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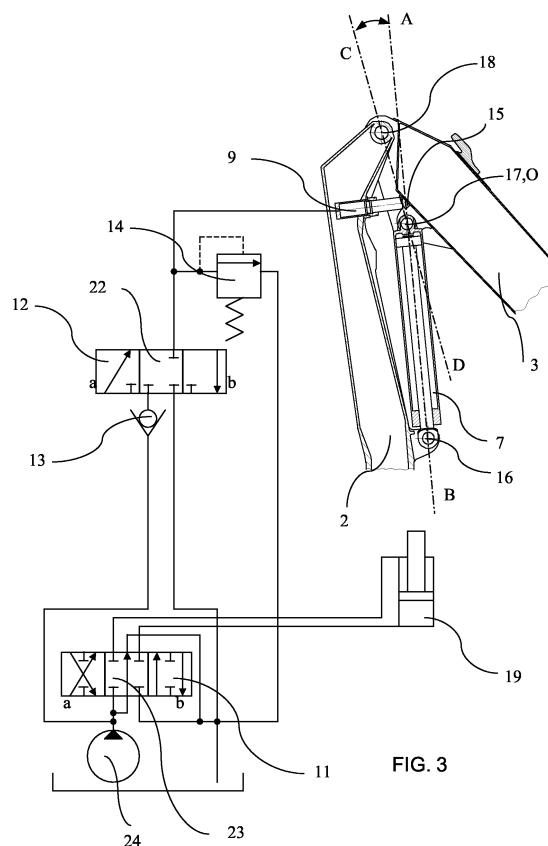
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(54) **Method of controlling crane boom arrangement and apparatus for implementation thereof**

(57) The invention relates to a method controlling a crane boom arrangement (2, 3, 4, 5, 6), comprising moving a lifting boom (3) functionally connected by a joint (18) to a post (2) mounted in a crane base (1) by at least one lifting cylinder (7). The lifting cylinder (7) is articulated with the post (2) by a first joint (16) and connected to the lifting boom (3) movable with respect to the post (3) by a second joint (17) and it is controlled by control means (23). The invention is characterized in that the lifting boom (3) is moved with respect to the post (2) by a moment generated by an auxiliary cylinder (9) controlled by separate control means (22) about a joint (18) connecting the post (2) and the lifting boom (3) in situations where the position between the post (2) and the lifting boom (3) is such that the moment of the lifting cylinder (7) alone is insufficient for moving the lifting boom (3).



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Description

BACKGROUND OF THE INVENTION

[0001] The invention relates to a method of controlling a crane boom arrangement according to the preamble of claim 1. The method comprises moving a lifting boom functionally connected by a joint to a post mounted in a crane base with respect to the post by at least one lifting cylinder, which is articulated with the post by a first joint and connected by a second joint to a lifting boom that can be moved with respect to the post, the operation of the lifting cylinder being controlled by control means. The invention further relates to an apparatus according to the preamble of claim 8 for controlling a crane boom arrangement. The apparatus comprises at least one lifting cylinder, which is articulated with a post mounted in a crane base by a first joint and connected by a second joint to a lifting boom, which can be moved with respect to the post and is functionally connected to the post by a joint, and control means for controlling at least the lifting cylinder.

[0002] Transport vehicles, for example log trucks and various lumbering machines, are nowadays equipped with loading cranes which have to be arranged for transportation in a transport position that takes up as little space as possible. In particular, cranes with Z-shaped boom structures are used for this purpose, in which case the boom arrangement of the loading crane is designed to be brought into the transport position by lowering the boom arrangement onto a fixed transport support provided in the crane. The purpose of the boom structure solutions of such cranes is to ensure that the outer dimensions of the loading crane arranged transversely to the longitudinal direction of the vehicle conform to the maximum dimensions of vehicles in their transport positions laid down in motor vehicle legislation in different countries. Here the transport position refers to a position where the loading crane is when it is not used for loading and the boom arrangement is on a transport support included in the crane structure. In addition to the maximum dimensions for the transport position, requirements are set for the geometry of the loading crane boom arrangement and joints by the geometry related to the actual work that enables the required lifting capacity in different working areas and by boom lengths and fulcrums required by the work objects, such as timber of different sizes.

[0003] It is problematic to implement all the design requirements related to the outer dimensions of a crane in the transport position and the geometry of the boom arrangement having good lifting capacity in various working areas because the boom geometry and the fulcrums have to be dimensioned so that in the transport position, the lifting cylinder enabling the movement between a post mounted in the crane base and the lifting boom functionally connected to it by a joint ends up in a disadvantageous position or in a blind spot, where the

lifting cylinder cannot alone generate the required moment caused by the weight of the boom arrangement for moving the lifting boom with respect to the post towards the working position.

[0004] In prior art solutions, the above-mentioned problem has been solved by a boom mechanism where the movement between the post and the lifting boom is combined with the movement of the lifting cylinder using a separate power joint, which prevents the lifting cylinder from ending up in a blind spot or in an otherwise disadvantageous position and thus enables the opening of the boom arrangement from the transport position only by means of the lifting cylinder. When a power joint is used, the boom structure becomes considerably more complicated due to the shafts and intermediate arms needed in the structure, and consequently the structure is more expensive to produce, service and maintain in working order. The structure is also considerably heavier, which decreases the effective load of the vehicle.

[0005] In practice, boom arrangements exist which utilize auxiliary cylinders to facilitate the opening of the arrangement from the transport position as follows: an auxiliary cylinder mounted in the post is connected hydraulically in parallel to the piston side of the lifting cylinder, in which case the piston of the auxiliary cylinder tries to reach the outer position and pushes the boom arrangement away from the transport position each time the lifting cylinder is controlled towards the direction where the boom arrangement is lifted, i.e. pressure medium is led to the piston side of the lifting cylinder. The auxiliary cylinder connected in parallel with the lifting cylinder functions advantageously in the cases where the lifting cylinder does not end up in a blind spot at all or where the blind spot is so small that the force opposing the opening of the boom arrangement of the lifting cylinder of the crane is overcome by the force of the auxiliary cylinder only. When the blind spot is large, the post, the lifting boom and other structures of the crane have to be made considerably more durable and heavier because the auxiliary cylinder and the lifting cylinder produce large opposite moments in the boom arrangement specifically when it is opened from the transport position into the working position. When this implementation is used, the boom geometry cannot be designed to be light and optimal with respect to the lifting capacity in different working areas.

[0006] The problem associated with the prior art arrangements described above is that the boom geometry cannot be designed to be light and optimal with respect to the lifting capacity in different working areas. Furthermore, the boom structure often becomes considerably more complicated, which makes it more expensive to produce, service and maintain in working order.

BRIEF DESCRIPTION OF THE INVENTION

[0007] The object of the invention is to provide a method of controlling a crane boom arrangement and an ap-

paratus implementing the method so as to solve the above-mentioned problems. The object of the invention is achieved by a method according to the preamble of claim 1, which is characterized in that the lifting boom is moved with respect to the post also by a moment generated by an auxiliary cylinder controlled by separate control means about the joint connecting the lifting boom of the post in situations where the position between the post and the lifting boom is such that the moment of the lifting cylinder alone is insufficient for moving the lifting boom. The object of the invention is further achieved by an apparatus according to the characterizing part of claim 6. The apparatus is characterized in that it further comprises an auxiliary cylinder controlled by separate control means for assisting the movement of the lifting boom by means of the lifting cylinder with respect to the post about a joint between the post and the lifting boom in situations where the position between the post and the lifting boom is such that the moment of the lifting cylinder is insufficient for moving the lifting boom.

[0008] The preferred embodiments of the invention are disclosed in the dependent claims.

[0009] The invention is based on providing, by the method and the apparatus implementing the method, an auxiliary cylinder for the crane control circuit and an independent control for the auxiliary cylinder for driving the boom arrangement from the transport position or into it utilizing the actual control circuit of the crane in a less typical manner. In that case, the auxiliary cylinder is controlled independently of the control of the lifting cylinder and other cylinders of the boom arrangement in situations where the lifting cylinder for moving the lifting boom with respect to a post mounted in the crane base is in a disadvantageous position or in a blind spot, where the moment of the lifting cylinder alone is insufficient for moving the lifting boom with respect to the post. Thus the auxiliary cylinder generates a moment between the post and the lifting boom which together with the moment generated by the lifting cylinder enables the movement of the lifting boom in the above-mentioned disadvantageous positions; for example, when the lifting cylinder is in a blind spot, when the booms are driven from the transport position into the working position or from the working position into the transport position. The separate control means for the auxiliary cylinder are preferably functionally connected to the control of the lifting cylinder so that the operation of the auxiliary cylinder is associated with the simultaneous operation of the lifting cylinder, thus enabling as effective use of the cylinders as possible and avoiding generation of large opposite moments.

[0010] An advantage of the method according to the invention and the apparatus implementing the method is that they improve the control properties particularly when the boom arrangement is driven into the transport position or away from it. Furthermore, the structure of the loading crane can be made considerably lighter and less expensive to produce and maintain in working or-

der. In addition, the implementation according to the invention allows to design the boom geometry as more suitable for different working areas.

[0011] In a preferred embodiment of the method according to the invention, the lifting boom is moved with respect to the post by generating a moment between the lifting boom and the post by the auxiliary cylinder which tries to move the lifting boom with respect to the post about a joint between the lifting boom and the post or to slow down the movement of the lifting boom with respect to the post about the joint between the lifting boom and the post.

[0012] In another embodiment, the auxiliary cylinder is used when the crane boom arrangement is driven from the transport position into the working position and/or from the working position into the transport position when the lifting cylinder and its joint rods are in a blind spot or in an otherwise disadvantageous position with respect to the post and the lifting boom, in which case the moment of the lifting cylinder alone is insufficient for moving the lifting boom about the joint between the post and the lifting boom.

[0013] In an embodiment of the method according to the invention, the method comprises the following steps when the crane boom arrangement is driven from the transport position into the working position:

controlling the auxiliary cylinder independently of the control of the lifting cylinder so that when the lifting cylinder and its joint rods are in a blind spot with respect to the post and the lifting boom, the working pressure is led in the control means to the piston rod side of the lifting cylinder to bring the boom arrangement into the working position, and simultaneously controlling the auxiliary cylinder by separate control means against the lifting boom so as to provide a moment which subjects the lifting boom to a force which turns it apart from the post about the joint towards the working position; and switching the control of the lifting cylinder from the piston rod side to the piston side when the lifting cylinder reaches a position where it no longer is in a blind spot, and simultaneously controlling the auxiliary cylinder against the lifting boom until the lifting boom reaches a position with respect to the post where the moment of the lifting cylinder alone is sufficient for moving the lifting boom with respect to the post.

[0014] Furthermore, in an embodiment of the method according to the invention, the method comprises the following steps when the crane boom arrangement is driven from the working position into the transport position:

lowering the lifting boom against the auxiliary cylinder controlled out by leading the working pressure of the lifting cylinder to the piston rod side;

controlling the auxiliary cylinder independently of the control of the lifting cylinder and keeping the control of the lifting cylinder on the piston rod side so that the combined moment of the auxiliary cylinder and the lifting cylinder allows the lifting boom to move with respect to the post about the joint towards the transport position; and switching the control of the lifting cylinder from the piston rod side to the piston side when the lifting cylinder reaches the position where it and its joint rods end up in a blind spot with respect to the post and the lifting boom, and simultaneously controlling the auxiliary cylinder against the lifting boom so that the combined moment of the lifting cylinder and the auxiliary cylinder allows the lifting boom to move into its transport position.

[0015] In a preferred embodiment of the apparatus according to the invention, the control means are formed by a valve set for controlling the lifting cylinder hydraulically, and in another embodiment the control means for the auxiliary cylinder comprise a separate control valve for controlling the auxiliary cylinder hydraulically independently of the control of the lifting cylinder.

[0016] In an embodiment of the apparatus, the control valve is provided with a check valve, and/or the apparatus further comprises a pressure relief valve arranged in a pressure space between the auxiliary cylinder and the control valve.

[0017] In addition, in a preferred embodiment the boom arrangement comprises a stopper, against which the auxiliary cylinder is pressed, in which case the auxiliary cylinder is mounted in the post and is pressed during use against a stopper provided in the lifting boom, thus pushing the lifting boom apart from the post or slowing down the movement of the lifting boom towards the post about the joint connecting the post and the lifting boom. The auxiliary cylinder may also be mounted in the lifting boom, in which case it is during use pressed against a stopper provided in the post, thus pushing the lifting boom and the post apart or slowing down the movement of the lifting boom towards the post about the joint connecting the post and the lifting boom.

[0018] In an embodiment of the apparatus, the separate control means of the auxiliary cylinder and the control means of the lifting cylinder are functionally connected to each other, in which case the lifting cylinder and its control means and the auxiliary cylinder and its control means form a hydraulic system for controlling the crane boom arrangement hydraulically.

BRIEF DESCRIPTION OF THE FIGURES

[0019] The invention will now be described in greater detail by means of preferred embodiments, with reference to the accompanying drawings, in which:

Figure 1 illustrates a prior art loading crane in its

transport position with the boom arrangement on a transport support provided in the base, in which case the lifting cylinder is in a blind spot.

Figure 2 illustrates part of a boom arrangement according to the invention and a hydraulic chart. In the figure, the lifting boom is in a position from which the driving of the boom arrangement from the transport position into the working position starts.

Figure 3 illustrates part of the boom arrangement according to the invention when the lifting boom is in a position from which the driving of the boom arrangement from the working position into the transport position starts, and a hydraulic chart of the boom arrangement.

Figure 4 illustrates the position of the lifting boom, lifting cylinder and auxiliary cylinder according to the invention with respect to one another and to the crane post when the lifting boom is in the transport position.

Figure 5 illustrates the position of the lifting boom, lifting cylinder and auxiliary cylinder according to the invention with respect to one another and to the crane post when the lifting boom is in the position from which the driving of the boom arrangement from its working position into its transport position starts.

DETAILED DESCRIPTION OF THE INVENTION

[0020] Figure 1 illustrates a prior art Z-type loading crane, whose base 1 is connected to a vehicle or the like. The crane boom arrangement is mounted in the base 1 so that the crane boom arrangement can be used for moving a load, loading, unloading and other similar measures. In the solution according to the example, the crane boom arrangement comprises a post 2 mounted in the base 1 so that it turns substantially horizontally with respect to the base 1. A lifting boom 3, whose movement with respect to the post 2 is controlled by a lifting cylinder 7, is functionally connected to the post 2. In turn, a transfer boom 4, whose movement with respect to the post 2 and lifting boom 3 is controlled by two transfer cylinders 8, is functionally connected to the lifting boom 3. According to Figure 1, the free end of the transfer boom 4 is equipped with an extension 5, to which a clamshell bucket 6 is connected for grabbing the load. The base 1 is also provided with a transport support 10, against which the boom arrangement rests in the transport position according to Figure 1. The crane boom arrangement 2, 3, 4, 5 and 6 is controlled by cylinders 7 and 8 connected to the control means 23 and by cylinders of the clamshell bucket 6 and the extension 5.

[0021] Figure 2 illustrates part of the crane boom arrangement where the post 2 is provided with an auxiliary cylinder 9 for facilitating the moving of the lifting boom 3 in situations where the lifting cylinder 7 is in a disadvantageous position or in a blind spot with respect to the post 2 and the lifting boom 3. According to the prior art,

the lifting boom 3 is functionally connected to the post 2 by a joint 18 so that it can turn with respect to the post 2. A cylinder 7, by means of which the lifting boom 3 is moved with respect to the post 2, is articulated with the lower part of the post by a joint 16 at its lower end and with the upper part of the post 2 and the lifting boom 3 by a second joint 17 at its upper end.

[0022] Figure 2 further schematically illustrates a hydraulic chart for the control of the crane boom arrangement, where control means 23 are provided for controlling the lifting cylinder 7, transfer cylinders 8 and a loose cylinder 19. In this embodiment, the control means 23 comprise the actual control valve 11, actuators, i.e. cylinders, and actuator-specific pressure relief valves, which together form a valve set. The loose cylinder 19 is used for controlling the movement of the clamshell bucket 6. In addition to these prior art control means, the apparatus according to the invention comprises separate control means 22 for auxiliary cylinders 9. In addition, the pressure connection of the control valve 12 in the auxiliary cylinder 9 is provided with a check valve 13, and the pressure space between the auxiliary cylinder 9 and the control valve 12 is equipped with a pressure relief valve 14. The separate control means 22 for the auxiliary cylinder 9 are functionally connected to the control means 23 so that the auxiliary cylinder 9 can be controlled completely independently of the control of the lifting cylinder 7 or the control of other cylinders in the apparatus, in which case the auxiliary cylinder 9 can also be moved independently of the movement of the lifting cylinder or other cylinders in the apparatus.

[0023] In Figure 2, the lifting boom 3 is illustrated in its transport position with respect to the post 2. In this position, where the lifting boom 3 is as close to the post 2 as possible, the lifting cylinder 7 gets into a disadvantageous positions with respect to the post 2 and the lifting boom 3. Dotted lines AB and CD describe line segments connecting joints 17 and 16 and 18 and 17, respectively, which both pass through joint 17, i.e. point O. As illustrated by the line segments, in this transport position, the angle AOD is smaller than 180 degrees when viewed from the auxiliary cylinder 9 side. This means that the lifting cylinder 7 is in what is known as a 'blind spot', in which case the ratio of the straight line going through fulcrums 16 and 17 of the lifting cylinder to the straight line CD going through the fulcrum 17 between the lifting cylinder 7 and the lifting boom 3 and the fulcrum 18 between the lifting boom 3 and the post 2 is disadvantageous so that the lifting cylinder 7 cannot alone generate the required moment caused by the weight of the boom arrangement to open the boom arrangement about the fulcrum 18 from the transport position. When the boom arrangement is in this kind of transport position, an auxiliary cylinder 9 mounted in the post 2 is utilized when the boom arrangement, in particular the lifting boom 3, is to be controlled from the transport position into the working position, where the lifting boom 3 is extended apart from the post 2. The compact

transport position described in Figure 2 is necessary for fitting a crane in a vehicle so that any regulations concerning vehicles are met. The auxiliary cylinder is also used in the same disadvantageous positions of the boom arrangement when it is driven from the working position into the transport position.

[0024] This transport position is the initial situation when a crane is prepared for the working position. Driving the loading crane into the working position by the method according to the invention is carried out as described in the following. A working pressure is applied to the hydraulic system of the crane consisting of control means, cylinders, pressure medium and other means generally included in it by controlling an actuator selected by the actual control valve 11 of the control means, e.g. a loose cylinder 19, so that the clamshell bucket of the actuator of the actual control valve 11 deflects from its middle position and closes the middle channel of the round-pumping valve, increasing the pressure corresponding to the movement of the actuator selected for the hydraulic system. The actuator to be controlled by the actual control valve 11 is selected so that the hydraulic system can be provided with a hydraulic pressure sufficient for the auxiliary cylinder 9 to generate a moment which opens the boom arrangement and so that the controlling of the actuator does not cause harm or danger when the crane is driven into the working position. The movement selected by the actual control valve 11 of the crane is implemented so that the actuator is driven into the end position, in which case the pressure of the hydraulic circuit rises either up to the level of the main pressure in the system or up to the level of the actuator-specific pressure relief valve of the actuator, depending on which level is lower. In the example, the clamshell bucket is controlled into the closed position, which in Figure 2 is represented by a cylinder 19, whose control is represented by the control pattern a of the crane's actual direction valve 11, for providing hydraulic pressure for the auxiliary cylinder 9.

[0025] The actual control valve 11 of the crane is described in a simplified manner by means of one spindle block to illustrate the inventive concept. In a real crane control valve 11, there are several spindle blocks. In the example, the actual control valve 11 of the crane is the valve of the open middle position. When all the spindles of the control valve 11 are in the middle position, the pump's 24 output flows through the middle channel of the control valve 11 in the case of open channel flow.

[0026] The auxiliary cylinder 9 is driven by a control valve 12 arranged specifically for it. When the auxiliary cylinder 9 is driven outwards, control pattern a of the hydraulic circuit is activated. In the example, the auxiliary cylinder 9 is a single-acting cylinder. The control valve 12 for the auxiliary cylinder is a three-position direction valve, which is closed in its middle position. The pressure space between the auxiliary cylinder 9 and the control valve 12 of the auxiliary cylinder 9 is provided with a pressure relief valve 14 to protect the auxiliary

cylinder 9 and the control valve 12 of the auxiliary cylinder 9 from pressure pulses caused by external loads and impacts. Furthermore, a check valve 13 is arranged in the pressure connection of the control valve 12 of the auxiliary cylinder. The purpose of the check valve 13 is to prevent unintentional movements when no pressure is applied to the hydraulic system of the crane by the actual control valve 11 of the crane when the auxiliary cylinder 9 is driven. The check valve 13 prevents the movement of the auxiliary cylinder 9 inwards, i.e. in the direction in which the boom arrangement is lowered when the auxiliary cylinder is controlled outwards, i.e. in the direction where the boom arrangement is lifted so that oil is prevented from flowing from the motor port of the direction valve 12 of the auxiliary cylinder 9, to which the auxiliary cylinder 9 is connected, back to the hydraulic circuit where tank pressure prevails.

[0027] When the arrangement is moved into the working position, the auxiliary cylinder 9 extends outwards against a stopper 15 provided in the structure of the lifting boom 3. At the same, the actual control valve 11 of the crane controls the lifting cylinder 7 by leading the working pressure first to the piston rod side of the lifting cylinder. The fulcrum 16 between the lifting cylinder 7 and the lower end of the post 2, the fulcrum 17 between the lifting cylinder 7 and the lifting boom 3 and the fulcrum 18 between the lifting boom 3 and the upper end of the post 2 are in the starting position in a blind spot with respect to one another so that angle AOD is smaller than 180 degrees when viewed from the crane post side and that the direction of the control of the lifting cylinder 7 must be changed when the fulcrum 16 between the lifting cylinder 7 and the lower part of the post 2, the fulcrum 17 between the lifting cylinder 7 and the lifting boom 3 and the fulcrum 18 between the lifting boom 3 and the post 2 are on the same line, in which case the angle AOD is 180 degrees. By means of the auxiliary cylinder 9, the movement of the lifting boom 3 continues outwards as the control of the lifting cylinder 7 is switched from the piston rod side to the piston side. The force of the auxiliary cylinder 9 helps the lifting cylinder 7 to open the boom arrangement (the lifting boom 3 about the joint 18 with respect to the post) until the angle AOD is sufficiently large with respect to the moment so that the force of the lifting cylinder 7 can lift the lifting boom 3 and the rest of the boom arrangement. This position is illustrated in Figure 3, where the auxiliary cylinder 9 is completely extended out. As described by the example, when the boom arrangement is opened, both the direction valve 12 of the auxiliary cylinder and the movement of the lifting cylinder 7 are controlled completely independently of each other, which allows to avoid opposite moments during opening which stress the structures. After this step described by the example, the mechanical locking device between the transfer boom 4 and the lifting boom 3 can be unlocked, after which the crane is ready for use, provided that the normal drive routines specific to the crane type in question

have been performed. The separate control means 22 for the auxiliary cylinder 9 are preferably functionally connected to the control means 23 of the lifting cylinder 7 so that the operation of the auxiliary cylinder 9 is associated with the simultaneous operation of the lifting cylinder 7, which enables an effective use of these cylinders as possible and allows to avoid the generation of large opposite moments.

[0028] Figure 3 illustrates the driving of the crane from the working position into the transport position. Before the description according to the example of the invention, the transfer boom 4 of the crane is driven from the working position onto the top of the lifting boom 3 as a preparatory measure so that the device for locking the boom arrangement for transportation is locked. In the case shown in the figure, the lifting boom 3 of the crane is slowly lowered against the auxiliary cylinder 9 into the position shown in Figure 3 by leading the working pressure to the piston rod side of the lifting cylinder 7. When the stopper 15 on the lower surface of the lifting boom 3 meets the auxiliary cylinder, the control is kept switched on the piston rod side of the lifting cylinder 7 by the actual control valve of the crane until the angle AOD is larger than 180 degrees when viewed from the post 2 side. The direction valve 12 for the auxiliary cylinder 9 is simultaneously controlled so that the oil returning from the auxiliary cylinder 9 is guided to the tank connection of the hydraulic circuit according to the control pattern b of the direction valve 12 of the auxiliary cylinder. When the angle AOD is 180 degrees, i.e. the fulcrums 16, 17 and 18 are on the same line, the control pressure of the lifting cylinder 7 is switched to the piston side. The boom arrangement is lowered onto its transport support by employing the weight of the boom arrangement and the control of the lifting cylinder.

[0029] Utilization of the auxiliary cylinder 9 is illustrated in a simplified manner in Figures 4 and 5. In Figure 4, the lifting boom 3 is in its transport position, which corresponds to the crane position illustrated in Figure 2. In this position, the cylinder 7 is in a blind spot with respect to the post 2 and the lifting boom 3, i.e. in a disadvantageous position, where the lifting cylinder 7 cannot alone move the lifting boom 3 with respect to the post 2. In that case, the angle AOD defined by the line AB passing through via joints 17 and 16 of the cylinder 7 and the line CD travelling via the joint 17 of the lifting cylinder and the joint 18 between the post 2 and the lifting boom 3 is smaller than 180 degrees. This angle is denoted by a curved arrow in Figure 4. Thus the blind spot refers to the angle AOD when it is smaller than 180 degrees as shown in Figure 4.

[0030] When the driving of the lifting boom 3 and other related parts of the boom arrangement parts from the transport position into the working position starts, working pressure is applied to the piston rod side of the lifting cylinder 7 by means of the control means 23, and at the same time, the auxiliary cylinder 9 is pressed against a stopper 15 provided in the lifting boom 3, in which case

the moment generated together by the lifting cylinder 7 and the auxiliary cylinder 9 is sufficient for turning the lifting boom 3 and the other parts of the boom arrangement parts connected to it about the joint 18 between the post 2 and the lifting boom 3 towards the working position. The driving of the boom arrangement into the working position is continued this way until the joints 18, 17 and 16 are all on the same line, i.e. the angle AOD is 180 degrees, and then the control of the lifting cylinder 7 is switched from the piston rod side to the piston side and the auxiliary cylinder 9 is pushed against the stopper provided in the lifting boom 3 until the position shown in Figure 5 is reached. In the position shown in Figure 5, the auxiliary cylinder 9 is completely extended out and the angle AOD defined by the joints 18, 17 and 16, which is illustrated by a curved arrow in the figure, is larger than 180 degrees. Now the lifting boom 3 and the rest of the boom arrangement connected to it is in a position where the moment of the lifting cylinder 7 alone is sufficient for moving the lifting boom 3 and the rest of the boom arrangement apart from the post 2 by joint rods articulated with it.

[0031] According to the present invention, the control of the auxiliary cylinder 9 may be arranged in various ways to make it independent of the control of the lifting cylinder 7, in which case the auxiliary cylinder can be moved independently of the moving of the lifting cylinder. In addition, the position of the auxiliary cylinder in the boom arrangement may be varied. For example, the auxiliary cylinder may be arranged in the lifting boom, in which case it is pressed during use against the post or the stopper attached to it. The position of the boom arrangement where the auxiliary cylinder is needed is specific to each crane structure and varies according to the boom geometry, as well as the size, strength, position and direction of movement of the auxiliary cylinder.

[0032] It is obvious to a person skilled in the art that as the technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are thus not restricted to the examples described above but they may vary within the scope of the claims.

Claims

1. A method of controlling a crane boom arrangement (2, 3, 4, 5, 6), comprising moving a lifting boom (3) functionally connected by a joint (18) to a post (2) mounted in a crane base (1) by at least one lifting cylinder (7), which is articulated with the post (2) by a first joint (16) and connected to the lifting boom (3) movable with respect to the post (3) by a second joint (17), the operation of the lifting cylinder (7) being controlled by control means (23), **characterized by** further moving the lifting boom (3) with respect to the post (2) by a moment generated by an auxiliary cylinder (9) controlled by separate control

means (22) about a joint (18) connecting the post (2) and the lifting boom (3) in situations where the position between the post (2) and the lifting boom 83) is such that the moment of the lifting cylinder (7) alone is insufficient for moving the lifting boom (3).

2. A method according to claim 1, **characterized in that** the lifting boom (3) is moved with respect to the post (2) by generating a moment between the lifting boom (3) and the post (2) by the auxiliary cylinder (9), which tries to move the lifting boom (3) with respect to the post (3) about the joint (18) between the lifting boom (3) and the post (3) or which tries to slow down the movement of the lifting boom (3) with respect to the post (2) about the joint (18) between the lifting boom (3) and the post (2).
3. A method according to claim 1 or 2, **characterized in that** the auxiliary cylinder (9) is used when the crane boom arrangement (2, 3, 4, 5, 6) is driven from a transport position into a working position and/or from a working position into a transport position while the lifting cylinder (7) is in a blind spot or in an otherwise disadvantageous position with respect to the post (2) and the lifting boom (3), in which case the moment of the lifting cylinder (7) alone is insufficient for moving the lifting boom (3) about the joint (18) between the post (2) and the lifting boom (3).
4. A method according to any one of claims 1 to 3, **characterized in that** when the crane boom arrangement (2, 3, 4, 5, 6) is driven from the transport position into the working position, the method comprises the steps of:

controlling the auxiliary cylinder (9) independently of the control of the lifting cylinder (7) so that when the lifting cylinder (7) is in a blind spot with respect to the post (2) and lifting boom (3), working pressure is led in the control means (23) to the piston rod side of the lifting cylinder (7) to bring the crane boom arrangement (2, 3, 4, 5, 6) into the working position and simultaneously controlling the auxiliary cylinder (9) by separate control means (22) against the lifting boom (3) so as to generate a moment which subjects the lifting boom (3) to a force which turns the lifting boom (3) apart from the post (2) about the joint (18) towards the working position; and
switching the control of the lifting cylinder (7) from the piston rod side to the piston side when the lifting cylinder (7) reaches the position where it no longer is in a blind spot, and simultaneously controlling the auxiliary cylinder (9) against the lifting boom (3) until the lifting boom (3) reaches a position with respect to the post

(2) where the moment of the lifting cylinder (7) alone is sufficient for moving the lifting boom (3) with respect to the post (2).

5. A method according to any one of claims 1 to 3, **characterized in that** when the crane boom arrangement (2, 3, 4, 5, 6) is driven from the working position into the transport position, the method comprises the steps of:

lowering the lifting boom (3) against the auxiliary cylinder (9) extended out by leading the working pressure of the lifting cylinder (7) to the piston rod side;

controlling the auxiliary cylinder (9) independently of the control of the lifting cylinder (7) and keeping the control of the lifting cylinder (7) on the piston rod side so that the combined moment of the auxiliary cylinder (9) and the lifting cylinder (7) allows the lifting boom (3) to move with respect to the post (2) about the joint (18) towards the transport position; and

switching the control of the lifting cylinder (7) from the piston rod side to the piston side when the lifting cylinder (7) reaches a position where it ends up in a blind spot with respect to the post (2) and the lifting boom (3), and simultaneously controlling the auxiliary cylinder (9) against the lifting boom (3) so that the combined moment of the lifting cylinder (7) and the auxiliary cylinder (9) allows the lifting boom (3) to move into its transport position.

6. An apparatus for controlling a crane boom arrangement (2, 3, 4, 5, 6) comprising at least one lifting cylinder (7), which is articulated with a post (2) mounted in a crane base (1) by a first joint (16) and connected to a lifting boom (3) by a second joint (17) of the lifting cylinder (7) that can be moved with respect to the post (2), and control means (23) for controlling at least the lifting cylinder (7), **characterized in that** the apparatus further comprises an auxiliary cylinder (9) controlled by separate control means (22) for assisting the movement of the lifting boom (3) by means of the lifting cylinder (7) with respect to the post (2) about a joint (18) between the post (2) and the lifting boom (3) in situations where the position between the post (2) and the lifting boom (3) is such that the moment of the lifting cylinder (7) is insufficient for moving the lifting boom (7).

7. An apparatus according to claim 6, **characterized in that** the control means (23) are formed by a valve set for controlling the lifting cylinder (7) hydraulically.

8. An apparatus according to claim 6 or 7, **characterized in that** the control means (22) of the auxiliary

cylinder (9) comprise a separate control valve (12) for controlling the auxiliary cylinder (9) hydraulically independently of the control of the lifting cylinder (7).

9. An apparatus according to claim 8, **characterized in that** a check valve (13) is arranged in connection with the control valve (12).

10. An apparatus according to claim 8 or 9, **characterized in that** it further comprises a pressure relief valve (14) arranged in a pressure space between the auxiliary cylinder (9) and the control valve (12).

11. An apparatus according to any one of claims 6 to 10, **characterized in that** the boom arrangement comprises a stopper (15) against which the auxiliary cylinder (9) is pressed.

12. An apparatus according to any one of claims 6 to 11, **characterized in that** the auxiliary cylinder (9) is mounted in the post (2), in which case it is during use pressed against the stopper (15) in the lifting boom (3), pushing the lifting boom (3) apart from the post (2) or slowing down the movement of the lifting boom (3) towards the post (2) about the joint (18) connecting the post and the lifting boom (3).

13. An apparatus according to any one of claims 6 to 11, **characterized in that** the auxiliary cylinder (9) is mounted in the lifting boom (3), in which case it is during use pressed against the stopper (15) in the post (2), pushing the lifting boom (3) apart from the post (2) or slowing down the movement of the lifting boom (3) towards the post (2) about the joint (18) connecting the post and the lifting boom (3).

14. An apparatus according to any one of claims 6 to 13, **characterized in that** the separate control means (22) of the auxiliary cylinder (9) and the control means (23) of the lifting cylinder (7) are functionally connected to each other.

15. An apparatus according to any one of claims 6 to 14, **characterized in that** the lifting cylinder (7) and its control means (23) and the auxiliary cylinder (9) and its control means (22) form a hydraulic system for controlling the crane boom arrangement (2, 3, 4, 5, 6) hydraulically.

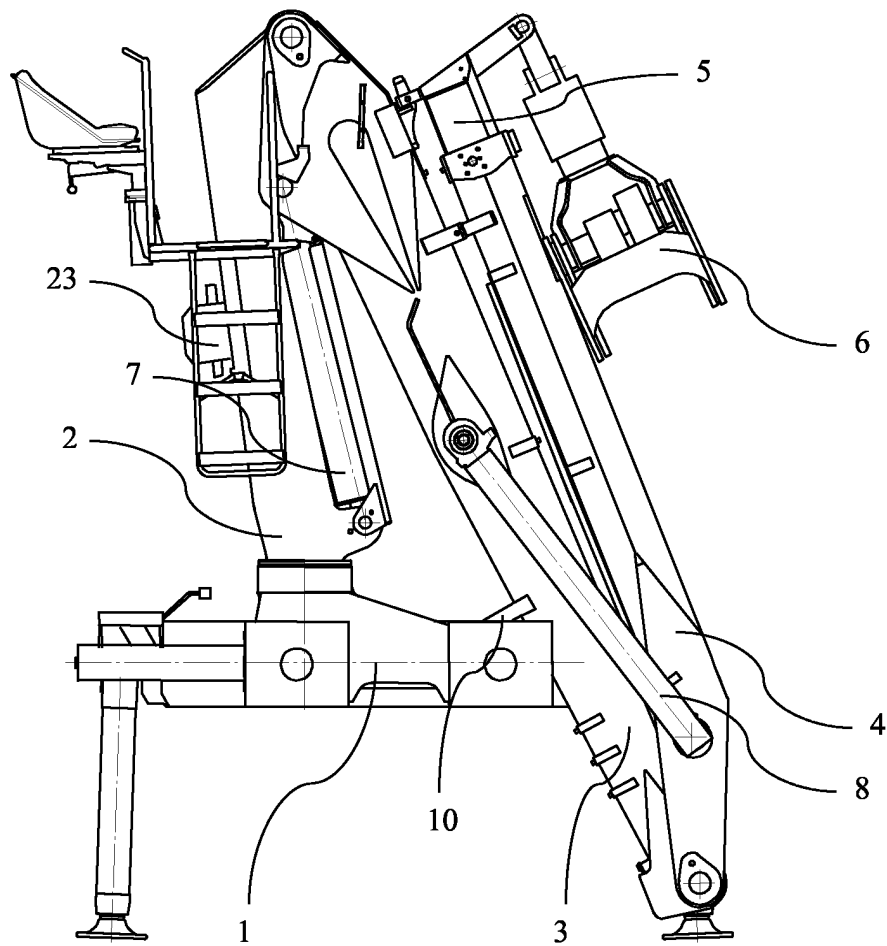


FIG. 1

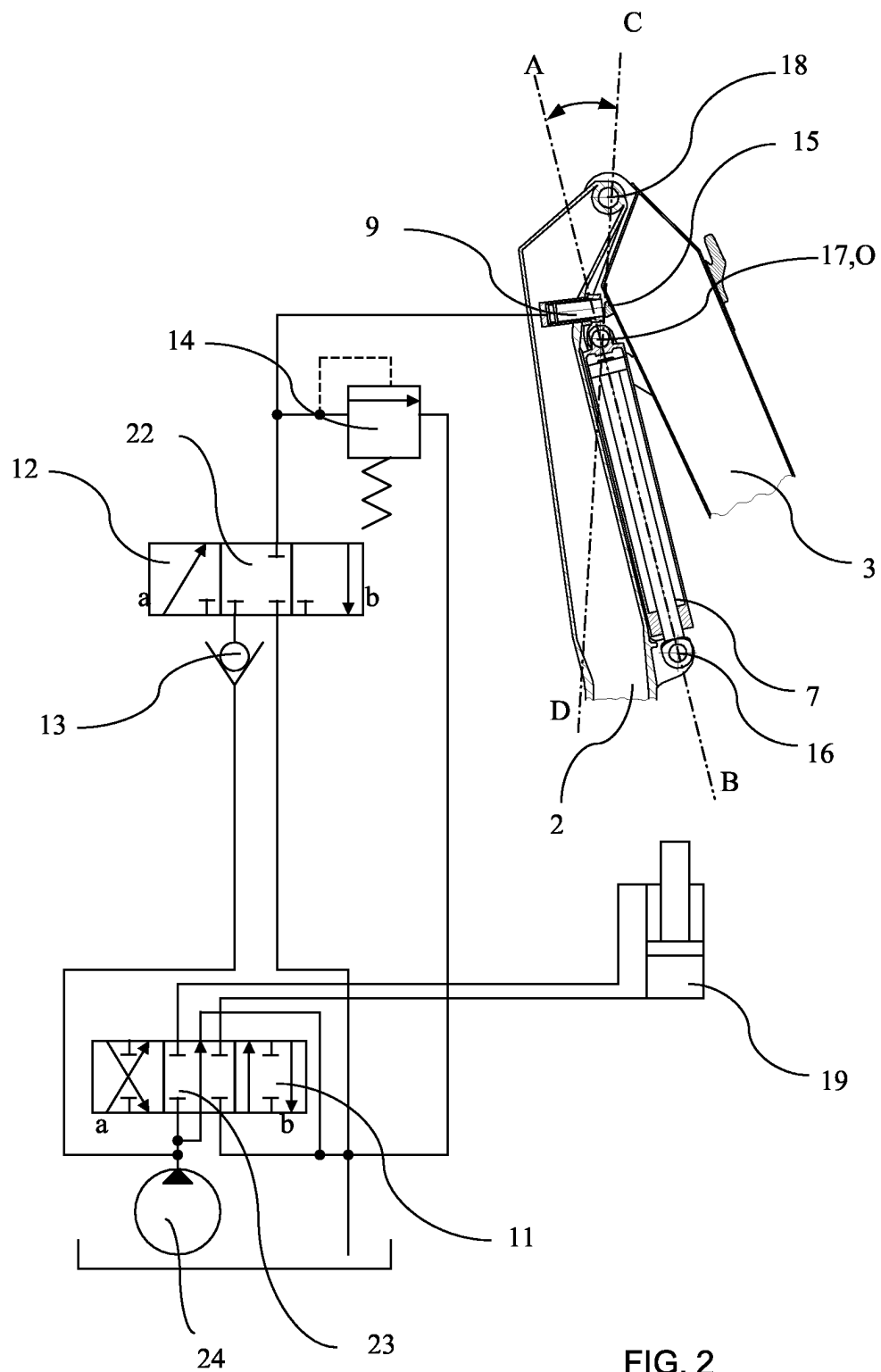
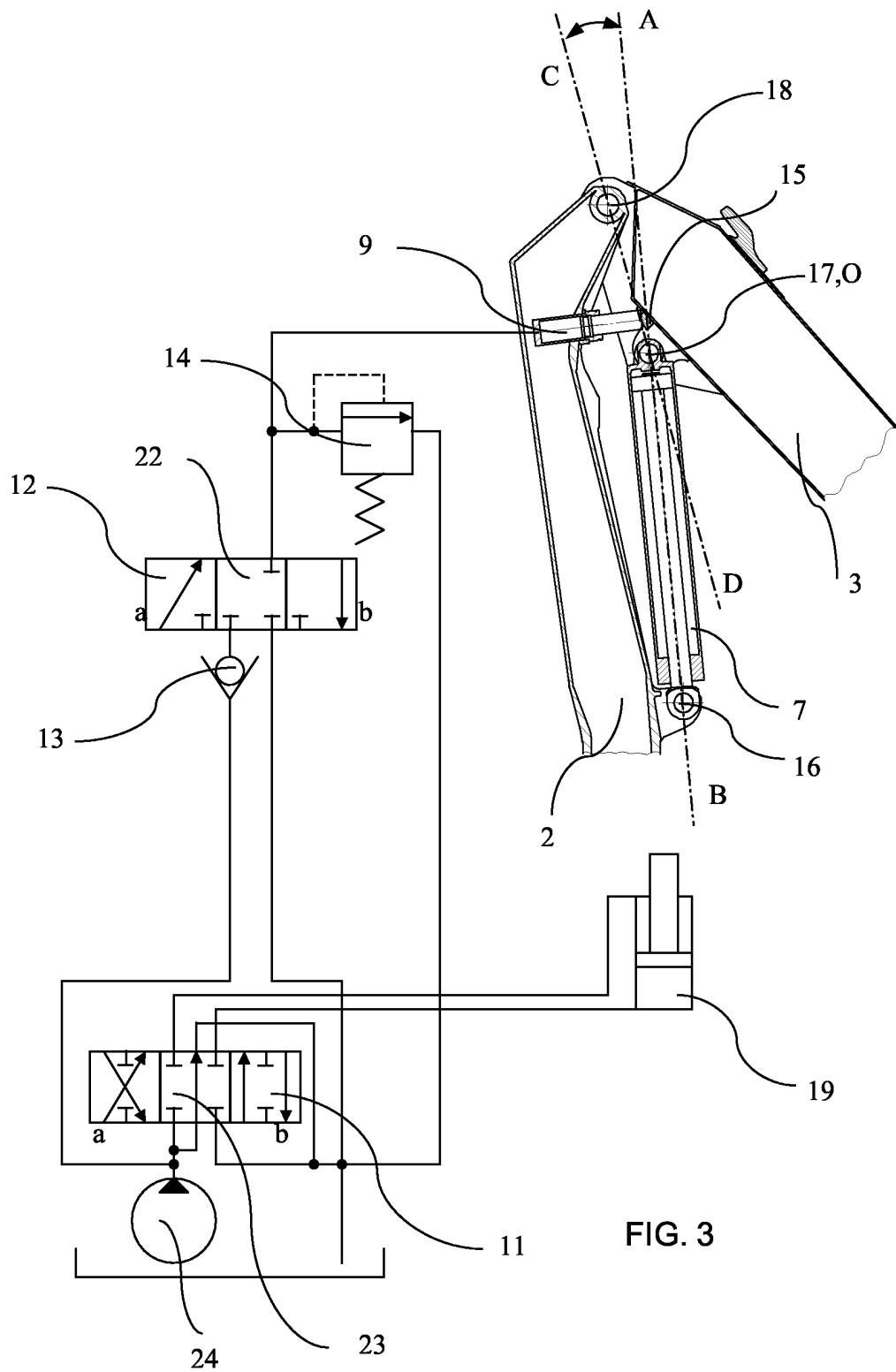


FIG. 2



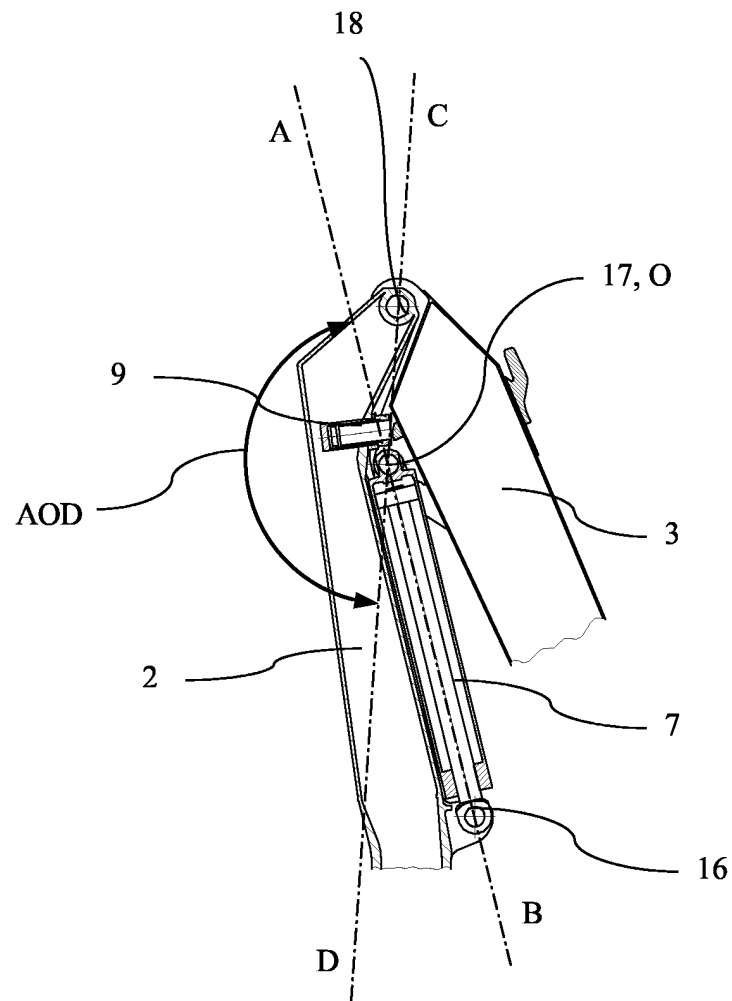


FIG. 4

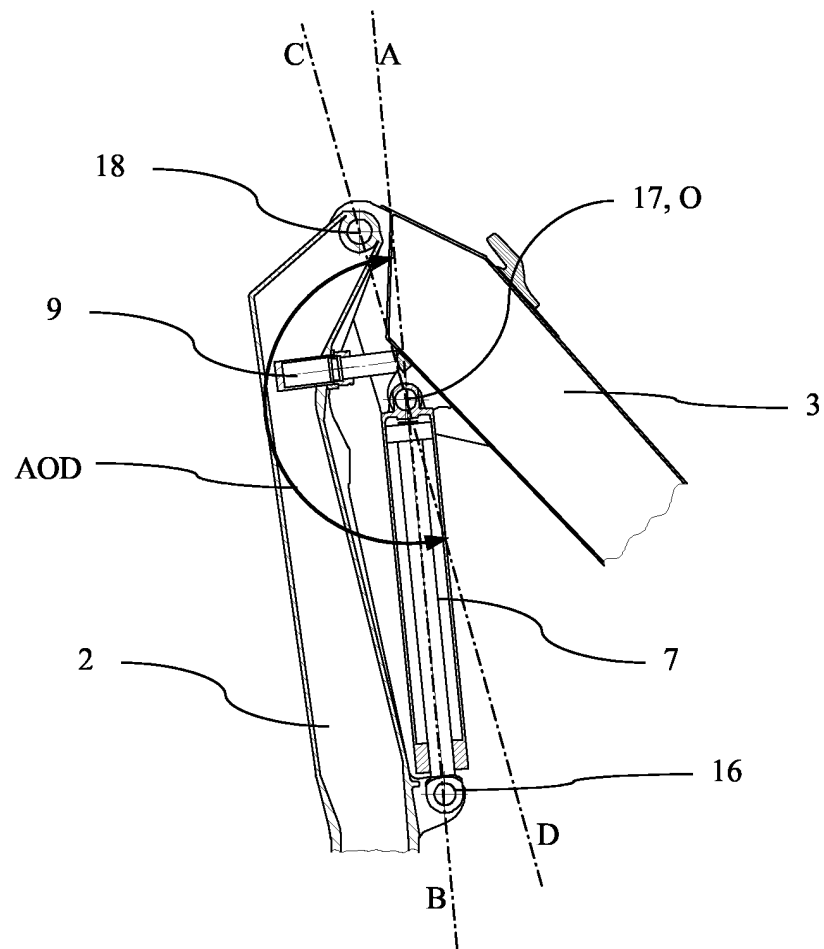


FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 04 10 1857

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 4 183 712 A (LINDBERG HANS E) 15 January 1980 (1980-01-15) * abstract * * column 2, line 15 - line 46 * * column 3, line 10 - line 36 * * figures 2,3 * -----	1-3,6	B66C23/42
A	EP 0 733 585 A (ROCHUS PENZ KRANBAU GMBH) 25 September 1996 (1996-09-25) * abstract * -----	1,6	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			B66C B60P
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 6 July 2004	Examiner Sheppard, B
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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ON EUROPEAN PATENT APPLICATION NO.**

EP 04 10 1857

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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06-07-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4183712 A	15-01-1980	SE 402903 B	24-07-1978
		AT 355256 B	25-02-1980
		AT 780977 A	15-07-1979
		DE 2748672 A1	15-06-1978
		DK 508977 A ,B,	11-06-1978
		FI 773293 A ,B,	11-06-1978
		FR 2373481 A1	07-07-1978
		GB 1556956 A	05-12-1979
		IT 1091615 B	06-07-1985
		SE 7613905 A	11-06-1978
EP 0733585 A	25-09-1996	AT 401925 B	27-12-1996
		AT 53495 A	15-05-1996
		EP 0733585 A2	25-09-1996
		JP 8319093 A	03-12-1996