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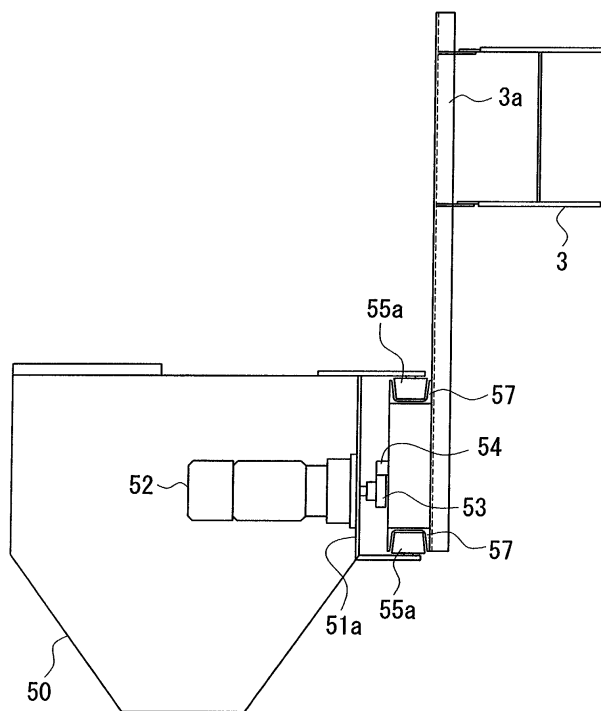
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(54) Crane and operating method thereof

(57) A crane and a crane operating method for reducing fatigue of the operator and for reducing the visual distance or the dead angle when the operator directly observes a load. The crane (1) comprises a raising and lowering device for raising and lowering the operator cab (50) in which an operator operates the crane. A position detecting device (60) for detecting the position of the operator cab may be provided. The position detecting device may output a signal for stopping the operator cab when the operator cab reaches a limit position. The raising and lowering device may includes a rack (54) provided along the frame; a pinion (53) which is engaged with the rack and is attached to the operator cab; and a motor (52) for driving the pinion, wherein the motor is attached to the operator cab. Accordingly, the working efficiency can be improved and safety environments for the crane operation can be realized.

FIG. 3



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a crane, and to an operating method thereof, for lifting and carrying a load.

Description of the Related Art

[0002] Generally, cranes are used in various places such as harbors, construction sites, and the like, so as to lift and carry loads such as containers for shipping, building materials, various kinds of goods, structures for construction, or the like. The basic structure of the crane includes at least a gib (or boom) for lifting a load, a wire hanging down from the gib, for vertically moving the load, a frame for supporting the base of the gib in a manner such that the base (i.e., the gib) is rotatable, and an operator cab attached to the frame, in which the operator operates the crane.

[0003] Fig. 7 shows an example of conventional cranes, that is, a mobile harbor crane which is used for lifting containers or the like at a harbor. The structure of this crane will be explained below.

[0004] In Fig. 7, reference numeral 1 indicates the mobile harbor crane, reference numeral 2 indicates a rotating frame, reference numeral 3 indicates a main frame, reference numeral 4 indicates a gib, reference numeral 5 indicates a hanging hook, reference numeral 6 indicates a main hoisting wire, and reference numeral 10 indicates an operator cab. In addition, reference numeral 100 indicates a container ship staying alongside a wharf at the harbor, and in Fig. 7, a sectional view of the container ship 100 is shown.

[0005] The mobile harbor crane 81, placed close to the container ship 100 alongside the wharf of the harbor, has a carrier frame 11 which is movable on the grounds. In order to build the crane, outriggers 12 are extended from the carrier frame 11 so as to stably build the crane, thereby preventing the crane body from falling down due to the raising operation of the projecting gib, the weight of the load (here, container 101), or the like. The carrier frame 11 can also run by storing the outriggers 12.

[0006] The rotating frame 2 is disposed on the top face of the carrier frame 11 via a rotating bearing 16, and this rotating frame 2 is rotatable on the carrier frame 11 within 360 degrees by a rotation driving apparatus (not shown).

[0007] On the rotating frame 2, the following structural elements are mainly provided, that is, a main frame 3 for supporting the base of the gib 4 in a manner such that the base (i.e., the gib) is rotatable, a winch 7 for winding up a main hoisting wire 6 to which a hanging hook 5 is connected, a cylinder 8 for raising the gib 4, and an operator cab 10 in which the operator operates

the crane. In addition, a counterweight 9 is attached at the rear side of the rotating frame 2 (i.e., opposite to the front side which may fall down), so as to balance the crane body (for preventing the falling-down of the crane) and to improve the load-lifting capability.

[0008] The main frame 3 of the mobile harbor crane 81 has a trussed structure which includes a plurality of rods combined with each other. At approximately the center position of the main frame 3 in the vertical direction, the base of the gib 4 (i.e., the right end of the gib 4 in Fig. 7) is attached via a gib foot pin (not shown). In addition, sheaves are attached to the upper end of the main frame 3, around which the main hoisting wire 6 (explained below) and the like are wound.

[0009] The gib 4 has a long beam shape having a trussed structure, and the base of the gib 4, that is, an end of the gib (the right end in Fig. 7), is rotatably supported at almost the center position of the main frame 3, as explained above. In addition, an end of the rod portion of the cylinder 8 is attached to the gib 4 so as to support the gib, where the position where the end of the rod portion is attached is close to the base of the gib 4. The other end of the cylinder 8 (i.e., the end at the bottom side) is rotatably attached to a front portion of the rotating frame 2.

[0010] Therefore, the operations of raising and lowering the gib 4 are performed by the extending and retracting operations of the cylinder 8. The gib foot pin functions as the center axis of these raising and lowering operations, thereby defining the operating radius of the crane at the end of the gib 4, that is, at the hanging hook 5 which is explained below.

[0011] That is, the hanging hook 5 for hanging a load is hanging down from the end of the gib 4 via the main hoisting wire 6. At the end of the gib 4, a support wire 4a is also connected so as to raise the gib 4 and support the weight of the gib 4.

[0012] An end of the main hoisting wire 6 is wound up around the hanging hook 5, and the other end is rolled up around the winch 7 which is provided on the rotating frame 2. More specifically, the main hoisting wire 6 is rolled up from the end of the gib 4 to the upper end of the main frame 3 (i.e., above the gib 4, see reference symbols 6a and 6b), and the main hoisting wire 6 reaches the winch 7.

[0013] The main hoisting wire 6 is wound up according to the rotation of the winch 7, so that the hanging hook 5 ascends. Conversely, according to the backward rotation of the winch 7, the hanging hook 5 descends.

[0014] The operator cab 10, in which the crane operation is controlled, is provided close to the cylinder 8 and on the rotating frame 2. The operator cab 10 has large glass windows in the front and top faces so that the operator in the cab can view the load as clearly as possible. In the operator cab 10, various kinds of levers used for the crane operations are provided, so that the operator performs operations such as raising and lowering the gib 4, winching up and down using the winch 7, and ro-

tating the rotating frame 2.

[0015] In the operations of the mobile harbor crane 81, discharging of containers 101 will be explained below.

[0016] Many containers 101 are carried inside the container ship 100, which stays alongside a wharf at the harbor, or on the deck of the container ship 100. In general processes, the containers 101 nearer to the wharf, that is, to the mobile harbor crane 81, are lifted first and are placed on the ground G by the crane. This is because when the operating radius of the crane is increased so as to lift a more distant container 101, the gib 4 must be lowered, so that a lower portion of the gib 4 may contact a nearer container 101.

[0017] In addition, when nearer containers 101 are first discharged, necessary visibility for discharging more distant containers 101 can be relatively easily ensured. In order to improve the visibility for the more distant containers, as many of the nearer containers should be discharged as possible. However, this may unbalance the container ship; thus, the containers 101 must be discharged with considerable equality so as to balance the ship. In addition, a hanging tool (e.g., a spreader) suitable for containers, which can be attached to the hanging hook 5, is used for discharging the container 101.

[0018] Below, the operation of discharging nearer containers 101 (indicated by reference symbol A in Fig. 7) will be explained in more detail. In this crane operation, the operator looks up, almost overhead, so as to directly observe the hanging hook 5 and the container 101 because the position of the operator cab 10 is lower than the target container 101 to be discharged. Therefore, in most cases, the operator cannot see the hanging hook 5 behind the containers 101; therefore, the operator should carefully operate the crane in response to signs from a slinger (who executes slinging work) or a guide.

[0019] After some of the nearer containers 101 on the deck are discharged, more distant containers 101 (indicated by reference symbol B) are discharged by lowering the gib 4. In this crane operation, if the visual field of the operator is obstructed by nearer containers 101 or a wall surface of the container ship 100, the operator may not be able to observe the target container 101 to be lifted, because the operator cab 10 is placed at a lower position and thus a dead angle is produced. Therefore, also in this case, the operator must carefully operate the crane according to signs of a slinger or a guide.

[0020] After the containers 101 on the deck are discharged, containers 101 (some of which are indicated by reference symbol C) inside the container ship 100 are discharged in turn.

[0021] In this operation, if the visual field of the operator is obstructed by a wall surface of the container ship 100, the operator may not be able to observe the container 101 to be lifted because the height of operator cab 10 is almost equal or lower than the height of the wall

surface (of the ship) of the container ship 100, which produces a dead angle. Therefore, also in this case, the operator must carefully operate the crane according to signs of a slinger or a guide.

[0022] In the operation of discharging containers 101 near the bottom of the container ship 100, the operator cannot observe containers 101 (indicated by reference symbol D) near the wall surface closer to the wharf because the visual field of the operator is obstructed by this wall surface. In addition, at this stage, many containers 101 have already been discharged and thus the load on the container ship 100 is reduced, so that the container ship 100 gradually floats up and the height of the wall surfaces of the container ship 100 also rise higher than the ground G. Therefore, it is more difficult for the operator to directly observe the target container 101.

[0023] In this case, a guide must be stationed on the deck and the crane must be carefully operated according to instructions of the guide. Here, this guide does not perform slinging work and functions as an indicator in the visual field of the operator, where the guide is positioned between the load and the operator so as to send signs to both the slinger and the operator.

[0024] As explained above, in the crane operation, a dead angle may be produced depending on the position of each container 101. In order to solve this problem, the operator cab 10 may be positioned at a higher place so as to enlarge the visual field of the operator and to reduce the dead angle. Accordingly, the operator can look down the target container 101 or look at the target container 101 front ways, without any obstruction in the visual field.

[0025] However, in the above-explained conventional crane operations, the operator in the operator cab 10 frequently cannot observe and confirm the lifting and slinging works of the container 101 as a load. This is because the lifting condition of the container 101 tends to change; thus, it may be difficult for the operator, who stays in the operator cab 10 at a fixed position, to continuously observe the container 101. That is, the position for lifting each load continuously changes, and the dead angle of the operator and the visual distance from the operator to the load are considerably changed depending on the lifting position, peripheral environments, the shape of the load, the shape of the ship, and the like.

[0026] In order to safely operate the crane, preferably, the operator performs the crane operation from a position as near to the crane as possible. If the distance between the operator and the load or the slinger or the like is long, the operator tends to lose the correct perspective sense, so that it may be difficult for the operator to accurately operate the crane, and that it may also be difficult for the operator to specify the position of the hanging hook 5.

[0027] If the hanging hook 5 enters the dead angle of the visual field of the operator, the operator is forced to operate the crane at low speed according to signs of the slinger, so as to ensure safety. Therefore, the efficiency

of loading is reduced and considerable time is necessary for the shipping and discharging operations. In addition, the operator becomes more fatigued.

[0028] In order to reduce the dead angle of the operator, the operator cab may be positioned at a higher place, as explained above. However, in this case, in the shipping and discharging operations for loads near the ground, the distance from the operator to the load is long, so that the above problem is not solved.

[0029] In addition, when the operator cab is positioned at such a higher place, the operator must access the higher operator cab from the ground, which is dangerous and takes considerable time. Additionally, it makes the operator fatigued, and it is troublesome for the operator to frequently access the operator cab from the ground, thereby reducing working efficiency (i.e., operability).

[0030] In order to assist the operator in accessing the higher operator cab, an elevator may be provided. However, such improvement of the equipment as adding an elevator causes increase of the equipment cost, and the weight of the crane is also increased.

SUMMARY OF THE INVENTION

[0031] In consideration of the above circumstances, an object of the present invention is to provide a crane and a crane operating method for reducing fatigue of the operator. Another object of the present invention is to provide a crane and a crane operating method for reducing the visual distance or the dead angle when the operator directly observes a load, thereby improving the working efficiency and realizing safety environments for the crane operation.

[0032] Therefore, the present invention provides a crane comprising:

- a gib for lifting a load;
- a frame for supporting the base of the gib in a manner such that the gib is rotatable;
- an operator cab in which an operator operates the crane,

wherein the crane is characterized by comprising:

- raising and lowering means for raising and lowering the operator cab.

[0033] Accordingly, the operator cab, in which the operator operates the crane, can ascend and descend; thus, the burden on the operator is reduced. More specifically, the operator in the operator cab can quickly move from the ground to a higher place so as to observe the load. In addition, according to the change of the height of the operator cab, the visual field of the operator changes, thereby reducing a dead angle in the visual field. The operator cab can ascend and descend by the raising and lowering means, and power is necessary for

performing the raising and lowering operations. The raising and lowering means may be provided at the operator cab or at a portion for supporting the operator cab.

[0034] Here, the operator cab moves substantially vertically (i.e., ascends or descends); thus, it is preferable to vertically move the operator cab along a fixed railway. For example, guide rails or the like, and guide rollers or the like which are guided along the guide rails, may be provided at the operator cab.

[0035] As explained above, the visual field of the operator can change and the operator can further reliably observe the load, thereby improving the efficiency of the crane operation and reducing the fatigue of the operator. In addition, the operator can get into the operator cab near the ground, thereby also reducing the fatigue of the operator and the time necessary for accessing the operator cab.

[0036] The raising and lowering means may have a driving device for driving the raising and lowering means; and the driving device may be attached to the operator cab. In this case, the operator cab ascends or descends according to the operation of the driving means. As the driving device is attached to the operator cab, the structure of the raising and lowering means can be simplified and a control section or the like for operating the driving section can be easily provided in the operator cab; therefore, the operator can easily raise or lower the operator cab and thus the operator can reliably observe the load.

[0037] As a typical example, the operator cab is raised or lowered by the raising and lowering means according to the height of the load. Therefore, if the load is placed at a higher position, the operator cab is raised so that the operator can confirm the lifting and slinging operations or the like from a place closer to the load. Generally, crane operations such as slinging, carrying, or the like are performed at various places according to each load; that is, the place for performing each operation is not fixed. In the present invention, the operator cab can be raised or lowered according to the change of the working place. That is, the distance between the operator and the load can be reduced and the operator can more easily observe the condition of the load, thereby improving the efficiency of the crane operation and reducing the burden on the operator.

[0038] Preferably, the operator cab is raised or lowered by the raising and lowering means so as to reduce a dead angle produced in the visual field of the operator who observes the load, so that the operator in the operator cab can observe the load under better conditions. That is, if the operator cannot observe the load by any obstruction, the load is placed within the dead angle in the visual field of the operator. In order to reduce the dead angle, the operator cab is raised or lowered by the operator to a position where the operator can observe the load and confirm the slinging operation or the like during the crane operation. Generally, crane operations such as slinging, carrying, or the like are performed at

any places according to each load, that is, the place for performing each operation is not fixed. In the present invention, the operator cab can be raised or lowered so as to reduce the dead angle, according to the change of the working place. Accordingly, the operator can reliably recognize the condition of the load, thereby improving the working efficiency and reducing the burden on the operator.

[0039] The crane may further comprises position detecting means for detecting the position of the operator cab which ascends or descends. That is, the position in the vertical direction is detected by the position detecting means. In this case, the operator or the like may be informed of the current position of the operator cab by showing data on a display or the like. In addition, an optimum position of the operator cab for each crane operation may be stored. Therefore, if the load can be estimated, the operator cab can be immediately moved to the optimum position at which the operator can easily observe the load, thereby improving the working efficiency.

[0040] Such position detecting means may be attached to the operator cab, so as to detect the position of the operator cab within the ascent and descent range of the operator cab. The position detecting means may also be attached to the frame in a manner such that the position of the position detecting means is within the ascent and descent range of the operator cab.

[0041] Preferably, the position detecting means outputs a signal for stopping the operator cab when the operator cab reaches a limit position. The operator cab can be raised or lowered within a predetermined ascent and descent range which depends on the mechanic limitation. Therefore, when the operator cab reaches each end of the ascent and descent range, the position detecting means detects that and outputs a signal for stopping the operator cab. According to this signal, the ascending or descending operation of the operator cab is stopped, thereby preventing the operator cab from going over the ascent and descent range or preventing the operator cab or the raising and lowering means from being damaged. Therefore, the safety of the moving operator cab, that is, the safety of the crane operation, can be ensured.

[0042] In addition, if the frame includes a passage or the like, the operator cab can be reliably stopped by the position detecting means at the position closest to the passage, so that the operator can easily and reliably access such a passage.

[0043] The raising and lowering means may include:

- a rack provided along the frame;
- a pinion which is engaged with the rack and is attached to the operator cab; and
- a motor for driving the pinion, wherein the motor is attached to the operator cab.

[0044] In this structure, according to the rotation of the

motor which is attached to the operator cab, the pinion rotates and moves along the rack while the teeth of the pinion are engaged with the rack. That is, the rack is provided along the frame, the motor connected with the pinion and the operator cab to which the motor is attached ascend or descend along the frame. Therefore, the rack is formed at least over the ascent and descent range of the operator cab. That is, the structure is light and can be easily realized, thereby reducing the equipment cost.

[0045] In addition, the rack is always engaged with the rack; thus, the operator cab can be easily stopped at any position within the ascent and descent range. The rack can be easily extended, that is, the ascent and descent range can be easily changed, or model changes or application to other cranes can be easily performed.

[0046] The crane may further comprise means for substantially moving the operator cab horizontally. In this case, the operator cab can be vertically and horizontally moved so that the operator can further approach the load and the dead angle can be further reduced. Therefore, the working efficiency can be further improved and the burden on the operator can be further reduced.

[0047] The crane may further comprise:

a cable for control, extending from the operator cab to the frame, wherein:

- the operator cab is raised or lowered within a predetermined ascent and descent range;
- the frame has a cable fastening portion provided at a position corresponding to almost the center of the ascent and descent range; and
- a middle portion of the cable is fastened to the cable fastening portion.

[0048] In the operator cab, at least devices for the crane operations performed by the operator are provided. On the other hand, a driving apparatus for the crane, such as an actuator, is generally attached to the frame. Therefore, the cable extending from the operator cab to the frame is provided, and cable routing should be considered in the raising and lowering operations of the operator cab. If the driving device of the raising and lowering means is attached to the operator cab and a driving source for the deriving device is provided at a portion other than the operator cab, a cable for connecting the driving device and the driving source is necessary.

[0049] When a middle portion of the cable is fastened to the cable fastening portion, as explained above, the cable can always follow the ascending or descending operation of the operator cab. In this case, the length of the cable can be minimized, and the cable can be routed without slackening even at the lower-limit position of the operator cab. Here, the cable fastening portion of the frame may include a member which is attached to the frame.

[0050] Below, the length of the cable will be explained in detail. When the operator cab is stopped at the upper-limit position, the upper half of the cable extends from the operator cab to the cable fastening portion (which is the center position of the ascent and descent range and to which the cable is fastened) without slackening.

[0051] On the other hand, when the operator cab is stopped at the lower-limit position of the ascent and descent range, the cable is folded downwards at the cable fastening portion. In this case, the distance from the cable fastening portion to the operator cab is substantially the same as that when the operator cab is positioned at the upper-limit position. Therefore, the cable has no slackening also in this case. Accordingly, in either case of (i) when the operator cab stays at the upper-limit position and (ii) when the operator cab stays at the lower-limit position, problems such as insufficient length of the cable or cable slackening do not occur.

[0052] If cable slackening occurs when the operator cab is positioned at the lower-limit position, the extra portion of the cable may obstruct suitable routing of the cable. Therefore, in the present invention, a center portion of the cable is fastened at the center of the ascent and descent range so that the cable can be suitably routed without slackening even at the lower-limit position, thereby reliably performing the raising and lowering operations of the operator cab.

[0053] The present invention also provides a method of operating a crane which comprises a gib for lifting a load; a frame for supporting the base of the gib in a manner such that the gib is rotatable; an operator cab in which an operator operates the crane, said method characterized by comprising the step of raising or lowering the operator cab according to the height of the load.

[0054] The operator cab which can ascend or descend is raised or lowered according to the height of the load, so as to stop the operator cab at any position suitable for the crane operation. Therefore, if the load is placed at a higher position, the operator cab is raised to the higher position so that the operator can confirm the lifting and slinging operations or the like from a place closer to the load. Accordingly, the burden on the operator can be reduced and working or operational environments can be improved, thereby improving the working efficiency.

[0055] The present invention also provides a method of operating a crane which comprises a gib for lifting a load; a frame for supporting the base of the gib in a manner such that the gib is rotatable; an operator cab in which an operator operates the crane, said method characterized by comprising the step of raising, lowering, or substantially horizontally moving the operator cab so as to reduce a dead angle produced in the visual field of the operator who observes the load.

[0056] Here, in the crane operation, the operator substantially vertically or horizontally moves the operator cab so as to observe the load to be lifted while reducing

the dead angle in the visual field. If the operator cannot observe the load by any obstruction, the load is placed within the dead angle in the visual field of the operator. In order to reduce the dead angle, the operator cab is raised or lowered by the operator to a position where the operator can reliably observe and confirm the load and reliably perform the crane operation. Accordingly, the burden on the operator can be reduced and working or operational environments can be improved, thereby improving the working efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

[0057] Fig. 1 is a side view showing the general structure of a mobile harbor crane as an embodiment of the present invention.

[0058] Fig. 2 is an enlarged view of the vicinity of the operator cab in Fig. 1, which shows a front view of the operator cab.

[0059] Fig. 3 is also an enlarged view of the vicinity of the operator cab in Fig. 1, which shows a plan view of the operator cab.

[0060] Fig. 4 shows a rear view of the operator cab and the main frame in Fig. 1 and also shows the ascent and descent range of the operator cab.

[0061] Fig. 5 is a side view showing the operator cab of a variation of the mobile harbor crane in the embodiment.

[0062] Figs. 6A and 6B are diagrams for explaining the visual field of the operator in the operator cab, where Fig. 6A explains the visual field of the operator when the operator cab is at the upper-limit position, and Fig. 6B explains the visual field of the operator when the operator cab is at the lower-limit position.

[0063] Fig. 7 is a side view showing the general structure of a conventional mobile harbor crane.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0064] Hereinafter, embodiments according to the present invention will be explained with reference to the drawings.

[0065] Fig. 1 is a side view showing the general structure of a mobile harbor crane 1 as an embodiment of the present invention. Figs. 2 to 4 are enlarged views of the vicinity of the operator cab 50 in Fig. 1, where Fig. 2 shows a front view of the operator cab 50, Fig. 3 shows a plan view of the operator cab 50, and Fig. 4 shows a rear view of the operator cab 50 and also shows the ascent and descent range of the operator cab 50.

[0066] In Fig. 1, reference numeral 1 indicates the mobile harbor crane, reference numeral 2 indicates a rotating frame (i.e., an element of the frame of the present invention), reference numeral 3 indicates a main frame (i.e., another element of the frame of the present invention), reference numeral 4 indicates a gib, and reference numeral 50 indicates the operator cab.

[0067] The mobile harbor crane 1 (sometimes referred to as a "crane" hereinbelow) has the following main structural elements, that is, a carrier frame 11 having a plurality of tires 14 (for running) and four outriggers 12, the rotating frame 2 and the main frame 3 which are placed on the carrier frame 11, and the gib 4 attached to the main frame 3.

[0068] At each end of the carrier frame 11, two outriggers 12 are extended in the direction perpendicular to the longitudinal direction of the carrier frame 11, so as to ensure the balance of the crane. At the end of each outrigger 20, a vertical cylinder 13 is attached, and an outrigger float 13a is further attached to the end of the vertical cylinder 13.

[0069] Each vertical cylinder 13 is operated using oil pressure and can extend or retract so as to ensure the horizontalness of the crane body. During the crane operation (such as lifting a load or the like), the tires 14 for running are separated from the ground by operating the vertical cylinders, so as to fix the position of the crane. Conversely, when the vertical cylinders 13 are stored together with the outriggers 12, the tires 14 contact the ground, so that the crane can move on the grounds of the harbor.

[0070] Each outrigger float 13a has a large area so as to disperse the weight of the crane itself, the moment produced during the crane operation, or the like, and to reduce effects onto the ground.

[0071] At almost the center position of the carrier frame 11, a rotating bearing 16 having a circular shape is provided, and the rotating frame 2 is disposed on the carrier frame 11 via the rotating bearing 16. The rotating bearing 16 has rack-shaped teeth formed at the peripheral edge of the bearing, which are engaged with a pinion attached to the rotation driving apparatus (not shown). Accordingly, the rotating frame 2 is rotatable within 360 degrees around the center of the rotating bearing 16, which is the center of rotation and also corresponds to the center with respect to the operating radius of the crane operation.

[0072] On the rotating frame 2, the following structural elements are mainly provided, that is, the main frame 3 for supporting the base of the gib 4 in a manner such that the base (i.e., the gib) is rotatable, a winch 7 for winding up a main hoisting wire 6 which is connected to a hanging hook 5, a cylinder 8 for raising and lowering the gib 4, and the operator cab 50 in which the operator operates the crane. In addition, a counterweight 9 is attached at the rear side of the rotating frame 2 (i.e., opposite to the front side which may fall down), so as to balance the crane body (for preventing the falling-down of the crane) and to improve the load-lifting capability. At one side of the main frame 3 and on the revolving frame 2, a generator room 15 for generating power using an engine (not shown), and the like, are provided.

[0073] The main frame 3 has a trussed structure which has a plurality of rods combined with each other. At approximately the center position of the main frame

3 in the vertical direction, the base of the gib 4 (i.e., the right end of the gib 4 (explained below) in Fig. 1) is attached via a gib foot pin 4e. As the base of the gib 4 is positioned relatively high from the ground, a load can be shipped on or discharged from a high position such as a deck of a ship.

[0074] The gib 4 has a long beam shape having a trussed structure, and the base of the gib 4, that is, an end of the gib is rotatably supported at almost the center position of the main frame 3, as explained above. In addition, an end of the rod portion of the cylinder 8 is rotatably attached to the gib 4 via a pin 8a, so as to support the gib, where the position where the end of the rod portion is attached is close to the base of the gib 4. The other end (i.e., bottom side) of the cylinder 8 is rotatably attached to a front portion of the rotating frame 2 via a pin 8b.

[0075] Therefore, the operations of raising and lowering the gib 4 are performed by the extending and retracting operations of the cylinder 8. The gib foot pin 4e functions as the center axis of the rising and lowering operation, thereby defining the operating radius of the crane at the end of the gib 4, that is, at the hanging hook 5.

[0076] That is, the hanging hook 5 for hanging a load is hanging down from the end of the gib 4 via the main hoisting wire 6. At the end of the gib 4, a support wire 4a is also connected so as to raise the gib 4 and support the weight of the gib 4.

[0077] This support wire 4a is connected to a weight 4c at the back face of the main frame 3, via the end of the gib 4 and a top sheave 4b attached to the upper end of the main frame 3. Therefore, a part of the weight of the gib 4 is supported by the weight 4c.

[0078] An end of the main hoisting wire 6 is wound up around the hanging hook 5, and the other end is rolled up around the winch 7 which is placed on the rotating frame 2. More specifically, the main hoisting wire 6 is rolled up from the end of the gib 4 to the upper end of the main frame 3 (i.e., above the gib 4, see reference symbols 6a and 6b), and the main hoisting wire 6 reaches the winch 7 via a sheave 6c attached to the upper end of the main frame 3.

[0079] The main hoisting wire 6 is wound up according to the rotation of the winch 7, so that the hanging hook 5 ascends. Conversely, according to the backward rotation of the winch 7, the hanging hook 5 descends.

[0080] Below, the structures of the operator cab 50, which can ascend and descend, and the main frame 3 for supporting the operator cab 50, will be explained as distinctive features of the present invention.

[0081] The operator cab 50 can ascend and descend within the ascent and descent range S (see the solid arrow in Fig. 1), that is, move vertically along a guide rail 57 (see Fig. 2) which is attached to and along the main frame 3.

[0082] The ascent and descent range S of the operator cab 50 is defined from a position on the rotating frame 2, which is in the vicinity of the bottom side of the cylinder

8, that is, where the conventional operator cab 10 is placed, to approximately the center position of the main frame 3, to which the base end of the gib 4 is attached. Therefore, the linear guide rail 57 is provided as connecting both ends of the above range.

[0083] The structure for moving the operator cab 50 will be explained in further detail with reference to Figs. 2 and 3.

[0084] The operator cab 50 is supported at one side face of the cab by the guide rail 57 which is arranged parallel to the main frame 3. The guide rail 57 is supported via support members 3a (i.e., constituents of the frame of the present invention) by the main frame 3. The guide rail 57 and the support members 3a form a ladder-like structure.

[0085] At the lower side of the left side face (i.e., the right side in Fig. 2) of the operator cab 50, two kinds of lower guide rollers 56a and 56b are attached via a lower bracket 51b.

[0086] The rotation axis of the first lower guide roller 56a (a constituent of the raising and lowering means of the present invention) perpendicularly intersects with the longitudinal direction of the guide rail 57 in a manner such that the rotation axis is perpendicular to the surface of Fig. 2. This first lower guide roller 56a can move while rotating on the guide rail 57 and also supporting one side of the operator cab 50, and the rear side of the operator cab 50 also has a first lower guide roller 56a.

[0087] The rotation axis of the second lower guide roller 56b (another constituent of the raising and lowering means of the present invention) also perpendicularly intersects with the longitudinal direction of the guide rail 57 in a manner such that the rotation axis extends from the vicinity of the right side of the main frame 3 and is parallel to the surface of Fig. 2. This second lower guide roller 56b can move while rotating on the guide rail 57 and also prevent the operator cab 50 from swinging back and forth, and the rear side of the operator cab 50 also has a second lower guide roller 56b.

[0088] An upper bracket 51a is formed at the upper portion of the operator cab 50, and along the left side face of the operator cab 50. Two kinds of upper guide rollers 55a and 55b, similar to the above-explained lower guide rollers 56a and 56b, are attached to the upper side to the upper bracket 51a.

[0089] That is, the rotation axis of the first upper guide roller 55a (a constituent of the raising and lowering means of the present invention) perpendicularly intersects with the longitudinal direction of the guide rail 57 in a manner such that the rotation axis is perpendicular to the surface of Fig. 2. This first upper guide roller 55a can move while rotating on the guide rail 57 and also supporting one side of the operator cab 50, and the rear side of the operator cab 50 also has a first lower guide roller 55a.

[0090] The rotation axis of the second upper guide roller 55b (another constituent of the raising and lowering means of the present invention) also perpendicularly

intersects with the longitudinal direction of the guide rail 57 in a manner such that the rotation axis extends from the vicinity of the right side of the main frame 3 and is parallel to the surface of Fig. 2. This second upper guide roller 55b can move while rotating on the guide rail 57 and also prevent the operator cab 50 from swinging back and forth, and the rear side of the operator cab 50 also has a second upper guide roller 55b.

[0091] A motor 52 (another constituent (i.e., the driving device) of the raising and lowering means of the present invention) is also provided at the upper bracket 51a, and the rotation shaft of the motor 52 perpendicularly intersects with the longitudinal direction of the guide rail 57 in a manner such that the rotation shaft extends from the vicinity of the right side of the main frame 3 and is parallel to the surface of Fig. 2.

[0092] A pinion 53, around which teeth are formed, is attached to an end of the rotation shaft of the motor 52, so that driving force generated by the motor 52 is transmitted to the pinion 53.

[0093] At the upper portion of the guide rail 57, a position detecting member 57a (i.e., a constituent of the position detecting means of the present invention) for indicating the upper end of the guide rail 57 is provided. The position of this position detecting member 57a is conformed to the position of a limit switch 60 (another constituent of the position detecting means of the present invention) which is attached to the upper end of the upper bracket 51 a of the operator cab 50.

[0094] When the operator cab 50 ascends and the limit switch 60 contacts the position detecting member 57a, the limit switch 60 detects that the operator cab 50 has reached the upper-limit position, and the limit switch 60 then makes the operation of raising the operator cab 50 stop (i.e., outputs a signal for stopping the operator cab 50). That is, the limit switch functions as a protective or safety device for the raising operation of the operator cab 50.

[0095] A similar limit switch 61 (i.e., another constituent of the position detecting means of the present invention) is provided at the lower bracket 51b. When the limit switch 61 contacts a position detecting member (not shown) for indicating the lower-limit position of the guide rail 57, the limit switch 61 detects that the operator cab 50 has reached the lower-limit position and makes the operator cab 50 automatically stop.

[0096] The position detecting means may also be provided at any position within the ascent and descent range of the operator cab, and the operator or the like may be informed of the current position of the operator cab by showing data on a display or the like. In addition, an optimum position of the operator cab for each crane operation may be stored. Therefore, if the load can be estimated, the operator cab can be immediately moved to the optimum position at which the operator can easily observe the load, thereby improving the working efficiency.

[0097] As shown in Fig. 3 (a plan view of the operator

cab 50), the pinion 53 is engaged with a rack 54 which is provided along the guide rail 57. The rack 54 is made of a plate or square-shaped material and teeth corresponding to the ascent and descent range of the operator cab 50 are formed on a side face of the material. Therefore, according to the rotation of the motor 52, the pinion 53 moves along the rack 54, thereby raising or lowering the operator cab 50.

[0098] That is, the guide rail 57 and the rack 54 are formed over the ascent and descent range S of the operator cab 50 and along the main frame 3. The guide rail 57 is coupled with the main frame 3 via support members 3a which are constituents of the main frame 3. This support member 3a are arranged at equal intervals within the ascent and descent range, so as to support the long guide rail 57.

[0099] Below, with reference to Fig. 4 (i.e., a rear view of the operator cab 50 and the like), the routing of a cable 58 will be explained.

[0100] In the operator cab 50, devices for the crane operations performed by the operator, control devices for outputting data of the devices mounted on the rotating frame 2, and the like are provided. In addition, a control panel or the like for controlling the above-explained raising and lowering means (for moving the operator cab 50) is also provided in the operator cab 50. That is, the raising and lowering means can be easily operated by the operator via the control panel.

[0101] In addition, the winch 7, the cylinder 8, the rotation driving apparatus (not shown), and the like are operated according to outputs from a control section (not shown) provided on the rotating frame 2.

[0102] Therefore, the cable 58 for control is provided from the operator cab 50 to the rotating frame 2; thus, the cable 58 should be suitably routed in consideration of the ascending and descending operation of the operator cab 50. This cable 58 also functions as a cable for supplying electrical power from the generator room 15 on the rotating frame 2 to the motor 52 attached to the operator cab 50.

[0103] As shown in Fig. 4, the cable 58 hangs down from the operator cab 50 and a middle portion of the cable is fastened to a cable fastening portion F at almost the center position of the ascent and descent range S. The lower portion of the cable 58 is routed downward from the position F along the main frame 3 to the control section on the rotating frame 2 while being fastened at specific intervals by using metal fittings 59. In order to prevent the cable 58 from flapping, cable guides (not shown) or the like may be provided between the operator cab 50 and the cable fastening portion F and also between the portion F and the rotating frame 2.

[0104] In order that the operator cab 50 reaches the lower-limit position of the ascent and descent range S (see the operator cab 50 indicated by two-dot chain lines in Fig. 4), the cable 58 also moves according to the movement of the operator cab 50 (see a portion of the cable 58 indicated by dotted lines).

[0105] Below, the length of the cable 58 will be explained in detail. When the operator cab 50 is stopped at the upper-limit position, the upper half of the cable 58 extends from the operator cab 50 to the cable fastening portion F (which is the center position of the ascent and descent range S and to which the cable 58 is fastened) without slackening.

[0106] On the other hand, when the operator cab 50 is stopped at the lower-limit position of the ascent and descent range S, the cable 58 is folded downwards at the cable fastening portion F. In this case, the distance from the cable fastening portion F to the operator cab 50 is substantially the same as that when the operator cab 50 is positioned at the upper-limit position F. Therefore, the cable 58 has no slackening also in this case. Accordingly, in either case of (i) when the operator cab 50 stays at the upper-limit position and (ii) when the operator cab 50 stays at the lower-limit position, problems such as insufficient length of the cable or cable slackening do not occur.

[0107] If cable slackening occurs when the operator cab 50 is positioned at the lower-limit position, the extra portion of the cable may obstruct suitable routing of the cable 58. Therefore, in the present embodiment, a center portion of the cable 58 is fastened at the center of the ascent and descent range S so that the cable 58 can be routed without slackening even at the lower-limit position.

[0108] The mobile harbor crane 1 having the above-explained structure can work as shown in Figs. 6A and 6B. Figs. 6A and 6B are diagrams for explaining the visual field of the operator in the operator cab 50. Fig. 6A explains the visual field of the operator when the operator cab 50 is at the upper-limit position, while Fig. 6B explains the visual field of the operator when the operator cab 50 is at the lower-limit position.

[0109] In the figure, reference numeral 100a indicates a large container ship, reference numeral 100b indicates a small container ship, and reference numerals 101 indicate containers. In each figure, the shaded area indicates the dead angle produced in the visual field of the operator.

[0110] The mobile harbor crane 1 of the present embodiment is mounted at a small-to-medium-sized harbor, at which large or small ships as the ships 100a and 100b may dock. That is, such a small-to-medium-sized harbor rarely accepts a large ship, and even in such a case, the crane operation must be performed with existing equipment.

[0111] As shown in Fig. 6A, when containers 101 mounted on the large ship 100a are discharged, the operator cab 50 is positioned at the upper-limit position of the ascent and descent range S, thereby realizing preferable working environment for the operator who operates the crane.

[0112] To explain in much greater detail, many containers 101 are loaded on the deck and the like of the large container ship 100a, that is, at higher places in

comparison with the ground. Therefore, the slinging and lifting operations of these containers 101 are probably performed at higher positions. In order to perform such a slinging operation and the like, the operator raises or lowers the operator cab 50 according to the height of each container 101 and then performs the necessary crane operation.

[0113] In addition, such a large container ship 100a has a high wall and thus it is generally difficult for the operator to observe the bottom of the ship. However, in the present embodiment, the operator cab 50 can be moved to a higher position; thus, it is difficult for the wall surface of the large container ship 100a to obstruct the observation of the container 101 by the operator. That is, the dead angle (see the shaded area) can be reduced so that the operator can perform the necessary crane operation while reliably observing the containers 101 at the bottom of the ship.

[0114] On the other hand, in the small container ship 100b as shown in Fig. 6B, the operator cab 50 may be positioned at the lower-limit position of the ascent and descent range S or at a position corresponding to the upper edge of the wall surface of the small container ship 100b.

[0115] According to such positioning of the operator cab 50, the crane operation can be performed at a position closer to a target container 101; thus, the visual distance of the operator can be reduced.

[0116] Additionally, in order to lift a container 101 on the bottom face of the small container ship 100b, the operator cab 50 can be moved upward, thereby reducing the dead angle of the visual field of the operator.

[0117] As explained above, at a small-to-medium-sized harbor into which various sized ships (from large to small) may enter, the position of each load to be lifted and the shape of each load considerably change according to the size of the ship, and the visual field of the operator also considerably changes according to the height of the wall surface of each ship. Therefore, the raising and lowering operation of the operator cab 50 can reduce the visual distance and the dead angle, thereby safely performing the crane operation. In addition, the operator can observe the container 101 (as the load) and the like; thus, the actual states of the slinging and lifting operations can be observed and confirmed, thereby improving the working efficiency (i.e., operability) of the operator and reducing the fatigue of the operator.

[0118] Furthermore, the operator can get into the operator cab 50 at the lower-limit position of the ascent and descent range S; thus, the operator need not access a higher operator cab by using stairs or the like and the burden on the operator is reduced, so that the problem of accessing a higher operator cab can be solved. In addition, no elevator is necessary and the size of the equipment can be minimized.

[0119] As explained above, it is possible to provide the mobile harbor crane 1 having the operator cab 50

by which the burden on the operator can be reduced and the operability can be improved.

[0120] A variation of the present embodiment will be explained below.

[0121] In the above explanations, the rack 54 is provided along the guide rail 57 so as to raise and lower the operator cab 50, and the pinion 53 which is engaged with the rack 54 ascends or descends by driving the motor 52. However, the means for raising and lowering the operator cab 50 is not limited to such a structure. For example, a driving source such as a motor may be provided to the main frame 3 or the rotating frame 2, and the operator cab 50 may be attached to a wire, chain, cylinder, or the like. In this case, the operator cab 50 can be sufficiently raised or lowered, thereby obtaining effects similar to those explained above.

[0122] Also in the above explanations, the operator cab 50 ascends and descends along the main frame 3. However, the means for raising and lowering the operator cab 50 may be independently provided on the rotating frame 2. That is, the main frame 3 functions as a constituent of the rotating frame 2, and the means for raising and lowering the operator cab 50, which is provided on the rotating frame 2, can raise or lower the operator cab 50 so as to handle the load.

[0123] As shown in Fig. 5, a structure for moving the operator cab 50 in the horizontal direction may be employed. Reference numerals 62 in Fig. 5 indicate guide rollers (i.e., constituents of the means for horizontally moving the operator cab of the present invention), and a motor 63 is another constituent of the means for horizontally moving the operator cab. Here, an extension cable 58a connecting to the operator cab 50a is provided (a hoist-type crane has a similar structure). An upper bracket 51a' for supporting the operator cab 50a is a structural element independent of the operator cab 50a and the length of the upper bracket 51a' corresponds to the range of the horizontal movement of the operator cab 50a.

[0124] According to the above structure, when the operator in the operator cab 50a cannot observe the load, the operator cab 50a can be moved back and forth, or right and left so as to reduce the dead angle of the visual field of the operator, thereby further reducing the burden on the operator and realizing safety working environment for the crane operation.

[0125] In the above embodiments, the mobile harbor crane 1 which can move in the grounds of the harbor has been explained. However, the present invention can be applied to various kinds of cranes which have a gib and an operator cab.

Claims

1. A crane (1) comprising:

a gib (4) for lifting a load;

a frame for supporting the base of the gib in a manner such that the gib is rotatable; an operator cab (50) in which an operator operates the crane,

wherein the crane is **characterized by** comprising:

raising and lowering means for raising and lowering the operator cab.

2. A crane as claimed in claim 1, characterized in that:

the raising and lowering means has a driving device for driving the raising and lowering means; and the driving device is attached to the operator cab.

3. A crane as claimed in claim 1 or 2, characterized in that:

the operator cab is raised or lowered by the raising and lowering means according to the height of the load.

4. A crane as claimed in claim 1 or 2, characterized in that:

the operator cab is raised or lowered by the raising and lowering means so as to reduce a dead angle produced in the visual field of the operator who observes the load.

5. A crane as claimed in any one of claims 1 to 4, characterized by further comprising:

position detecting means (60) for detecting the position of the operator cab which ascends or descends.

6. A crane as claimed in claim 5, characterized in that:

the position detecting means outputs a signal for stopping the operator cab when the operator cab reaches a limit position.

7. A crane as claimed in any one of claims 1 to 6, characterized in that the raising and lowering means includes:

a rack (54) provided along the frame; a pinion (53) which is engaged with the rack and is attached to the operator cab; and a motor (52) for driving the pinion, wherein the motor is attached to the operator cab.

8. A crane as claimed in any one of claims 1 to 7, characterized by further comprising:

means for substantially horizontally moving the operator cab.

9. A crane as claimed in any one of claims 1 to 8, characterized by further comprising:

a cable (58) for control, extending from the operator cab to the frame, wherein:

the operator cab is raised or lowered within a predetermined ascent and descent range; the frame has a cable fastening portion (F) provided at a position corresponding to almost the center of the ascent and descent range; and a middle portion of the cable is fastened to the cable fastening portion.

10. A method of operating a crane which comprises a gib for lifting a load; a frame for supporting the base of the gib in a manner such that the gib is rotatable; an operator cab in which an operator operates the crane, said method characterized by comprising the step of:

raising or lowering the operator cab according to the height of the load.

11. A method of operating a crane which comprises a gib for lifting a load; a frame for supporting the base of the gib in a manner such that the gib is rotatable; an operator cab in which an operator operates the crane, said method characterized by comprising the step of:

raising, lowering, or substantially horizontally moving the operator cab so as to reduce a dead angle produced in the visual field of the operator who observes the load.

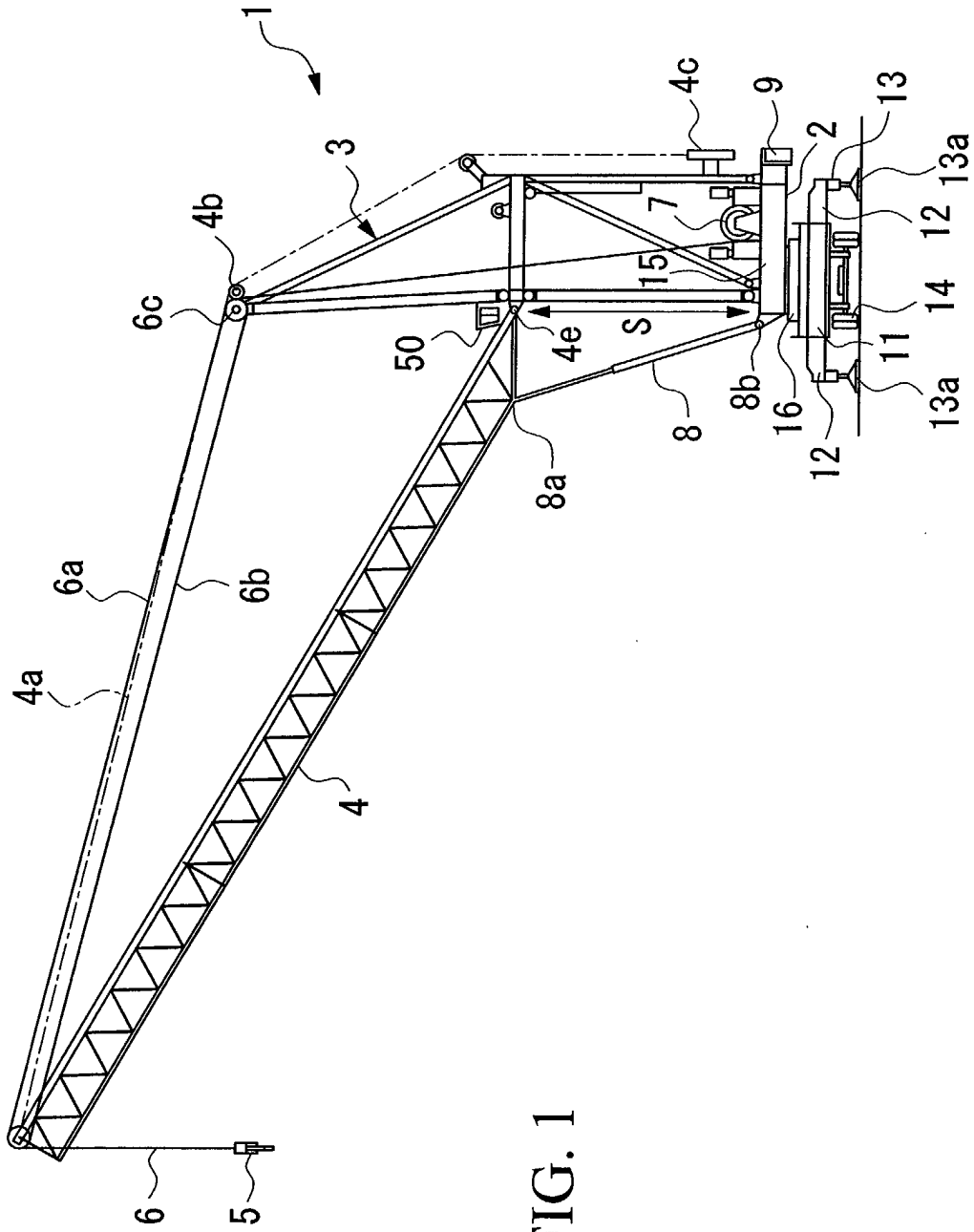


FIG. 1

FIG. 2

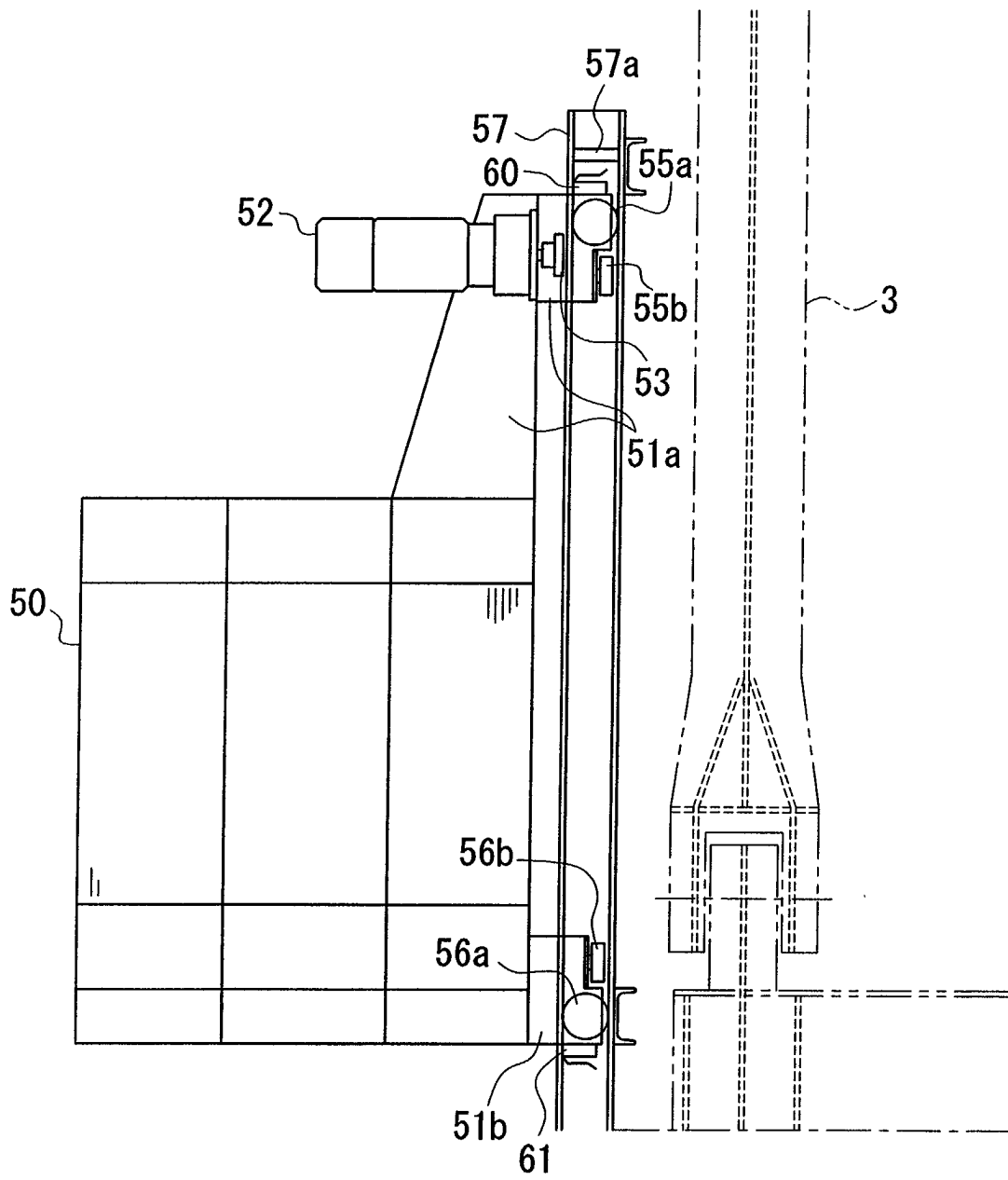


FIG. 3

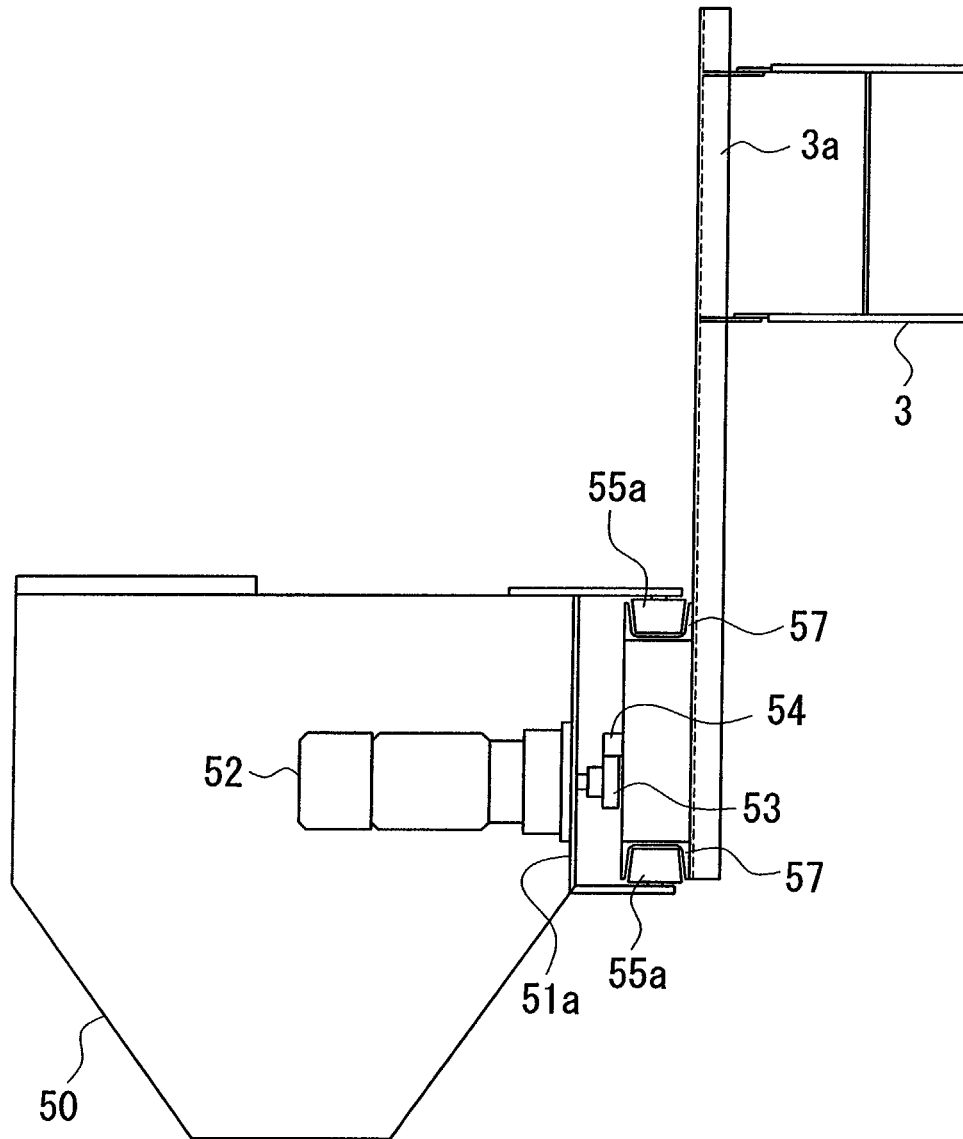


FIG. 4

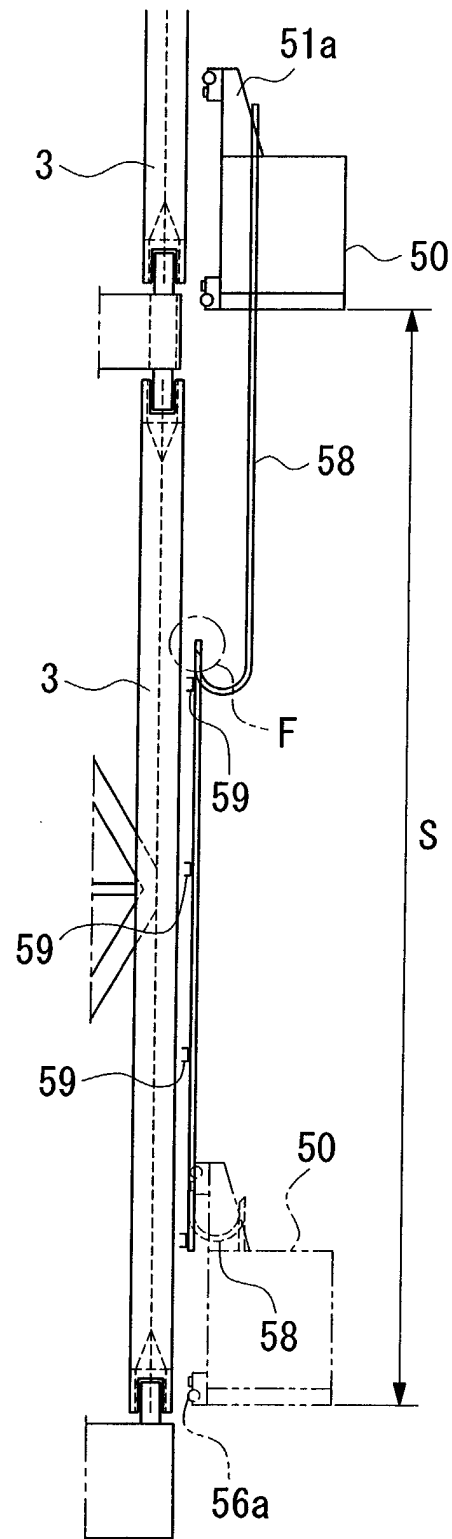


FIG. 5

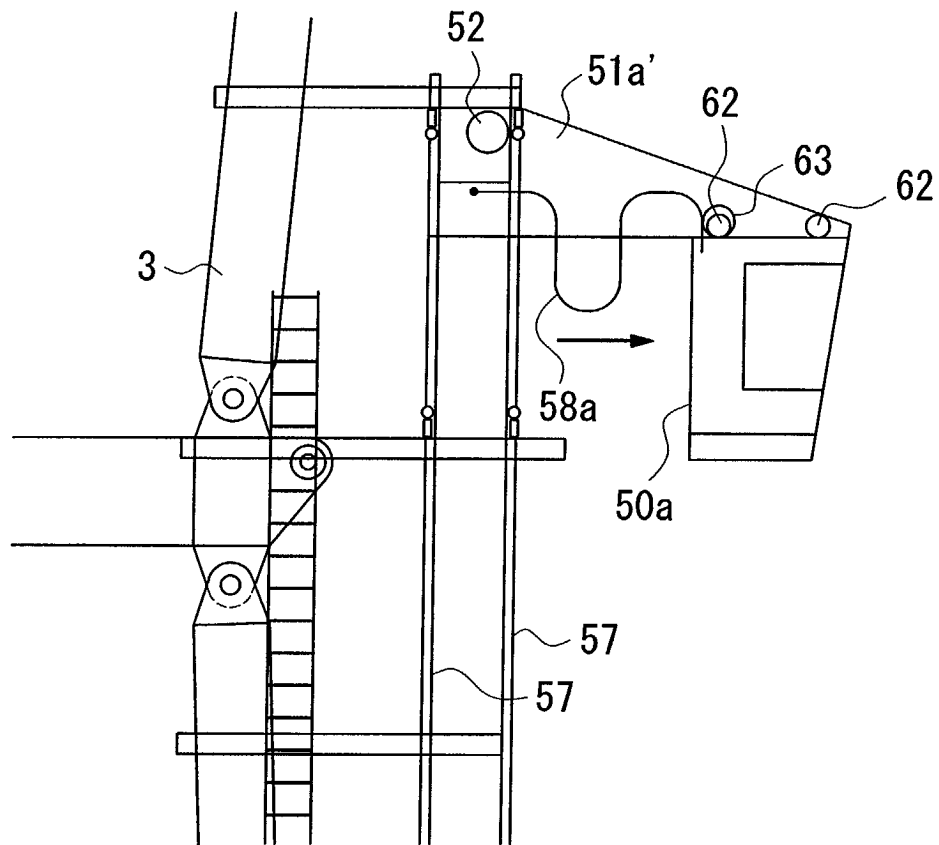


FIG. 6B

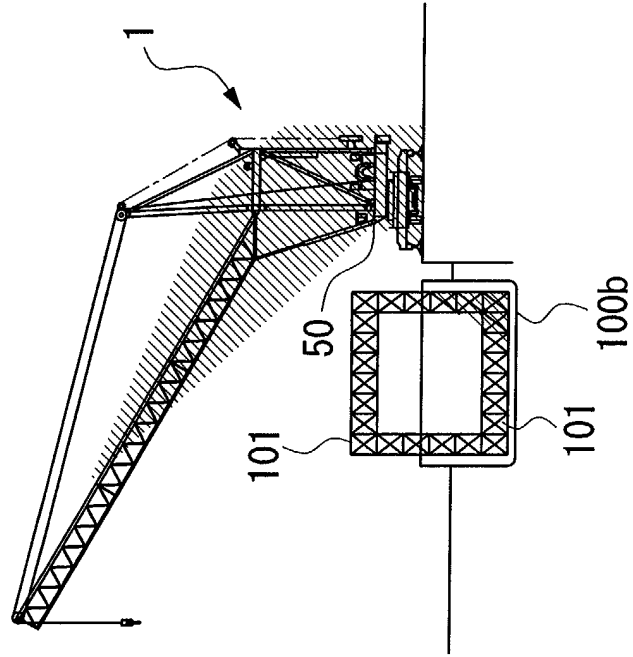


FIG. 6A

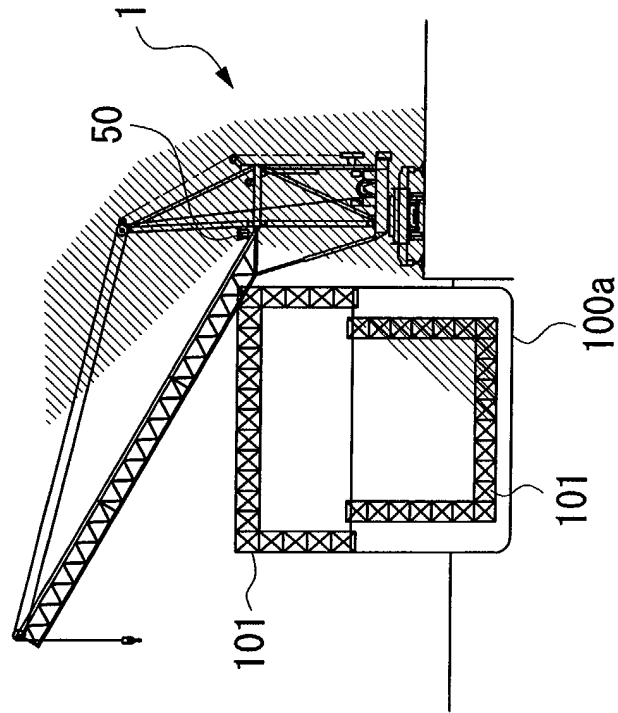
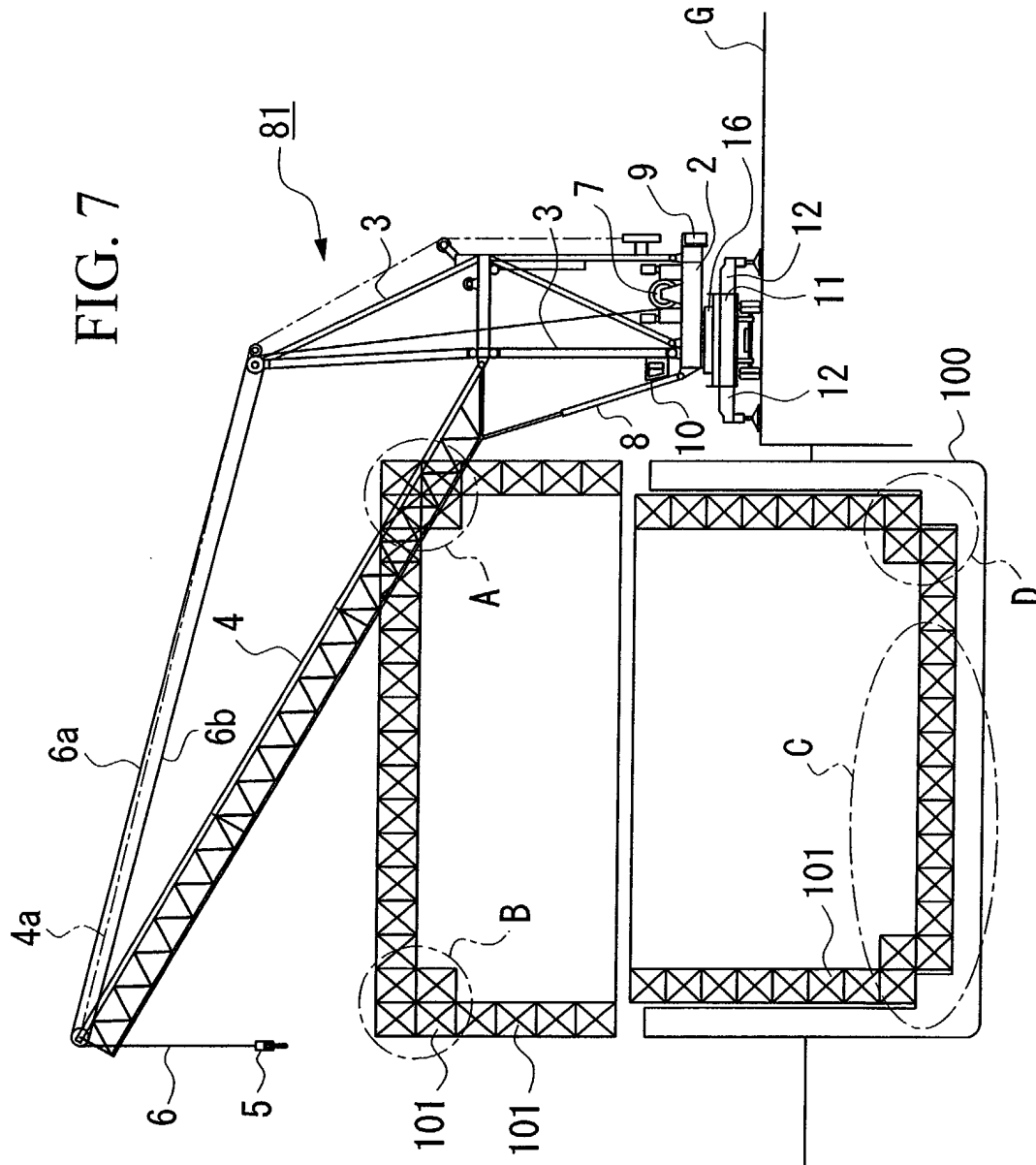


FIG. 7





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Application Number
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Place of search		Date of completion of the search	Examiner
THE HAGUE		12 February 2003	Sheppard, B
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