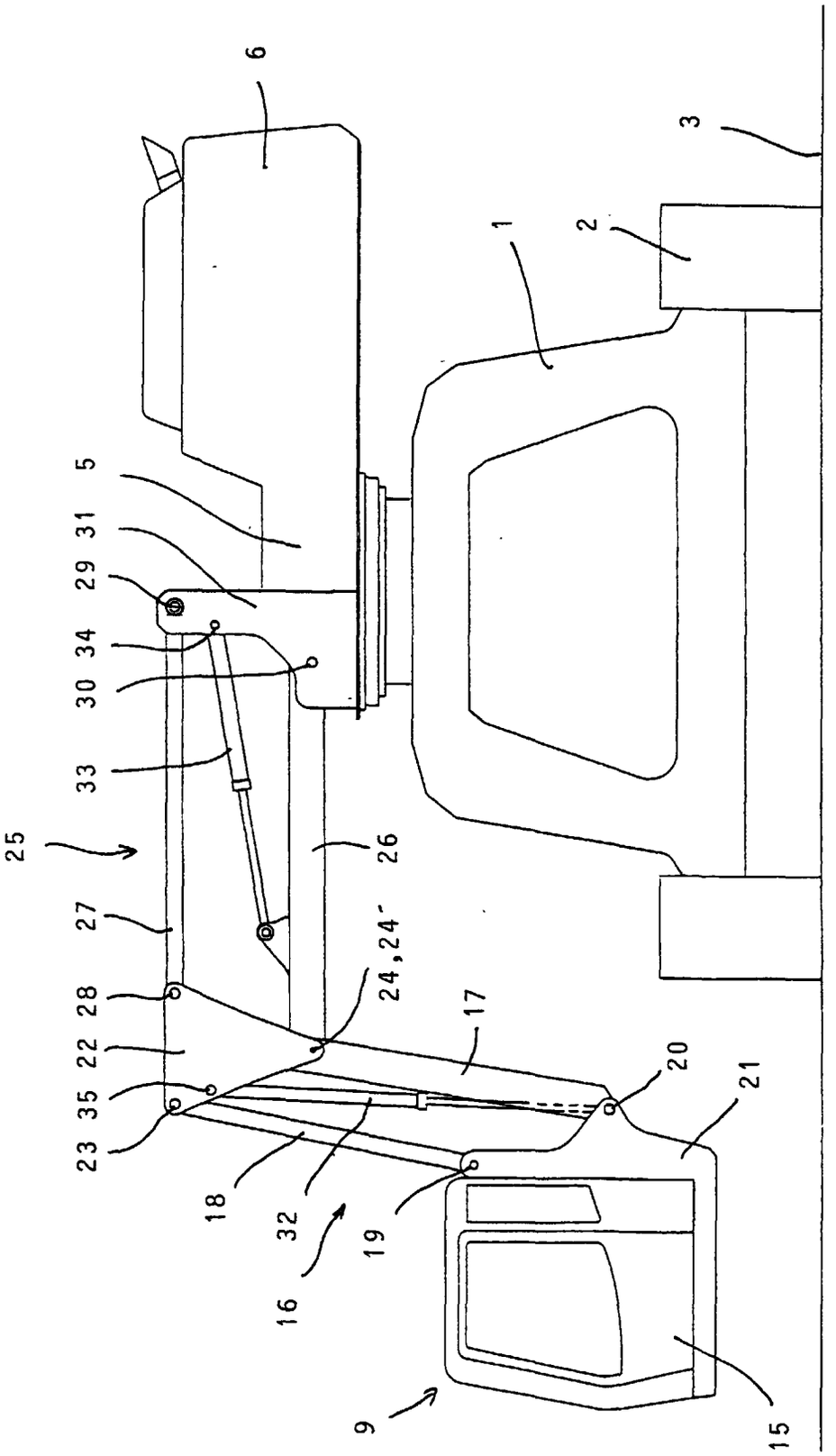
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Fig 5