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(54) **BOOM TYPE VEHICLE**

(57) A boom type vehicle comprises a traveling body that can travel, a rotating superstructure that is provided to be rotatable on the traveling body, a boom that is provided to be vertically swingable on the rotating superstructure, a working apparatus provided on the boom,

and a counterweight provided on the boom. The counterweight is provided so that a center of gravity of the counterweight is closer to a rear end of the boom than a vertical swing center of the boom.

EP 3 896 025 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a boom type working vehicle which has a boom mounted vertically swingable on a vehicle body, in which a working apparatus, such as a work platform on which an operator can board or a hoisting apparatus capable of hanging a baggage, is attached to the boom.

TECHNICAL BACKGROUND

[0002] In a boom type vehicle such as a vehicle with an aerial work platform or a mobile crane, a boom is provided on a rotating superstructure which can be rotated, and a working apparatus (a hoisting apparatus composed of a hook and a winch, a work platform, or the like) attached to the boom raises and lowers an operator or a baggage (hereinafter referred to as an "operator or others"). In the boom type vehicle, generally a counterweight is attached to the rotating superstructure to keep a balance with a load to be applied to a tip end portion when the boom is made to stand to raise the operator or others. For example, an articulating boom type vehicle with an aerial work platform described in the specification in U.S. Patent No. 5669517 comprises three section Z-shaped articulating boom provided with a work platform, and a counterweight is attached to an arm in a section closest to a vehicle body among three sections. As a result, when the articulating boom operates to raise the work platform, the counterweight, together with movement of the arm, shifts in a direction away from an overturn support point. Accordingly, a weight balance with the work platform can be kept.

[0003] A vehicle with an aerial work platform described in Japanese Laid-Open Patent Publication No. 2001-146396(A) includes a chassis having wheels, a turret (rotating body) provided to be rotatable on the chassis, a boom provided to be vertically swingable on the turret, and a work platform attached to the boom. A link mechanism is attached to the rear of a vertical swing center of the boom, and the link mechanism is coupled to the counterweight provided on the turret. As a result, when the boom stands, the counterweight in the turret moves obliquely downward toward a swing axis of the turret by movement of the boom. As a result, a weight balance with the work platform that has risen is kept, and the counterweight is moved to a lower position when the work platform is at a highest position, to lower a center of gravity of the entire vehicle with an aerial work platform and improve stability of the vehicle with an aerial work platform.

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0004] Conventionally, in a boom type vehicle, a counterweight that generates a stable moment is provided on a rotating superstructure to ensure stability when a boom is made to stand to raise an operator or others. However, an overturn moment may be generated by the counterweight provided on the rotating superstructure depending on geography (specifically, inclination) at a stop position of the boom type vehicle, a direction of the rotating superstructure, and an upright position of the boom. To counteract the overturn moment generated by the counterweight, a counterweight can also be provided on the vehicle body side. However, in this case, the weight of the entire boom type vehicle increases, which is not preferable when a load burden on a vehicle body, a deterioration in traveling performance, and the like are considered.

[0005] The present invention has been made in view of such a problem, and is directed to providing a boom type vehicle in which an overturn moment is not easily generated by a counterweight when a boom stands.

MEANS TO SOLVE THE PROBLEMS

[0006] To solve the above-described problem, a boom type vehicle according to the present invention comprises a traveling body that can travel, a rotating superstructure that is provided to be rotatable on the traveling body, a boom that is provided to be vertically swingable on the rotating superstructure, a working apparatus (e.g., a work platform 40 in the embodiment) provided on the boom, and a counterweight provided on the boom, in which the counterweight is provided so that a center of gravity of the counterweight is closer to a rear end of the boom than a vertical swing center of the boom.

[0007] The boom type vehicle having the above-described configuration preferably includes a link mechanism (e.g., a driving link 23 and a driven link 24 in the embodiment) that moves, when the boom stands from a laid flat state, the vertical swing center of the boom to come closer to a swing center of the rotating superstructure while further raising the vertical swing center of the boom than a position in the laid flat state.

[0008] In the boom type vehicle having the above-described configuration, the rotating superstructure preferably includes a protective member (e.g., a bumper 25 in the embodiment) that protects side and rear portions of the counterweight from outside in a range where the counterweight moves with a vertical swing operation of the boom from the laid flat state to an upright state.

[0009] In the boom type vehicle having any one of the configurations, the working apparatus may be a work platform on which an operator can board, or may be a hoisting apparatus that can rise and lower a baggage hung.

ADVANTAGEOUS EFFECTS OF THE INVENTION

[0010] In a boom type vehicle according to the present invention, a counterweight is provided on a boom, and a center of gravity of the counterweight is closer to a rear end of the boom than a vertical swing center of the boom. Thus, the center of gravity of the counterweight moves toward the vertical swing center of the boom as the boom stands. As a result, an overturn moment by the counterweight is not more easily generated than when the counterweight is fixed to a rotating superstructure.

[0011] The boom type vehicle having the above-described configuration preferably includes a link mechanism that moves, when the boom stands from a laid flat state, the vertical swing center of the boom to come closer to a swing center of the rotating superstructure while more raising the vertical swing center of the boom than a position in the laid flat state. As a result, the boom can be moved such that a position of the counterweight does not come closer to the ground while the counterweight moves as the boom stands. Thus, a ground clearance of the boom in the laid flat state can be reduced. The length of the boom required to raise a working apparatus to a predetermined height can be shortened by a rise amount of the vertical swing center of the boom.

[0012] The boom type vehicle having any one of the configurations preferably includes a protective member that protects side and rear portions of the counterweight from outside in a range where the counterweight moves with a vertical swing operation of the boom from the laid flat state to an upright state. As a result, even if the rotating superstructure contacts a wall surface or the like when performing a swing operation, for example, the counterweight, the boom, and the like can be protected.

[0013] Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present invention will become more fully understood from the detailed description given herein below and the accompanying drawings which are given by way of illustration only and thus are not limitative of the present invention.

FIG. 1 is a diagram illustrating an appearance of a boom type vehicle according to the present invention, where FIG. 1(a) is a plan view of a vehicle with an aerial work platform, and FIG. 1(b) is a side view of the vehicle with an aerial work platform;
FIG. 2 is a perspective view illustrating an appear-

ance of the boom type vehicle;

FIG. 3 is a block diagram illustrating an operation control configuration of the boom type vehicle;

FIG. 4 is a side view illustrating how a vertical swing operation of a boom provided on the boom type vehicle is performed;

FIG. 5 is a side view illustrating an upright state of the boom provided on the boom type vehicle; and

FIG. 6 is a side view illustrating an appearance in another embodiment of the boom type vehicle according to the present invention.

DESCRIPTION OF THE EMBODIMENTS

[0015] An embodiment of the present invention will be described below with reference to the drawings. As an example of a boom type vehicle according to the present invention, an appearance of a self-propelled vehicle with an aerial work platform 1 is illustrated in FIGS. 1 and 2. As illustrated in FIGS. 1 and 2, the vehicle with an aerial work platform 1 comprises a traveling body 10 configured to be able to travel, a rotating superstructure 20 provided on an upper portion of the traveling body 10 and rotatable in a horizontal direction, a boom 30 provided on an upper portion of the rotating superstructure 20 and vertically swingable, an articulating arm 45 provided on a tip end portion of the boom 30, and a work platform 40 attached to the articulating arm 45.

[0016] The traveling body 10 has a pair of left and right steering wheels 12 (a left steering wheel 12L and a right steering wheel 12R) and a pair of left and right driving wheels 13 (a left driving wheel 13L and a right driving wheel 13R) that are rotatably provided on a traveling body frame 11. The left driving wheel 13L and the right driving wheel 13R are driven to rotate by a traveling motor 16 illustrated in FIG. 3. The left steering wheel 12L and the right steering wheel 12R are configured to be caused to perform a steering operation (steering angle displacement operation) by the steering mechanism 60. The steering mechanism 60 is constituted by left and right steering brackets that respectively rotatably support the left steering wheel 12L and the right steering wheel 12R, a tie rod that couples the left and right steering brackets to each other, a steering cylinder 66 (see FIG. 3) that causes the left and right steering brackets to perform a steering operation, and the like. When a rod of the steering cylinder 66 performs an extension or contraction operation from a neutral position, the left and right steering brackets are interlockedly steered by the tie rod. As a result, a steering angle of the steering wheel 12 is displaced. In the present embodiment, as illustrated in FIG. 1(b), rightward movement and leftward movement in the figure of the travelling body 10 are respectively referred to as "forward movement" and "rearward movement".

[0017] A rotation mechanism 15 is provided at an upper center of the traveling body frame 11. The rotation mechanism 15 is configured to rotate the rotating superstructure 20 around a rotation axis TA illustrated in FIG. 1(b).

The rotation mechanism 15 includes an outer wheel gear fixed to the traveling body frame 11, an inner pinion gear engaging with the outer wheel gear and fixed to the rotating superstructure 20, and a rotary center joint (not illustrated) for supplying hydraulic oil to various types of actuators (described below) provided on the rotating superstructure 20. The rotating superstructure 20 has a rotating superstructure housing 21 (see FIG. 2) and a rotating superstructure chassis 22. In FIGs. 1(a) and 1(b), the rotating superstructure housing 21 is indicated by a broken line. The rotating superstructure housing 21 houses various types of components constituting a hydraulic circuit, for example, a hydraulic pump, an engine as its driving source, and various types of valves. The rotating superstructure chassis 22 pivotably supports a driving link 23 and a driven link 24 that are pivotably connected to the boom 30. More specifically, a driving support shaft DLP pivotably supports one end of the driving link 23, and a driven support shaft FLP supports one end of the driven link 24.

[0018] A bumper 25 for protecting a counterweight 37, described below, is provided on the rearward side of the rotating superstructure 20. As illustrated in FIG. 1(a), a width W_b of the bumper 25 is wider than a width W_c of the counterweight 37. An end of the bumper 25 in a rearward direction of the traveling body 10 is longer by a length D than an end of the counterweight 37. The width of the rotating superstructure housing 21 is also the same dimension as the width W_b of the bumper 25, and thus is wider than the width W_c of the counterweight 37.

[0019] The boom 30 is provided via the driving link 23 and the driven link 24, described above, on an upper part of the rotating superstructure 20. The boom 30 includes a base boom 31 and an intermediate boom 32 and a top boom 33 combined with the base boom 31 in a telescopic form. In a front-rear direction of the boom 30, the base boom 31 side (the left side in FIG. 1) is referred to as a rearward side, and the top boom 33 side (the right side in FIG. 1) is a forward side. The counterweight 37 is fixed to a rear part of the base boom 31, and an articulating arm 45 is provided ahead of the top boom 31.

[0020] The base boom 31 is pivotably connected to the other end of the driving link 23 in a driving link pivotable connection shaft DPC, and is pivotably connected to the other end of the driven link 24 in a vertical swing center shaft UDC. The counterweight 37 is fixed closer to a rear end of the base boom 31 than the vertical swing center shaft UDC of the base boom 31. A cylinder support shaft SP (see FIGs. 4 and 5) is provided between the driving link pivotable connection shaft DPC and the driving support shaft DLP in the driving link 23, and is pivotably connected to a main body of a boom vertical swing cylinder 35. A tip end of a cylinder rod of the boom vertical swing cylinder 35 is pivotably connected to a cylinder support shaft SPC provided on the boom 30. A work platform 40 that can be boarded by an operator M is provided at a tip end of the articulating arm 45. The work platform 40 has a work floor 41 having a substantially rectangular

shape that can be boarded by the operator M and a hand-rail 42 provided to stand around the work floor 41. The work platform 40 is provided with an operation apparatus 70 (see FIG. 3) that performs traveling control of the traveling body 10 and operation control of the boom 30, or the like.

[0021] Then, a control apparatus that performs traveling control of the traveling body 10 and operation control of the rotating superstructure 20, the boom 30, the articulating arm 45, and the work platform 40 will be described with reference to FIG. 3 based on an operation of the operation apparatus 70. The control apparatus controls various types of actuators that operate the traveling body 10, the rotating superstructure 20, the boom 30, the articulating arm 45, and the work platform 40, and comprises the operation apparatus 70 provided on the work platform 40, a hydraulic unit 80 that supplies hydraulic oil to the various types of actuators as a driving source of the various types of actuators, and a controller 50 that controls hydraulic oil to be supplied to the various types of actuators from the hydraulic unit 80 in response to an operation for various types of operation levers in the operation apparatus 70. The controller 50 is installed inside the rotating superstructure housing 21.

[0022] Examples of the actuator related to traveling control among the actuators provided on the vehicle with an aerial work platform 1 include a traveling motor 16 that causes the traveling body 10 to move forward or move rearward in a predetermined speed range, a steering cylinder 66 that causes the steering wheel 12 to perform a steering operation, and a brake cylinder 18 that brakes the traveling body 10 during traveling. Examples of the actuator related to movement control of the work platform 40 include a rotation motor 26, a boom vertical swing cylinder 35, a boom axial extension cylinder 36, a horizontal swing motor 46, an articulating cylinder 47, and a leveling cylinder 48.

[0023] The traveling motor 16 transmits rotation of a motor shaft to be driven by hydraulic pressure of hydraulic oil to be supplied to the driving wheel 13 (see FIG. 1) and normally or reversely rotates the motor shaft to normally or reversely rotate the driving wheel 13, thereby causing the traveling body 10 (see FIG. 1) to move forward or move rearward. A rotational speed of the motor shaft is controlled, to change a traveling speed of the traveling body 10. The brake cylinder 18 is a negative brake that brakes and locks the rotation of the motor shaft of the traveling motor 16 with a force of a contained spring and brakes the rotation of the driving wheel 13 when not supplied with hydraulic oil. The tip end of the cylinder rod of the steering cylinder 66 is connected to the steering mechanism 60 (see FIG. 1(a)), and the steering cylinder 66 extends and contracts to cause the steering wheel 12 to perform a steering operation.

[0024] The rotation motor 26 is provided on the rotating superstructure 20, and transmits rotation of its motor shaft to the inner pinion gear engaging with the outer wheel gear fixed to the traveling body frame 11 and nor-

mally or reversely rotates the rotation motor 26, to swing the rotating superstructure 20 in a clockwise or counter-clockwise direction with respect to the traveling body 10. The boom vertical swing cylinder 35 is provided astride between the driving link 23 and the boom 30, and causes the cylinder rod to extend and contract to vertically swing the boom 30 with the vertical swing center shaft UDC used as a center. The boom axial extension cylinder 36 is provided in the boom 30, and the boom axial extension cylinder 36 is made to extend and contract, to cause the intermediate boom 32 and the top boom 33 that are combined with the base boom 31 in a telescopic form to extend and contract with respect to the base boom 31.

[0025] The horizontal swing motor 46 is provided on the work platform 40, and causes the work platform 40 to perform a swing operation (horizontal swing operation) in a direction indicated by an arrow A illustrated in FIG. 1(a) by rotation of a motor shaft to be driven by hydraulic pressure of hydraulic oil to be supplied. The articulating arm 45 is formed of a parallel link mechanism including a leveling bracket 45a pivotably connected to a tip end portion of the top boom 33 to be vertically swingable and a first arm 45c and a second arm 45d having their respective one ends pivotably connected to the leveling bracket 45a to be vertically swingable and having respective other ends pivotably connected to a head bracket 45b that supports the work platform 40 to be vertically swingable. The articulating arm 45 is provided with the articulating cylinder 47 (see FIG. 3) between the first arm 45c and the second arm 45d, and is configured to be able to vertically swing the articulating arm 45 with respect to the leveling bracket 45a by causing the articulating cylinder 47 to perform an extension and contraction operation. The leveling cylinder 48 is provided between the top boom 33 and the leveling bracket 45a, and by extending and contracting the leveling cylinder 48, the leveling bracket 45a is controlled to always hold a predetermined angular posture with respect to a vehicle body regardless of a vertical swing angle position of the boom 30. As a result, an angular posture of the head bracket 45b is always kept constant by a function of the parallel link mechanism including the first arm 45c and the second arm 45d.

[0026] The hydraulic unit 80 that supplies hydraulic oil as a driving source that operates the various types of actuators, described above, includes an engine E provided on the rotating superstructure 20, a hydraulic pump P to be driven by the engine E, a hydraulic oil tank T, and a control valve unit 85 that controls a supply direction and a supply amount of hydraulic oil to be supplied to each of the hydraulic actuators from the hydraulic pump P. The control valve unit 85 includes a plurality of control valves respectively provided to correspond to the hydraulic actuators. The plurality of control valves include a traveling control valve V1 that controls driving of the traveling motor 16, a brake control valve V2 that controls the brake cylinder 18, a steering direction switching valve V3 that controls the steering cylinder 66, a swing control valve V4, a vertical swing control valve V5, an axial ex-

tension control valve V6, a horizontal swing control valve V7, an articulating control valve V8, and a leveling control valve V9.

[0027] The operation apparatus 70 constituting the control apparatus illustrated in FIG. 3 includes a traveling operation lever 71 that performs start and stop, forward movement and rearward movement, and traveling speed switching, for example, of the traveling body 10, a steering lever 72 that performs a steering operation of the traveling body 10 (a steering operation of the steering wheel 12), a rotation operation lever 73 that performs a swing operation of the rotating superstructure 20, a boom operation lever 74 that performs vertical swing and axial extension operations of the boom 30, a work platform operation lever 75 that performs a horizontal swing operation (swing operation) of the work platform 40, and an articulating arm operation lever 76 that performs a bend and stretch operation of the articulating arm 45. Each of the operation levers is configured to be positioned at a neutral position where a direction of the lever is a vertical posture and to be operable to be tilted in a direction determined depending on the operation lever with the neutral position used as a reference when the operation lever remains non-operated.

[0028] The controller 50 controls the control valves in the control valve unit 85 in response to an tilting operation to be performed by the operator of each of the above-described operation levers. The traveling operation lever 71 is operable to be tilted in a front-rear direction from the neutral position. When the traveling operation lever 71 is operated to be tilted forward, the controller 50 controls a spool movement direction and a valve opening of the traveling control valve V1 such that the traveling body 10 moves forward at a speed corresponding to an tilting angle of the lever, to control a supply direction and a flow rate of hydraulic oil to be supplied to the traveling motor 16. On the other hand, when the traveling operation lever 71 is operated to be tilted rearward, the controller 50 controls the spool movement direction and the valve opening of the traveling control valve V1 such that the supply direction of hydraulic oil to be supplied to the traveling motor 16 is opposite to that when the traveling operation lever 71 is operated to be tilted forward, to control the supply direction and the flow rate of hydraulic oil such that the traveling body 10 moves rearward at a speed corresponding to an tilting angle of the lever.

[0029] When the traveling operation lever 71 is operated to be tilted either forward or rearward from the neutral state, the controller 50 brings the brake control valve V2 into an open state, to supply hydraulic oil to the brake cylinder 18. As a result, in the motor shaft of the traveling motor 16, a braked and locked state is released so that the motor shaft enters a rotatable state. On the other hand, when the traveling operation lever 71 is at the neutral position, or when the traveling operation lever 71 returns to the neutral position from a state where it is operated to be tilted, the controller 50 brings the brake control valve V2 into a closed state, to stop supplying hy-

draulic oil to the brake cylinder 18. As a result, the motor shaft of the traveling motor 16 enters the braked and locked state, to brake rotation of the driving wheel 13.

[0030] The steering lever 72 is operable to be tilted in a left-right direction from the neutral position, and the controller 50 displaces the steering angle of the steering wheel 12 such that the traveling body 10 turns left when it moves forward with the lever operated to be tilted leftward and the traveling body 10 turns right when it moves forward with the lever operated to be tilted rightward. The steering operation of the steering wheel 12 is performed when the controller 50 controls a spool movement direction and a valve opening of the steering direction switching valve V3. The rotation operation lever 73 is configured to be operable to be tilted in a left-right direction from the neutral position, and the controller 50 controls a spool movement direction and a valve opening of the swing control valve V4 to drive the rotation motor 26 such that the rotating superstructure 20 rotates in a clockwise direction with the swing axis TA illustrated in FIG. 1(b) used as a center when the lever is operated to be tilted rightward and rotates in a counterclockwise direction with the swing axis TA used as a center when the lever is operated to be tilted leftward.

[0031] The boom operation lever 74 is configured to be operable to be tilted in left-right and front-rear directions from the neutral position. When the boom operation lever 74 is operated to be tilted in the left-right direction, the controller 50 switches a spool movement direction of the axial extension control valve V6 depending on an tilting direction of the operation lever and controls a valve opening of the axial extension control valve V6 to a predetermined valve opening, to drive the boom axial extension cylinder 36 to cause the boom 30 to perform an extension and contraction operation. On the other hand, when the boom operation lever 74 is operated to be tilted in a front-rear direction, the controller 50 switches a spool movement direction of the vertical swing control valve V5 depending on an tilting direction of the lever and controls a valve opening of the vertical swing control valve V5 to a predetermined valve opening, to drive the boom vertical swing cylinder 35 to cause the boom 30 to perform a vertical swing operation. Although the extension and contraction operation and the vertical swing operation of the boom 30 are performed by the operation of the one boom operation lever 74 in the above-described embodiment, the vertical swing operation lever and the axial extension operation lever may be separately provided to perform the vertical swing operation of the boom 30 by an tilting operation in a front-rear direction of the vertical swing operation lever and perform the extension and contraction operation of the boom 30 by an tilting operation in a front-rear direction of the axial extension operation lever.

[0032] When the boom 30 performs a vertically upward swing operation to an upright state, the controller 50 controls a spool movement direction and a valve opening of the leveling control valve V9 such that the work platform 40 moves downward (in a clockwise direction) in an arrow

B illustrated in FIG. 1(b) to hold a horizontal state of the work floor 41 to match the vertical swing operation of the boom 30. On the other hand, when the boom 30 performs a vertically downward swing operation, the controller 50 controls the spool movement direction and the valve opening of the leveling control valve V9 such that the work platform 40 moves upward (in a counterclockwise direction) in the arrow B illustrated in FIG. 1(b) to hold a horizontal state of the work floor 41 to match the vertical swing operation of the boom 30.

[0033] The work platform operation lever 75 is configured to be operable to be tilted in a left-right direction from the neutral position. The controller 50 controls a spool movement direction and a valve opening of the horizontal swing control valve V7 such that the work platform 40 performs a horizontal swing operation in a counterclockwise direction in the direction indicated by the arrow A illustrated in FIG. 1(a) when the lever is operated to be tilted rightward. On the other hand, when the work platform operation lever 75 is operated to be tilted leftward, the controller 50 controls the spool movement direction and the valve opening of the horizontal swing control valve V7 such that the work platform 40 performs a horizontal swing operation in a clockwise direction in the direction indicated by the arrow A illustrated in FIG. 1(a). The controller 50 controls a spool movement direction and a valve opening of the articulating control valve V8 in response to an operation of the articulating arm operation lever 76 to cause the articulating cylinder 47 to extend and contract, to cause the articulating arm 45 to perform a vertical bend and stretch operation with respect to the boom 30.

[0034] Then, a vertical swing operation of the base boom 31 caused by an extension and contraction operation of the boom vertical swing cylinder 35 will be described with reference to FIGs. 4 and 5. In FIGs. 4 and 5, illustration of the rotating superstructure housing 21 and the rotating superstructure chassis 22 in the rotating superstructure 20 is omitted to make an operation situation of the base boom 31 easy to see. First, FIG. 4(a) illustrates a laid flat state of the base boom 31. In this state, the cylinder rod of the boom vertical swing cylinder 35 contracts, and the base boom 31 is inclined more downward than the horizontal. When the boom operation lever 74 is operated to be tilted forward from this state by the operator, the cylinder rod of the boom vertical swing cylinder 35 starts to extend, to act on the cylinder pivotable connection shaft SPC of the base boom 31. As a result, as illustrated in FIG. 4(b), the base boom 31 is brought into a horizontal state with the vertical swing center shaft UDC used as a center, and the driving link 23 and the driven link 24 are turned in a clockwise direction in the figure with the driving support shaft DLP and the driven support shaft FLP respectively used as centers. By operating the driving link 23 and the driven link 24, respective positions of the vertical swing center shaft UDC and the driving link pivotable connection shaft DPC move more slightly upward to the right in the figure than

a position in the laid flat state illustrated in FIG. 4(a).

[0035] When the operator continuously maintains a forward tilting operation of the boom operation lever 74 from a state illustrated in FIG. 4(b), the cylinder rod of the boom vertical swing cylinder 35 further extends, and the base boom 31 is inclined upward from the horizontal with the vertical swing center shaft UDC used as a center, as illustrated in FIG. 4(c). The driving link 23 and the driven link 24 are further turned in a clockwise direction with the driving support shaft DLP and the driven support shaft FLP respectively used as centers. As a result, the respective positions of the vertical swing center shaft UDC and the driving link pivotable connection shaft DPC further move upward to the right in the figure. As a result, the counterweight 37 comes closer to the swing axis TA of the rotating superstructure 20 beyond the bumper 25.

[0036] When the operator further maintains the forward tilting operation of the boom operation lever 74 from a state illustrated in FIG. 4(c), the cylinder rod of the boom vertical swing cylinder 35 continues to extend, and the base boom 31 enters an upright state, as illustrated in FIG. 5. FIG. 5 illustrates a base boom 31', a vertical swing center shaft UDC', and a counterweight 37' in the laid flat state illustrated in FIG. 4(a), respectively, by broken lines. A trajectory of the vertical swing center shaft UDC that moves while the base boom 31 shifts from the laid flat state to the upright state is indicated by an arrow C.

[0037] As illustrated in FIG. 5, a position of the vertical swing center shaft UDC is the highest in the upright state of the base boom 31, and the vertical swing center shaft UDC comes closest to the swing axis TA so that the counterweight 37 can be brought closer to the swing axis TA. Accordingly, an overturn moment by the counterweight 37 can be made difficult to generate while a weight balance with the work platform 40 is kept. The vertical swing center shaft UDC follows a trajectory indicated by the arrow C illustrated in FIG. 5 while the base boom 31 reaches the upright state from the laid flat state by the driving link 23 and the driven link 24. Thus, the counterweight 37 can be brought closer to the swing axis TA without a height from the ground of the counterweight 37 being greatly changed. In addition, a position of the vertical swing center shaft UDC is the highest in the upright state of the base boom 31. Accordingly, the length of the boom 30 required to raise the work platform 40 to a predetermined height can be shortened.

[0038] Further, in the laid flat state of the base boom 31, an end of the bumper 25 in the rearward direction of the traveling body 10 is longer by the length D than the end of the counterweight 37. The counterweight 37 moves to a position indicated by a solid line from a position indicated by a broken line while the base boom 31 shifts from the laid flat state to the upright state. However, during the movement, the respective widths of the bumper 25 and the rotating superstructure housing 21 are wider than the width Wc of the counterweight 37 (see FIG. 1(a)). Therefore, even if the boom 30 takes any posture between the laid flat state and the upright state, the bump-

er 25 and the rotating superstructure housing 21 enable the counterweight 37, the boom 30, the driving link 23, the driven link 24, and the like to be protected not to contact a wall surface or the like when the rotating superstructure is performing a swing operation.

[0039] Although the position of the vertical swing center shaft UDC is moved upward by the driving link 23 and the driven link 24 when the boom 30 is shifted from the laid flat state to the upright state in the above-described embodiment, the links may be omitted. For example, the rotating superstructure chassis 22" is provided with a boom support 27 that supports the boom 30 to be vertically swingable, and is pivotably connected to a vertical swing center shaft UDC" of a base boom 31", as illustrated in FIG. 6. A cylinder rod of the boom vertical swing cylinder 35" is pivotably connected by a cylinder pivotable connection shaft SPC" of the base boom 31", and a body end portion of the boom vertical swing cylinder 35" is pivotably connected by a cylinder support shaft SP" provided on the boom support 27. As a result, a counterweight 37" can be brought closer to the swing axis TA in the rotating superstructure 20 as the base boom 31 shifts from a horizontal state (indicated by a broken line in FIG. 6) to an upright state.

[0040] The present invention is not limited to the above-described embodiment, but can be appropriately improved without departing from the scope and spirit of the present invention. Although the vehicle with an aerial work platform 1 in which the tip end portion of the top boom 32 is provided with the articulating arm 45 and the work platform 40 is illustrated in the present embodiment, for example, the present invention is also applicable to a crane truck comprising a hoisting apparatus including a hook that hangs a baggage, a wire connected to the hook, and a hoisting apparatus capable of hoisting the wire instead of the work platform.

Claims

1. A boom type vehicle comprising:

a traveling body that can travel;
a rotating superstructure that is provided to be rotatable on the traveling body;
a boom that is provided to be vertically swingable on the rotating superstructure;
a working apparatus provided on the boom; and
a counterweight provided on the boom,
wherein the counterweight is provided so that a center of gravity of the counterweight is closer to a rear end of the boom than a vertical swing center of the boom.

2. The boom type vehicle according to claim 1, further comprising a link mechanism that moves, when the boom stands from a laid flat state, the vertical swing center of the boom to come closer to a swing center

of the rotating superstructure while further raising the vertical swing center of the boom than a position in the lowered flat state.

3. The boom type vehicle according to claim 1 or 2, wherein the rotating superstructure comprises a protective member that protects side and rear portions of the counterweight from outside in a range where the counterweight moves with a vertical swing operation of the boom from the laid flat state to an upright state.
4. The boom type vehicle according to any one of claims 1 to 3, **characterized in that** the working apparatus is a work platform on which an operator can board.
5. The boom type vehicle according to any one of claims 1 to 3, wherein the working apparatus is a hoisting apparatus that can rise and lower a baggage hung.

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FIG.1

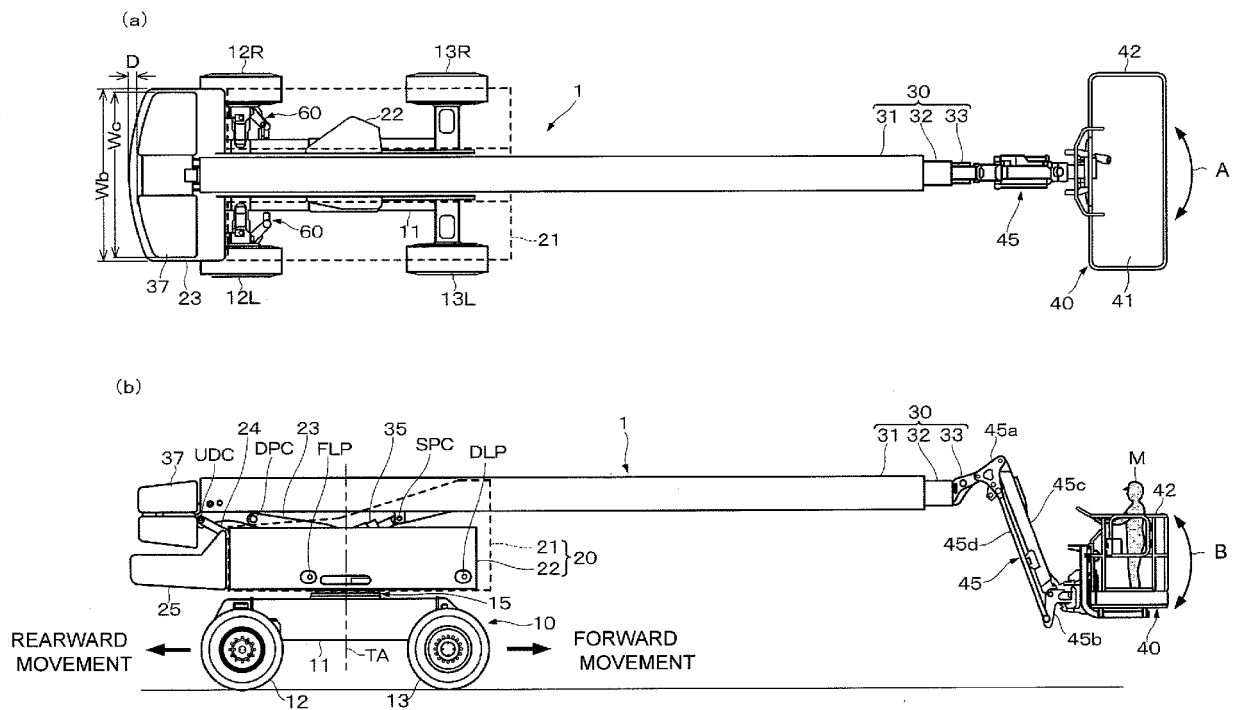


FIG.2

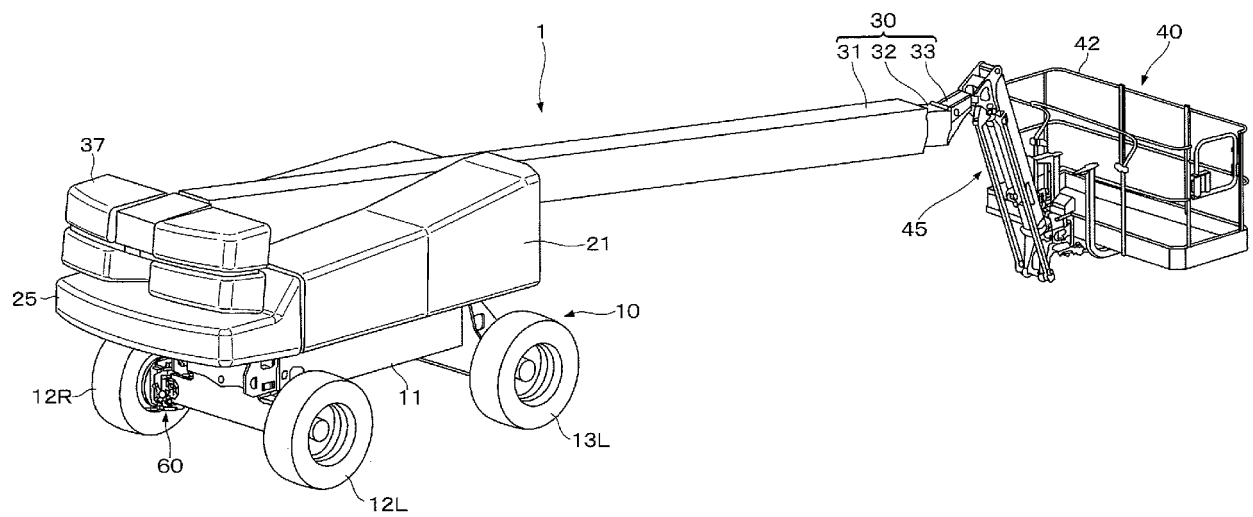


FIG.3

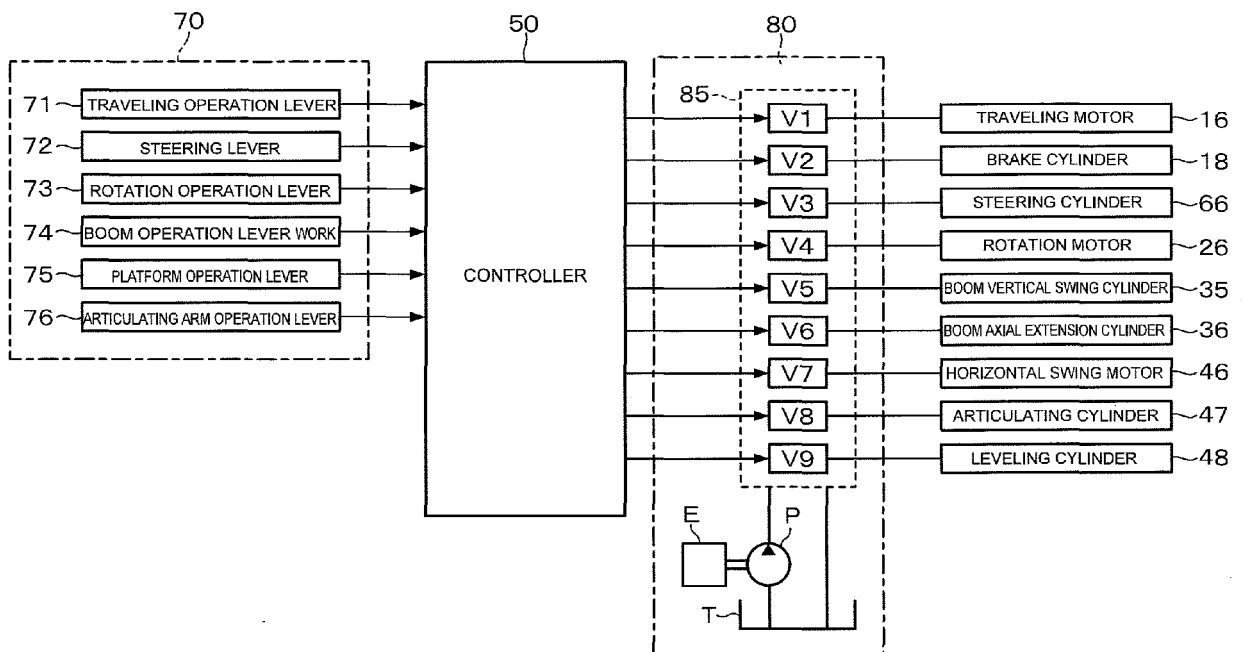


FIG.4

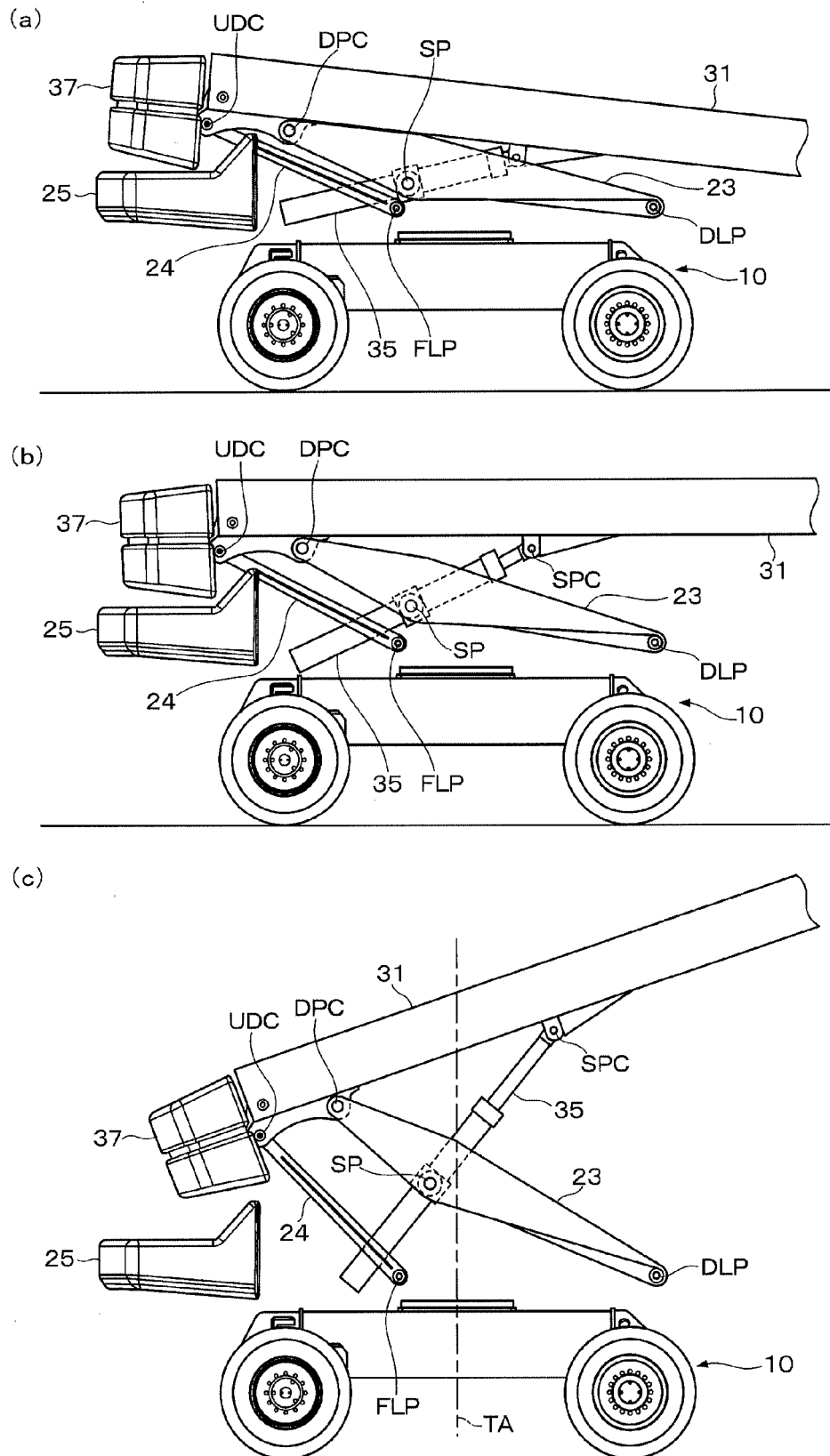


FIG.5

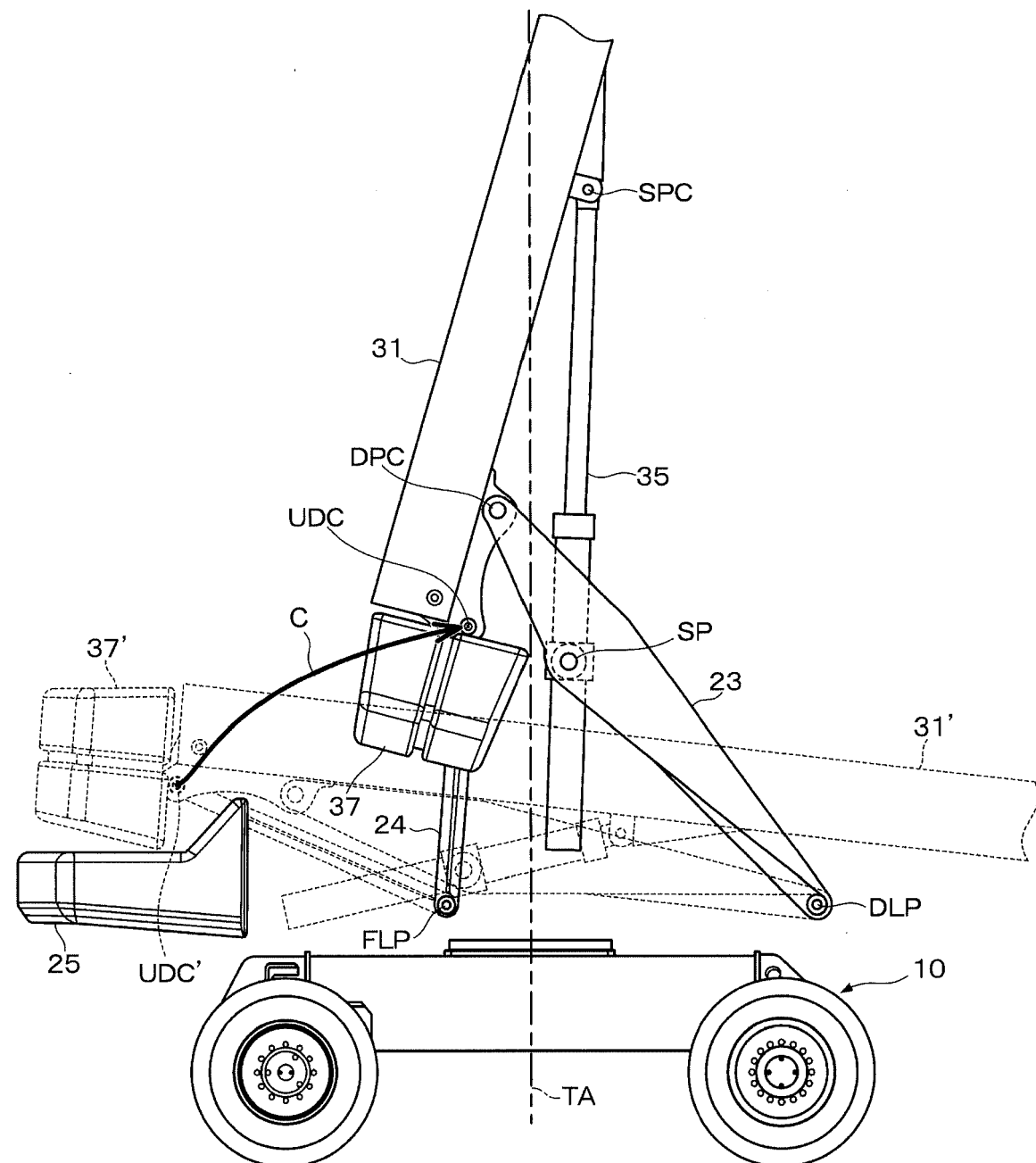
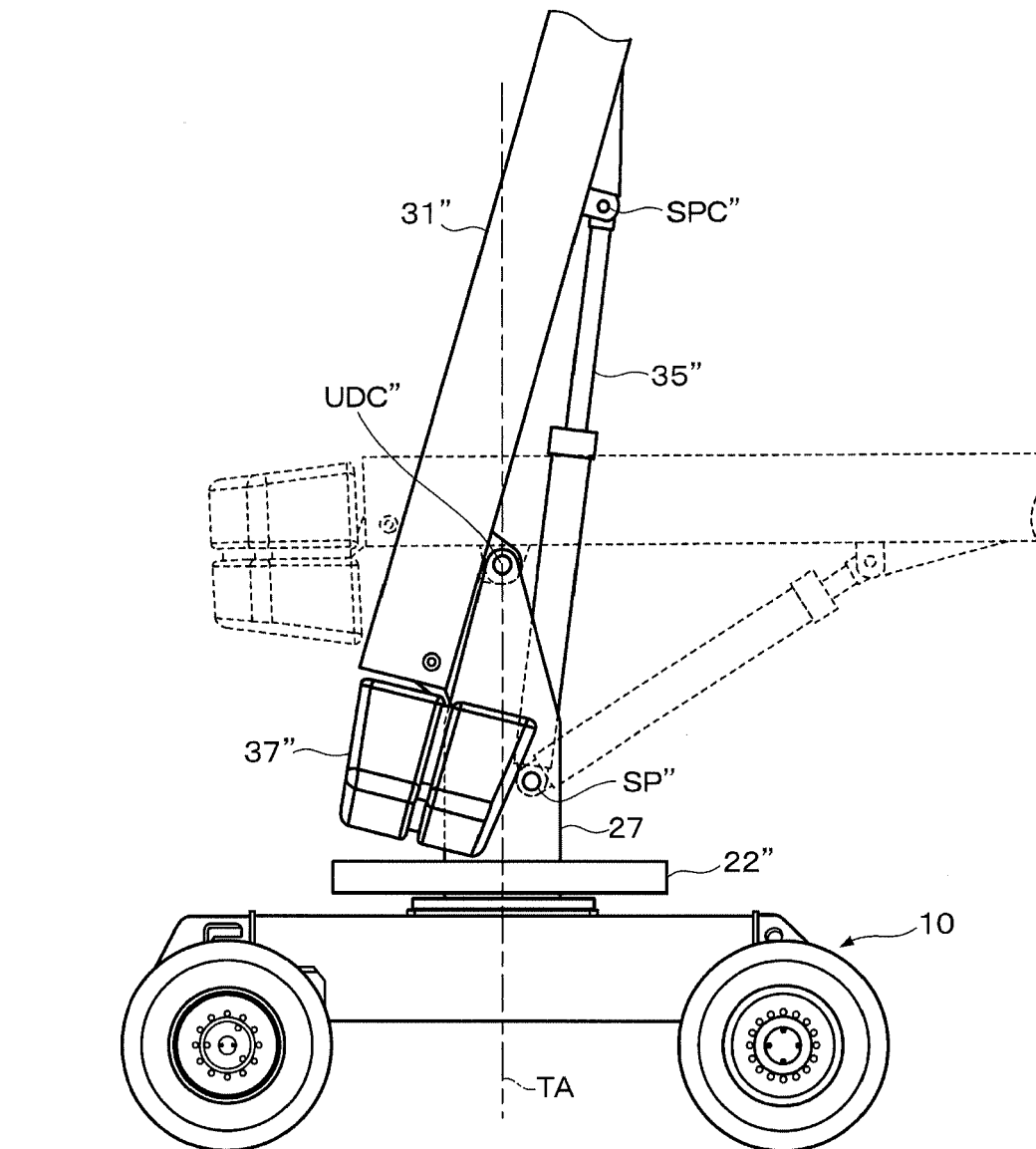


FIG.6





EUROPEAN SEARCH REPORT

Application Number
EP 21 16 1907

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			B66F B66C
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 7 September 2021	Examiner Verheul, Omiros
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