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(71) Applicants:
- **KOMATSU LTD.**
  **Minato-ku Tokyo 107 (JP)**
- **KOMATSU MEC KABUSHIKI KAISHA**
  **Tokyo 107 (JP)**

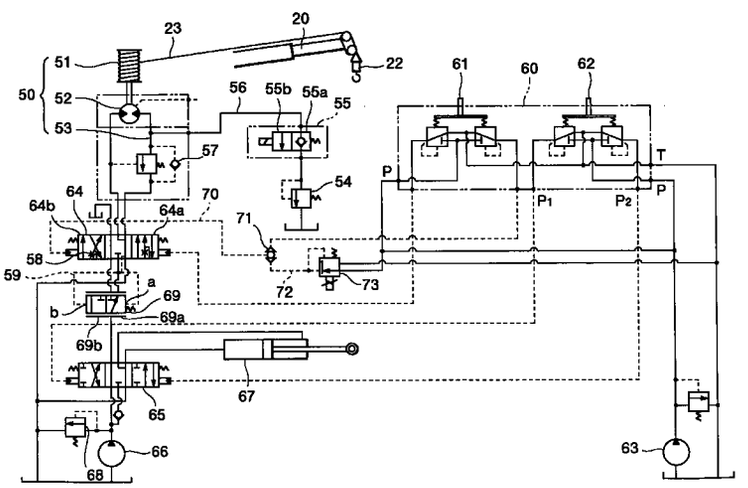
(72) Inventors:
- **Mukaino, Masayuki,**
  **Komatsu Mec Main Plant,**
  **Kawagoe-shi, Saitama 350-11 (JP)**
- **Mokka, Keiichi,**
  **Komatsu Mec Main Plant,**
  **Kawagoe-shi, Saitama 350-11 (JP)**
- **Ikari, Masanori,**
  **Komatsu Mec Main Plant,**
  **Kawagoe-shi, Saitama 350-11 (JP)**
- **Wada, Minori,**
  **Komatsu Mec Main Plant,**
  **Kawagoe-shi, Saitama 350-11 (JP)**

(74) Representative: **Meissner, Peter E., Dipl.-Ing. et al**
**Meissner & Meissner,**
**Patentanwaltsbüro,**
**Hohenzollerndamm 89**
**14199 Berlin (DE)**

## (54) METHOD OF AND APPARATUS FOR EXTENDING AND STORING BOOM

(57) The present invention relates to a method of and an apparatus for projecting and storing a boom, which can be operated from a cab since a hook is securely locked with a second boom, so that no loosening and over-tightening of a wire rope occurs. To this end, the apparatus comprises a locking means (34) for locking the hook (22) with the second boom (20), a low pressure relief, means (54) for a driving oil pressure of a hydraulic winch (50), a maintenance means (73) for maintaining a low-speed hoisting operation of the winch (50), and a sheave (14) engaged with a wire rope (23) which connects the winch (50) and the hook (22).

FIG.5




EP 0 768 274 A1

## Description

### TECHNICAL FIELD

The present invention relates to a method of and an apparatus for projecting and storing a boom, and more particularly, to a method of and an apparatus for projecting and storing a second boom of a crane track in which the second boom is stored in parallel with the side of a first boom.

### BACKGROUND ART

A construction and an operation of a conventional crane track will be described by appropriating Figs. 13 to 18 which are related to the present invention. In a conventional crane track, as shown in Figs. 13 and 14, a first boom 2 is mounted vertically swingably on a vehicle 1. A rotary bracket 10 is rotatably mounted to the tip of the first boom 2 by means of a shaft 11 disposed in a direction substantially perpendicular to the ground. A second boom 20 is mounted vertically swingably to the rotary bracket 10 by means of a pin 12. Figs. 13 and 14 illustrate a travelable condition in which the second boom 20 is stored in the side of the first boom 1, and outriggers 4 are stored in a chassis 1.

Hooks 5 and 22 disposed to the second boom 20 for suspending a cargo are hung by wire ropes 6 and 23 connected to a winch (not shown) carried in the chassis 1. In addition, in a travel condition, the wire ropes 6, 23 are hoisted by the winch, and the hooks 5, 22 are in the locked condition.

Next, the procedure of projecting the second boom 20 from a storage condition to put it in a suspending operation performable condition will be described.

(1) As shown in Fig. 15, the outriggers 4 are projected, then a first boom cylinder 3 of the first boom 2 is extended to raise, and thereafter the first boom 2 is extended about 1 m in a direction of the arrow.
(2) After the extension, as shown in Fig. 16, a second boom cylinder 21 is shortened to lower the second boom 20.
(3) Next, as shown in Fig. 17, the rotary bracket 10 is rotated approximately 180° about the shaft 11 to allow a longitudinal axis of the second boom 20 to coincide with a longitudinal axis of the first boom 2 (hereinafter, referred to as a projection stroke).
(4) After the coincidence, a connecting pin 18 is inserted at a position where a hole 9 formed in the other side of the first boom 2 coincides with a hole 17 formed in the other side of the rotary bracket 10. Incidentally, the holes 9, 17 and the connecting pin 18 in the storage condition are shown in Fig. 14.
(5) Next, as shown in Fig. 18, the second boom cylinder 21 is extended to raise the second boom 20. This finishes the projecting operation, so that the suspending operation performable condition can be created.

However, in such a construction, since the hook is locked due to hoisting of the winch with the second boom stored in parallel with the first boom, the wire rope may be loosened and over-tightened in the course of the above-described raising stroke and the projecting stroke. For example, in the projecting stroke shown in Fig. 16, slack occurs in the wire rope, so that the hooks 5 and 22 droop as shown in Fig. 19. For this reason, interference occurs at a position J and a position K, and at a position L and a position M, the wire ropes 6, 23 excessively bend to cause kink. In addition, in a section N, there is a malfunction such that distortion and irregular winding of the wire rope 6 occur. Further, when the first boom 2 is extended in a hook storage condition shown in Fig. 15, there is a problem such that an excessive tension is generated on the wire rope, whereby the wire rope is cut, or the boom components and sheaves, etc. are damaged.

Thus, in order to avoid the above-described malfunction, conventionally, the operator removed each of the hooks 5, 22, and wire ropes 6, 23 from the second boom 20, the operator set the wire ropes 6, 23 again after a series of projecting operation had been performed, and then engaged each of the hooks 5, 22 with the wire ropes 6 and 23 so as to create the suspending operation performable condition.

However, in this case, the operator is obliged to perform a dangerous operation and a bitter operation such that the operator gets off the cab, and gets on each boom to set the wire ropes 6, 23 on the second boom 20 and the first boom 2 using a stepladder and so forth. For this reason, a method and an apparatus for allowing all of the operations to be performed within the cab have been demanded.

### DISCLOSURE OF THE INVENTION

The present invention has been made to solve the drawbacks of the prior art, and has its object to provide a method of and an apparatus for projecting and storing a boom which can perform a projecting and a storing operations of a second boom with a hook locked with the second boom, without causing looseness and excessive tension on the wire rope during the projecting and storing operations of the boom.

A method of projecting and storing a boom according to the present invention provides a method of projecting and storing a boom of a crane track including a cargo suspending hook and a hydraulic winch for hoisting and lowering the hook in which a second boom is vertically swingably mounted to the tip of a first boom which is vertically swingably mounted to extend and contract in a multi-stage manner, and the second boom is stored in parallel with the side of the first boom, wherein the hydraulic winch maintains a correctly low-torque and correctly low-speed hoisting operation during projecting and storing of the second boom, whereby the hook is locked with the second boom at all times.

According to such a construction, the hook is

securely locked with the second boom by the hydraulic winch, so that an operator can perform the boom projecting and storing operations within a cab. In addition, since there is no looseness of the wire rope, interference between the hook and other members can be prevented and a correct tension of the wire rope can be obtained, so that damages to the boom components and wire rope, etc. can be also prevented.

An apparatus for projecting and storing a boom according to the present invention provides an apparatus for projecting and storing a boom of a crane track including a cargo suspending hook and a hydraulic winch for hoisting and lowering the hook in which a second boom is vertically swingably mounted to the tip of a first boom which is vertically swingably mounted to extend and contract in a multi-stage manner so that the second boom is stored in parallel with the side of the first boom, wherein the apparatus comprises a locking means for locking the hook with the second boom; a low pressure relief means for a driving oil pressure of the hydraulic winch; a maintenance means for maintaining a low-speed hoisting operation of the hydraulic winch; and a sheave mounted horizontal to the second boom to be engaged with a wire rope which connects the hydraulic winch and the hook. In addition, the apparatus may comprise a hook storage switch and a control device, and during actuating the hook storage switch, the control device may output an order for maintaining a pressure of a hook hoisting hydraulic motor of the hydraulic winch at a high pressure, or a non-excitation order for actuating the hook storage switch when a suspension load is a predetermined amount or more. Further, the number of the hook may be plural.

By such a construction, the same action and effect as those of the above-described method invention can be obtained. And, since the wire rope in time of storage is bent into a U-shape by a horizontally mounted sheave, the hook and winch are reasonably connected with the wire rope. Moreover, since the hook has been locked with the second boom, the wire rope is maintained in a suitable tight condition and hence does not loosen. In addition, since the control device outputs orders in response to the suspension load, when the hook is not in a storable condition, the hydraulic winch does not perform a hoisting operation even if the hook storage switch is turned on, and hence safety is ensured. Further, when a plurality of lockable hooks are mounted to the boom at all times, for example, when two hooks are mounted to the second boom, or when one hook is mounted to each of the first boom and the second boom, suspending operation performable object and range are expanded.

## BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a side view of a hook mounting section of the tip of a second boom according to an embodiment of the present invention;

Fig. 2 is a side view of another hook mounting section near the tip of the second boom according to the embodiment;

Fig. 3 is a plan view of a first boom and a rotary bracket connection in a second boom storage condition according to the embodiment;

Fig. 4 is a main part plan view of a second boom projecting condition according to the embodiment;

Fig. 5 is a hydraulic circuit diagram of a first embodiment of a boom and hook driving winch operating system according to the embodiment;

Fig. 6 is a block diagram of an interlocking device in the first embodiment of the winch operating system;

Fig. 7 is a flowchart of a projecting operation in the first embodiment of the winch operating system;

Fig. 8 is a flowchart of an interlocking device actuation in the first embodiment of the winch operating system;

Fig. 9 is a main part hydraulic circuit diagram of a second embodiment of the boom and hook driving winch operating system according to the embodiment;

Fig. 10 is a main part hydraulic circuit diagram of a third embodiment of the boom and hook driving winch operating system according to the embodiment;

Fig. 11 is a side view of a crane truck to which the present invention is applied, in which the hooks are mounted to the first and second boom and the second boom shows a storage position;

Fig. 12 is a side view of a position of the second boom in the course of projection of the crane track of Fig. 11;

Fig. 13 is a side view of a crane track according to an embodiment of the present invention in which a plurality of hooks are mounted to the second boom;

Fig. 14 is a plan view of the crane track of Fig. 13;

Figs. 15 to 18 are views for explaining mid-course of a stroke in the second boom projecting operation of the crane track of Fig. 13 in which: Fig. 15 is a side view of a first stroke; Fig. 16 is a side view of a second stroke; Fig. 17 is a side view of a third stroke; and Fig. 18 is a side view of a fourth stroke; and

Fig. 19 is an explanatory view of a hook wire rope malfunction of a crane track according to a prior art.

## BEST MODE FOR CARRYING OUT THE INVENTION

The preferred embodiments of a method of and an apparatus for projecting and storing a boom according to the present invention will be described in detail with reference to the attached drawings.

This embodiment is an example in which the present invention is applied to a crane track shown in Figs. 13 and 14. Referring to Fig. 1, a sheave bracket 24 is fixed to the tip of a second boom 20, and two sheaves 25, 26 are mounted thereto. A bracket 30 is rockably mounted to the tip of the sheave bracket 24 by means of a pin 31, and a hook 22 is disposed on the lower surface

32 of the bracket 30. The hook 22 and a hydraulic winch 50 (see Fig. 5) are connected with a wire rope 23 through the sheaves 25, 26.

When the hydraulic winch 50 (hereinafter, referred to as the winch 50) is actuated to pull the wire rope 23 in the direction of the arrow A, the hook 22 and the bracket 30 integrally rotate in the direction of the arrow B about the pin 31. And, at the position shown by fine lines, a stopper 33 provided in the bracket 30 abuts against a stopper 27 to present a locked state. That is, the stoppers 27, 33 constitute a locking means 34 of the hook 22.

Referring to Fig. 2, a sheave 35 is mounted to the side of the second boom 20 by means of a sheave bracket 36, and a sheave 37 is mounted to the lower surface of the second boom 20 by means of a sheave bracket 38, respectively. A bracket 40 is rockably mounted to the tip of the sheave bracket 38 by means of a pin 41, and a hook 5 is disposed on the lower surface 42 of the bracket 40. The sheave 46 of the hook 5 and the winch 50 (see Fig. 5) are connected with a wire rope 6 through the sheaves 35, 37, and the end of the wire rope 6 is connected to the bracket 43 provided on the lower surface of the second boom 20.

When the winch 50 is actuated to pull the wire rope 6 in the direction of the arrow C, the hook 5 and the bracket 40 integrally rotate in the direction of the arrow D about the pin 41. And, at the position shown by fine lines, a stopper 44 provided in the bracket 40 abuts against a stopper 45 to present a locked state. That is, the stoppers 44, 45 constitute a locking means 47 of the hook 5.

Referring to Fig. 3, brackets 7, 8 are fixed to both left and right of the tip of the front boom 2a of a first boom 2, and one side of a rotary bracket 10 is rotatably attached to the bracket 8 by means of a shaft 11. A rotary cylinder 13 is rotatably attached to the rotary bracket 10 by means of a pin 13a, and a lever 13a is disposed on a piston rod of the other end of the rotary cylinder 13. The lever 13b is rotatably attached to a pin 13c fixed to the rotary bracket 10, and the above-described piston rod is rotatably attached to one end thereof, and a link 13d is rotatably attached to the other end thereof. The link 13d is rotatably attached to the front boom 2a through a pin 13e. Rotatory power is given to a pin 13a with respect to the pin 13e by extension and contraction of the rotary cylinder 13, so that the rotary bracket 10 rotates about the shaft 11. That is, the rotary bracket 10 rotates in the direction of the arrow E when the rotary cylinder is extended, and rotates in the direction of the arrow E' when the rotary cylinder 13 is contracted. Incidentally, the pin 13c of this embodiment coincides with the axis of a sheave 14, which is described later.

In addition, the second boom 20 is rockably (vertical direction of the drawing) mounted to the tip of the rotary bracket 10 by means of the pin 12. The sheave 14 is mounted on one upper surface of the rotary bracket 10 horizontal to the second boom 20, and the wire rope 23 which connects the hook 22 and the winch 50 is engaged with the sheave 14. That is, the sheave 14 is disposed on one upper surface of the rotary bracket 10 so that the direction of rotation E of the rotary bracket 10 is horizontal to a groove engaged with the wire rope 23. Sheaves 15, 16 are horizontally mounted similar to the sheave 14 on the tip end upper surface of the first boom 2 and the other upper surface of the rotary bracket 10, and the wire rope 6 which connects the hook 5 and the winch 50 is engaged with the sheaves 15, 16.

According to such a construction, when the rotary cylinder 13 is extended, the rotary bracket 10 rotates in the direction of the arrow E about the shaft 11 to reach a position of alternate long and two short dashes line. When the rotary cylinder 13 is further extended, the rotary bracket 10, as shown in Fig. 4, reaches a position of solid line via the position of the alternate long and two short dashes line. In this condition, a hole 9 formed in a bracket 7 of the other side of the first boom 2 coincides with a hole 17 formed in the other side of the rotary bracket 10. In this coincided condition, a connecting pin 18 is inserted so as to fix the first boom 2 and the rotary bracket 10 at a projected position.

Next, a first embodiment of a boom and hook driving winch operating system according to the present invention will be described.

Fig. 5 is a hydraulic circuit diagram showing merely a winch operating system for the hook 22 of the second boom 20 and an operating system of a boom extension. A winch operating system for the hook 5 has been omitted because it is similar to the winch operating system for the hook 22. The winch 50 is provided with a drum 50, a hydraulic motor 52 and a hoisting circuit 53. Reference numeral 60 denotes an operating pilot valve, 61 denotes a winch operating valve, 62 denotes a boom extension operating valve, and 63 denotes a pilot pump. A pilot circuit for a winch selector valve 64 is connected to the winch operating valve 61, and a pilot circuit for a boom extension cylinder selector valve 65 is connected to the boom extension operating valve 62.

Discharging sides of the hydraulic pump 66 are connected to the boom extension cylinder 67 and to the hydraulic motor 52, respectively, via the boom extension cylinder selector valve 65 and the winch selector valve 64. Reference numeral 68 denotes a high pressure hydraulic relief valve, and 69 denotes a pressure compensating valve. A drain circuit 56 connected to the hoisting circuit 53 of the wire rope 23 for the hydraulic motor 52 is provided with a solenoid operated directional control valve 55 and a low pressure relief valve (low pressure means) 54.

A circuit 72 which connects a hoisting side pilot circuit 70 of the winch selector valve 64 and the pilot pump 63 through a shuttle valve 71 is provided with a solenoid operated proportional valve (maintenance means) 73. In addition, the hoisting circuit 53 is provided with a counter balance valve 57. The solenoid operated directional control valve 55 and the solenoid operated proportional valve 73 are connected to a control device 80 (see Fig. 6), which is described later, by a non-illus-

trated wiring.

Fig. 6 illustrates a construction of an interlocking device for ensuring safety of the above-described operating system, and the control device 80 is connected to a travel switch 81, a hook storage switch 82 and an operation switch 83 provided in a driver's seat. And, a pressure sensor 84 for a first boom derricking cylinder, a boom length sensor 85 and a boom angle sensor 86 are connected to the control device 80, and a suspension load is calculated therefrom.

In addition, the connecting pin 18 for connecting the rotary bracket 10 and the bracket 7 of the other side of the first boom 2, that is, the connecting pin 18 inserted when the hole 17 of the other side of the rotary bracket 10 coincides with the hole 9 of the bracket 7 is provided with a position detection sensor 87 which detects the insertion. The position detection sensor 87 is connected to the control device 80. Further, the control device 80 receives signals from each switch and each sensor, and sends out a control signal to the solenoid operated directional control valve 55 which opens and closes a circuit of the low pressure relief valve 64 (see Fig. 5) and to the solenoid operated proportional valve 73.

A second boom projecting method in the first embodiment of such winch operating system will be described in accordance with a flowchart shown in Fig. 7. A vehicle shall be initially in a travelable condition in which the second boom 20 is stored as shown in Fig. 13.

(1) In step 101, an operator turns the operation switch 82 on, and actuates an outrigger switch to project outriggers 4.

(2) In step 102, the operator turns the hook storage switch 82 on. The control device 80 sends out a control signal to change the solenoid operated directional control valve 55 shown in Fig. 5 into a position 55b, and an operating oil pressure acting the hoisting circuit for the hydraulic motor 52 is reduced to a low pressure Pa by the low pressure relief valve 54. At the same time, the solenoid operated proportional valve 73 is actuated to control a pilot pressure, and the winch selector valve 64 is controlled to a hoisting position 64b. After being changed to the hoisting position 64b, a pressure acting on a position a of the pressure compensating valve 69 is reduced to the pressure Pa by the low pressure relief valve 54 via a restrictor 58 within the selector valve 64. In addition, oil from the hydraulic pump 66 is restricted by the restrictor 58 to become a predetermined high pressure Pa + $\Delta$ P, and acts on a position b of the pressure compensating valve 69 via a pilot pipe 59. This allows a spring force to be balanced with respect to a differential pressure $\Delta$ P (differential pressure of the restrictor 58) between the pressure Pa + $\Delta$ P acting on the position b and the pressure Pa acting on the position a, so that the pressure compensating valve 69 is going to move in the direction of the position 69a. For this reason, a distribution flow rate of the oil from the hydraulic pump 66 is determined in accordance with the open area of the restrictor 58. This, will allow a low hoisting pressure to act on the hydraulic motor 52 at all times which drives the winch 50. Moreover, a constant low flow rate is supplied to the hoisting circuit 53. The wire rope 23 holds a constant tension at all times with the hook 22 engaged with the second boom 20. That is, the winch 50 maintains a low torque and a low-speed hoisting operation at all times.

(3) In step 103, the operator actuates a boom derricking lever (not shown) to raise the first boom 2, as shown in Fig. 15, and then actuates a boom extension lever (not shown) to extend the first boom 2 about 1 m in the direction of the arrow.

(4) In step 104, after the above-described extension, the operator shortens the second boom cylinder 21 to lower the second boom 20, as shown in Fig. 16.

(5) In step 105, the operator turns a boom projection and storage switch to the projection ON. The second boom 20 rotates in the direction of the arrow E about the shaft 11 by the extension of the rotary cylinder 13, that is, the rotary bracket 10 rotates about 180° as shown in Fig. 17 so as to be projected.

(6) In step 106, the operator inserts the connecting pin 18 to couple the first boom 2 and the rotary bracket 10.

(7) In step 107, the operator actuates the boom derricking lever to raise the second boom 20, as shown in Fig. 18. (8) In step 108, the operator turns the hook storage switch 82 off, and cancels the low-torque and low-speed hoisting to finish a projecting operation.

During the projecting operation as described above, the winch 50 is in a hoisting condition of a low-pressure and a low-speed at all times. For this reason, in the course of each of the above processes, for example, even in the projecting operation of the second boom 20 shown in Figs. 3 and 4, the wire rope 23 is suitably tightened at all times, so that looseness does not occur and there is no risk of kink and irregular winding. Therefore, it is possible to project and store the boom with the hook 22 engaged with the second boom 20, and moreover, with a low pressure and a low speed. That is, even if an excessive tensile force is going to act on the wire rope 23, the oil is relieved from the low pressure relief valve 54 and the wire rope 23 is wound out, so that there is no risk of fracture of the wire rope 23 and bracket damage. Moreover, the operator can easily perform projecting and storing operation of the second boom 20 in the driver's seat.

Next, the action of interlocking in the above-described winch operating system will be described in accordance with a flowchart of Fig. 8.

(1) In step 200, the operator turns the hook storage switch 82 on.

(2) In step 201, the control device 80 calculates a suspension load by the signals from the pressure sensor 84, the boom length sensor 83 and the boom angle sensor 86 to judge whether or not the suspension load is a predetermined amount or more. When the predetermined amount or more, under lifting operation is judged, and the procedure advances to step 204 to send an order of a high pressure to the winch 50 or to send a non-excitation order to the hook storage switch 82.

(3) When the suspension load is lower than the predetermined amount, it is judged that the hook can be stored, and the procedure advances to step 202 in which the control device 80 judges whether or not the connecting pin 18 connecting the first boom 2 and the second boom 20 is inserted by the signal from the position detection sensor 87 disposed on the connecting pin 18. When the connecting pin 18 is not inserted, it is judged that the second boom can be stored, and the procedure advances to step 205 in which the control device 80 sends a low-torque and low-speed rewinding order to the winch 50.

(4) When the connecting pin 18 is inserted, under lifting operation is judged and the procedure advances to step 203 in which the control device 80 judges whether or not the boom length is a predetermined amount or more by the signal from the boom length sensor 85. When the boom length is the predetermined amount or more, under lifting operation is judged and the procedure advances to step 204.

(5) When the boom length is shorter than the predetermined amount, it is judged that the hook can be stored, and the procedure advances to step 205.

As described above, by the action of interlocking of this embodiment, the winch 50 will not be in the hoisting operation, so that safety of the second boom projecting operation is ensured. Incidentally, although the similar action is exhibited even in a storing operation of the second boom 20, description thereof will be omitted.

Next, a second embodiment of the boom and hook driving winch operating system according to the present invention will be described.

Fig. 9 is a main part of a hydraulic circuit of this embodiment which illustrates only a portion different from that of Fig. 5. That is, the drain circuit 56 connected to the hydraulic motor 52 is provided with the solenoid operated directional control valve 55 and a solenoid operated proportional relief valve 90, and the solenoid operated directional control valve 55 is connected to the control device 80, as described above. In addition, the boom extension operating valve 62 of the pilot valve 60 is provided with a pressure switch 91 at a circuit of an extension side $P_1$, and a pressure switch 92 at a circuit of a contraction side $P_2$, and these pressure switches 91, 92 are connected to the control device 80.

An action due to such a construction will be described. When the hook storage switch 82 is turned on, the control device 80 sends out a control signal to switch the solenoid operated directional control valve 55 and receives a signal from the pressure switch 91 or 92. And, by a boom extending operation, the solenoid proportional relief valve 90 is controlled to control a pressure of the hoisting circuit 53 of the hydraulic motor 52. In other words, during extending the boom, the solenoid operated directional control valve 90 is switched to a low pressure to bring the winch 50 into a low-torque rewinding, and as the boom is extended, the wire rope 23 is allowed to be wound out from the winch 50 with the hook 22 engaged with the second boom 20. On the other hand, during shortening the boom, the solenoid operated directional control valve 90 is switched to a low pressure and the solenoid operated proportional valve 73 is actuated to bring the hydraulic winch 50 into a low-speed winding condition, whereby the wire rope 23 is suitably tightened at all times without being loosened.

Next, a third embodiment of the boom and hook driving winch operating system according to the present invention will be described.

Fig. 10 is a main part of a hydraulic circuit of this embodiment which illustrates only a portion different from that of Fig. 5. That is, the solenoid operated proportional valve 93 is provided on a circuit which connects a pump circuit P for the boom extension operating valve 62 and a tank circuit T. The solenoid operated proportional valve 93 controls a supply pressure of the pilot circuit to the boom extension operating valve 62 to control a extending and contracting speed of the boom. This prevents an excessive force from applying to the tightened wire rope 23 during extending the boom, and prevents a deflection phenomenon caused when the hoisting speed of the winch 50 does not catch up with the boom shortening speed during shortening the boom.

Although the embodiments of the method of and the apparatus for projecting and storing the boom are described in detail, the method and the apparatus are not limited to the above-described embodiments. First, regarding the hook 5 mounted to the second boom 20, the same actions and effects can be obtained by the same constructions as those of the above-described embodiments. In addition, regarding mounting positions of the plurality of hooks, for example, the hook 5 may be mounted to the first boom and the hook 22 may be mounted to the second boom 20, as shown in Figs. 11 and 12.

## INDUSTRIAL APPLICABILITY

The present invention is useful as a method of and an apparatus for projecting and storing a boom which can be operated from a cab since a hook is securely locked with a second boom during projecting and storing operation of the second boom, so that no loosening

and over-tightening of a wire rope occurs, and which can prevent occurrence of kink and irregular winding of the wire rope.

## Claims

1. A method of projecting and storing a boom of a crane track including a cargo suspending hook and a hydraulic winch for hoisting and lowering the hook in which a second boom is vertically swingably mounted to the tip of a first boom which is vertically swingably mounted to extend and contract in a multi-stage manner, and said second boom is stored in parallel with the side of said first boom,

   wherein said hydraulic winch (50) maintains a low-torque and low-speed hoisting operation during projecting and storing of said second boom (20), whereby said hook (22) is locked with said second boom (20) at all times.

2. An apparatus for projecting and storing a boom of a crane track including a cargo suspending hook and a hydraulic winch for hoisting and lowering the hook in which a second boom is vertically swingably mounted to the tip of a first boom which is vertically swingably mounted to extend and contract in a multi-stage manner so that said second boom is stored in parallel with the side of said first boom,

   wherein said apparatus comprises a locking means (34) for locking said hook (22) with said second boom (20); a low pressure relief means (54) for a driving oil pressure of said hydraulic winch (50); a maintenance means (73) for maintaining a low-speed hoisting operation of said hydraulic winch (50); and a sheave (14) mounted horizontal to said second boom (20) to be engaged with a wire rope (23) which connects said hydraulic winch (50) and said hook (22).

3. An apparatus for projecting and storing a boom according to claim 2 further comprising a hook storage switch (82) and a control device (80), wherein, during actuating said hook storage switch (82), said control device (80) outputs an order for maintaining a pressure of a hook hoisting hydraulic motor (52) of said hydraulic winch (50) at a high pressure, or a non-excitation order for actuating said hook storage switch (82) when a suspension load is a predetermined amount or more.

4. An apparatus for projecting and storing a boom according to claim 2 or 3, wherein the number of said hook (22) is plural (22, 5).

FIG.1

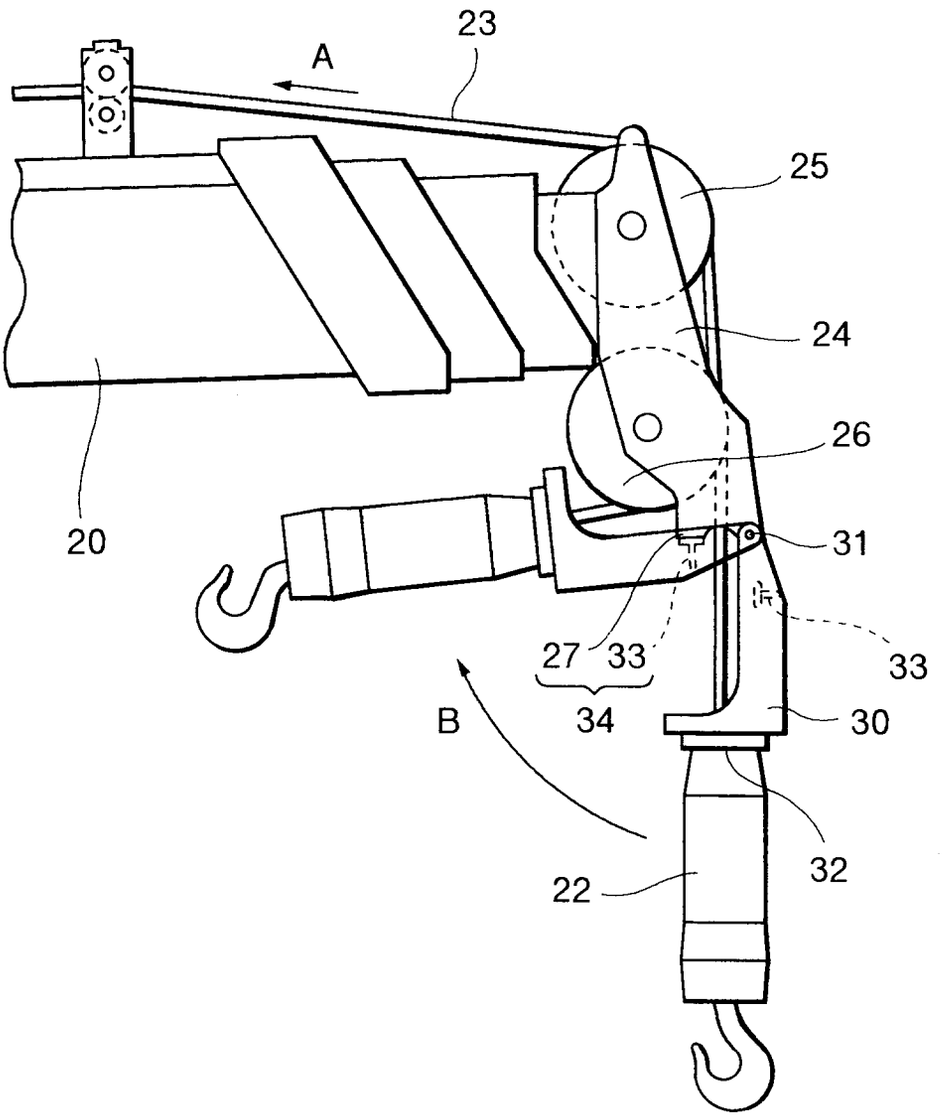


FIG.2

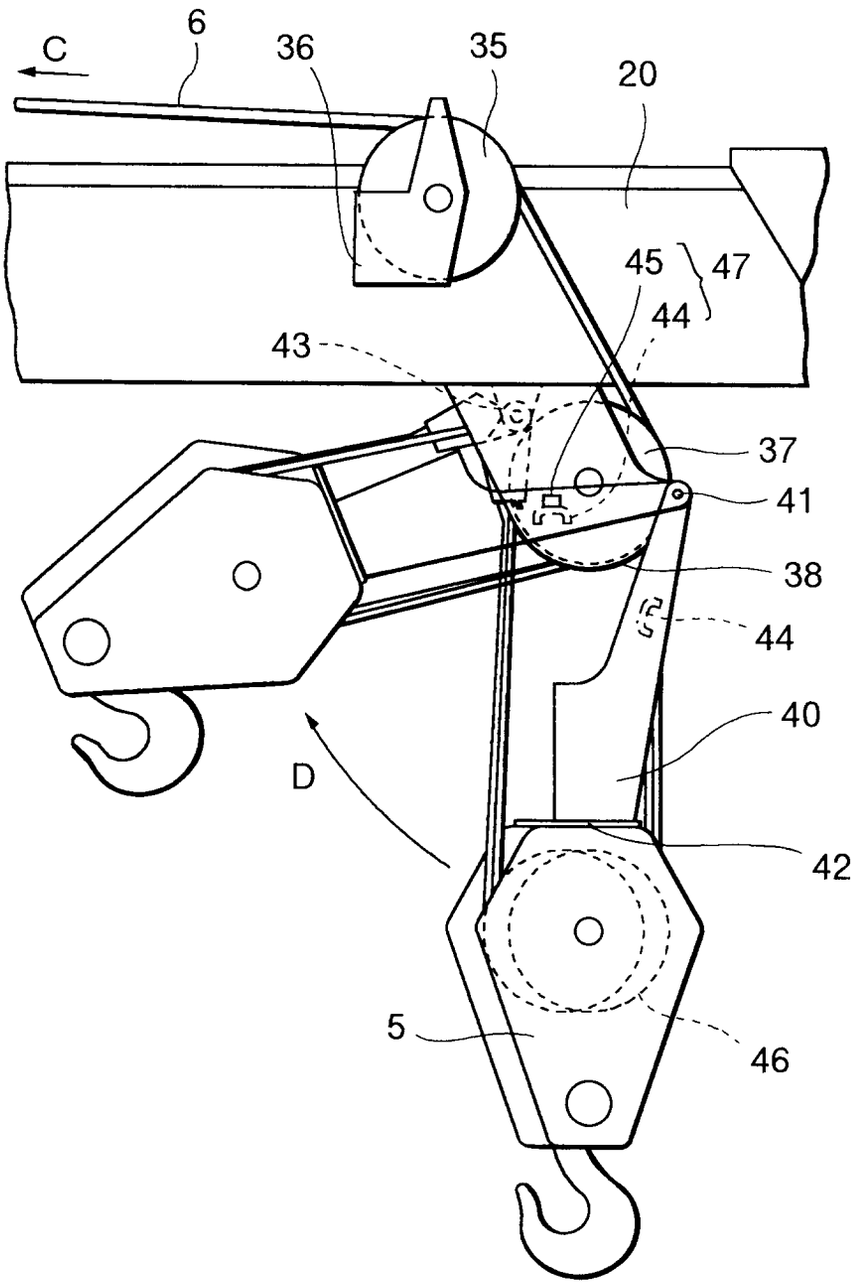


FIG.3

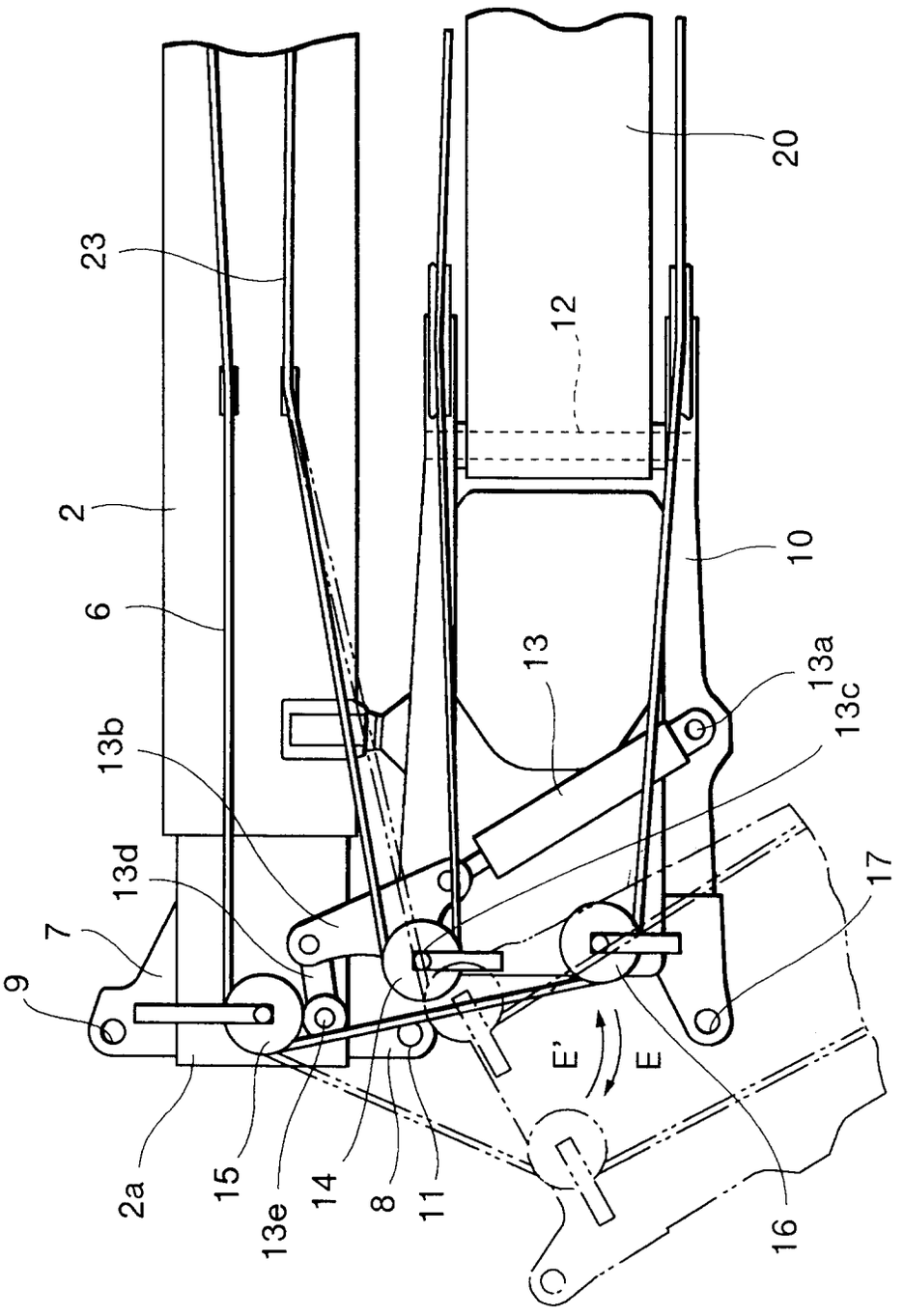


FIG.4

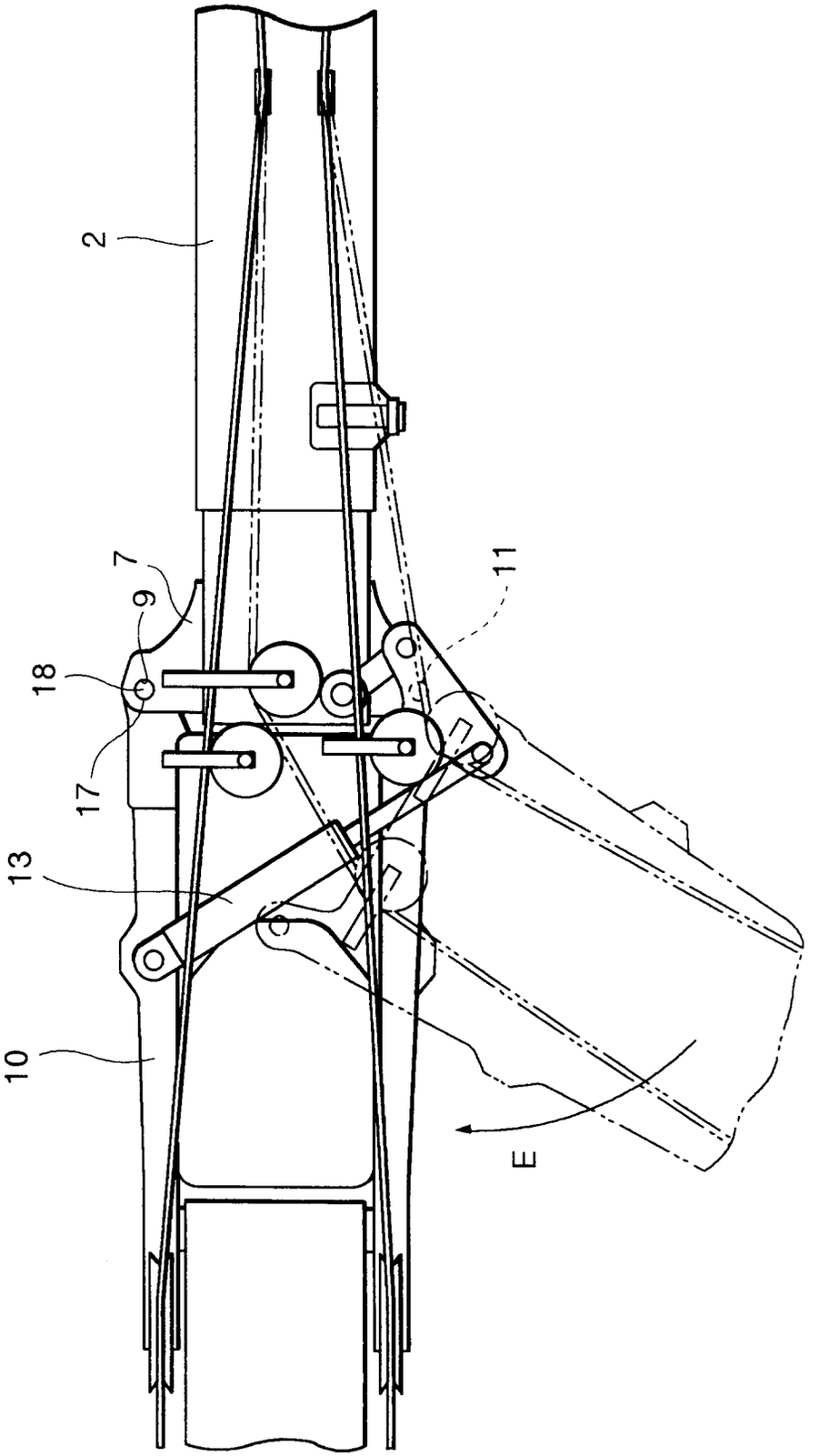


FIG.5

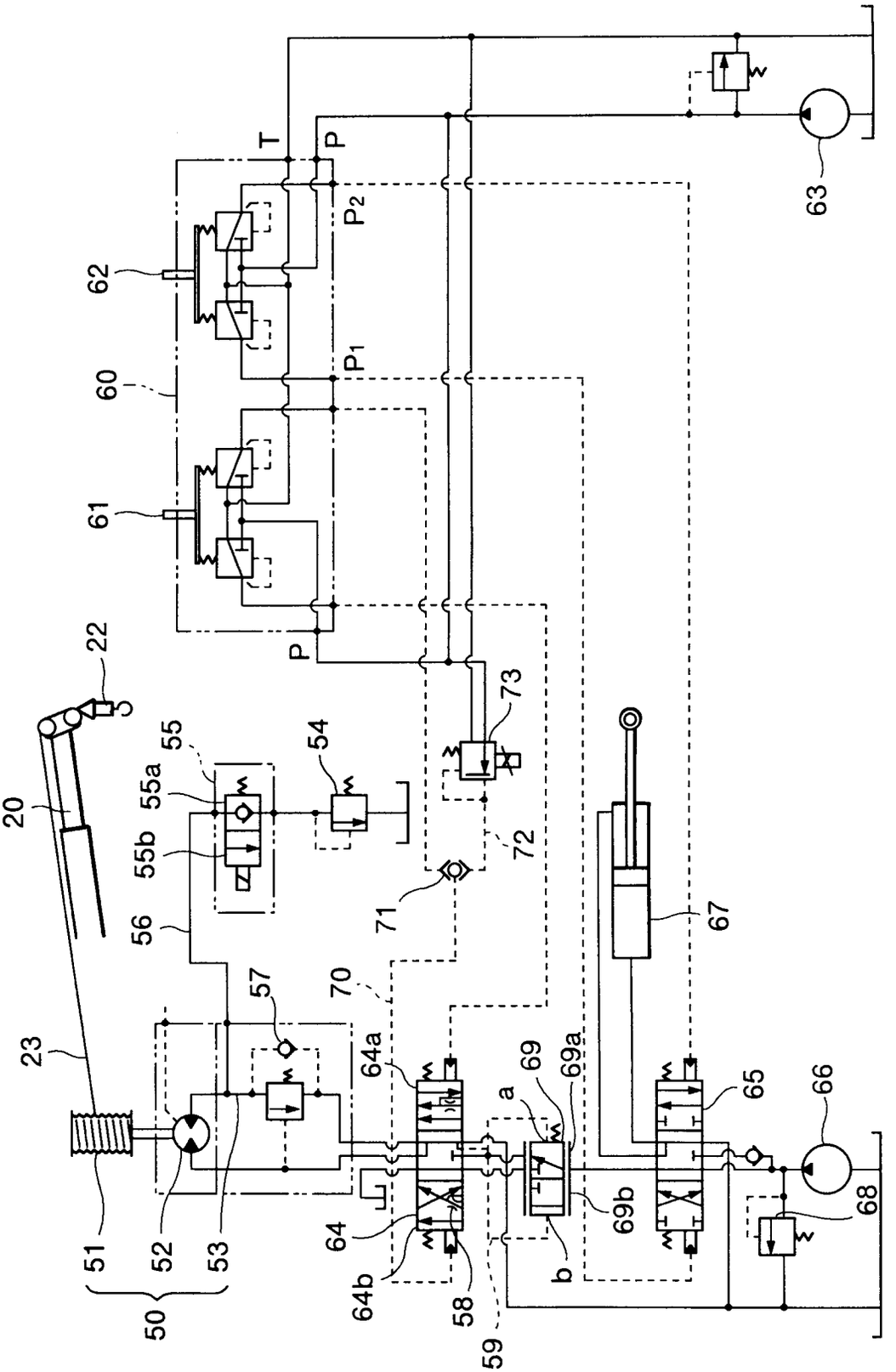

T
P
P2
P1
P
62
60
61
63
22
3
20
55
55a
55b
54
73
72
71
56
57
70
67
23
64a
69
69a
65
66
a
64
64b
58
59
69b
b
68
51
52
53
50

FIG.6

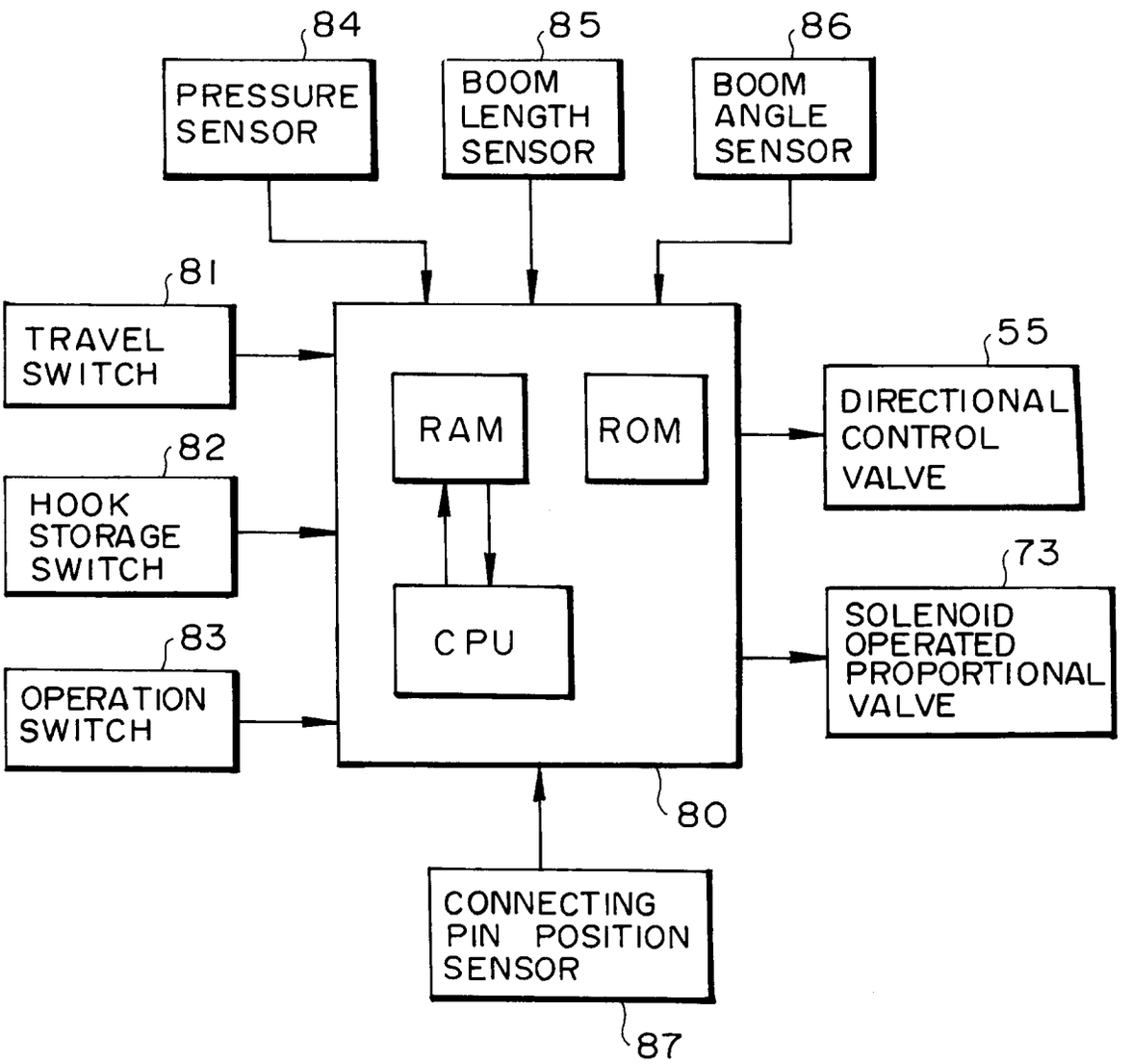

84
PRESSURE SENSOR
85
BOOM LENGTH SENSOR
86
BOOM ANGLE SENSOR
81
TRAVEL SWITCH
82
HOOK STORAGE SWITCH
83
OPERATION SWITCH
RAM
ROM
CPU
80
55
DIRECTIONAL CONTROL VALVE
73
SOLENOID OPERATED PROPORTIONAL VALVE
CONNECTING PIN POSITION SENSOR
87

FIG.7

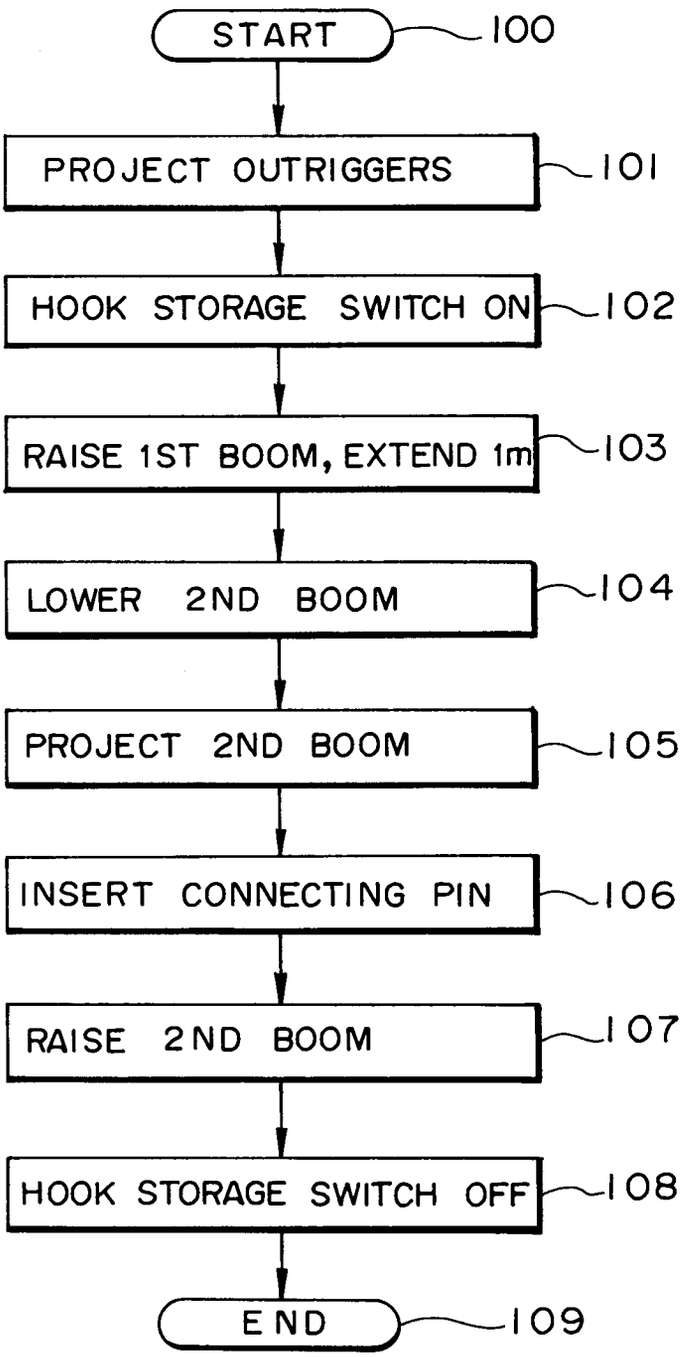

START
100
PROJECT OUTRIGGERS
101
HOOK STORAGE SWITCH ON
102
RAISE 1ST BOOM, EXTEND 1m
103
LOWER 2ND BOOM
104
PROJECT 2ND BOOM
105
INSERT CONNECTING PIN
106
RAISE 2ND BOOM
107
HOOK STORAGE SWITCH OFF
108
END
109

FIG.8

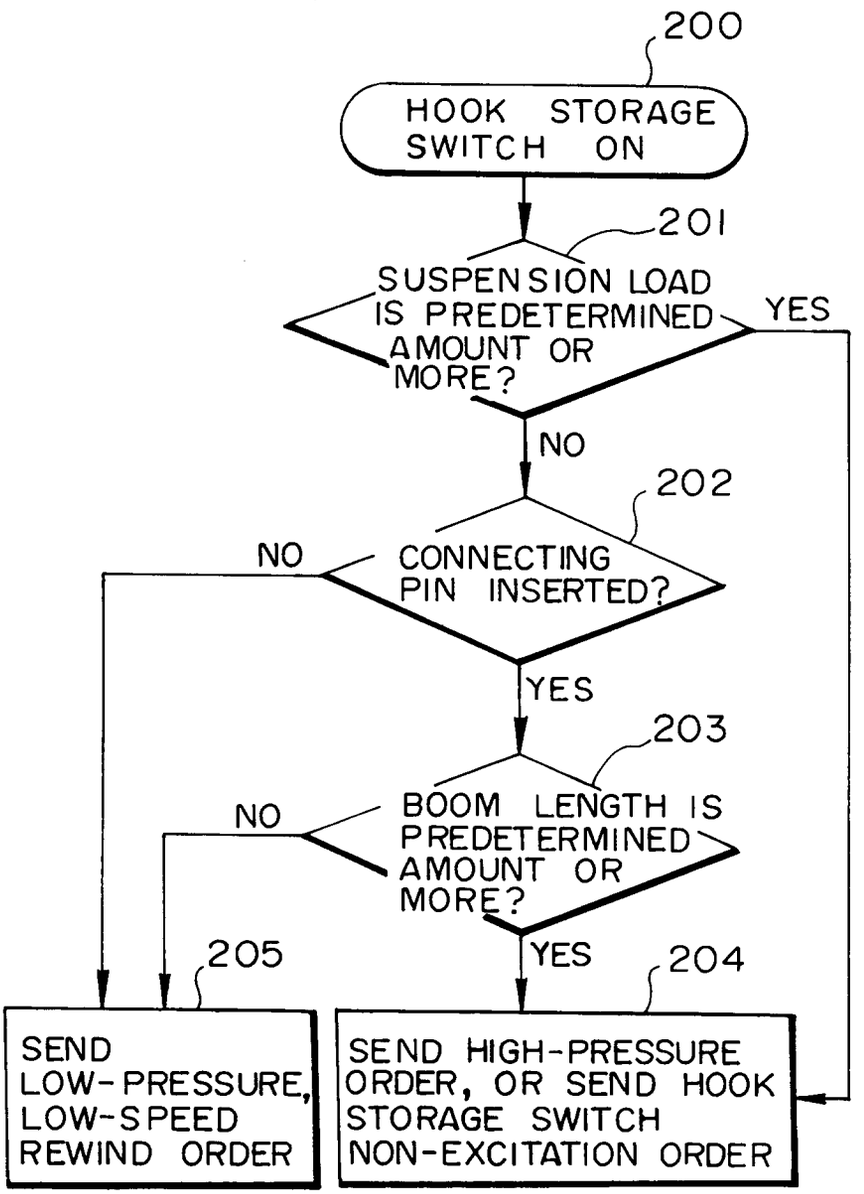

200
HOOK STORAGE SWITCH ON
201
SUSPENSION LOAD IS PREDETERMINED AMOUNT OR MORE?
YES
NO
202
NO
CONNECTING PIN INSERTED?
YES
203
NO
BOOM LENGTH IS PREDETERMINED AMOUNT OR MORE?
YES
205
204
SEND LOW-PRESSURE, LOW-SPEED REWIND ORDER
SEND HIGH-PRESSURE ORDER, OR SEND HOOK STORAGE SWITCH NON-EXCITATION ORDER

FIG.9

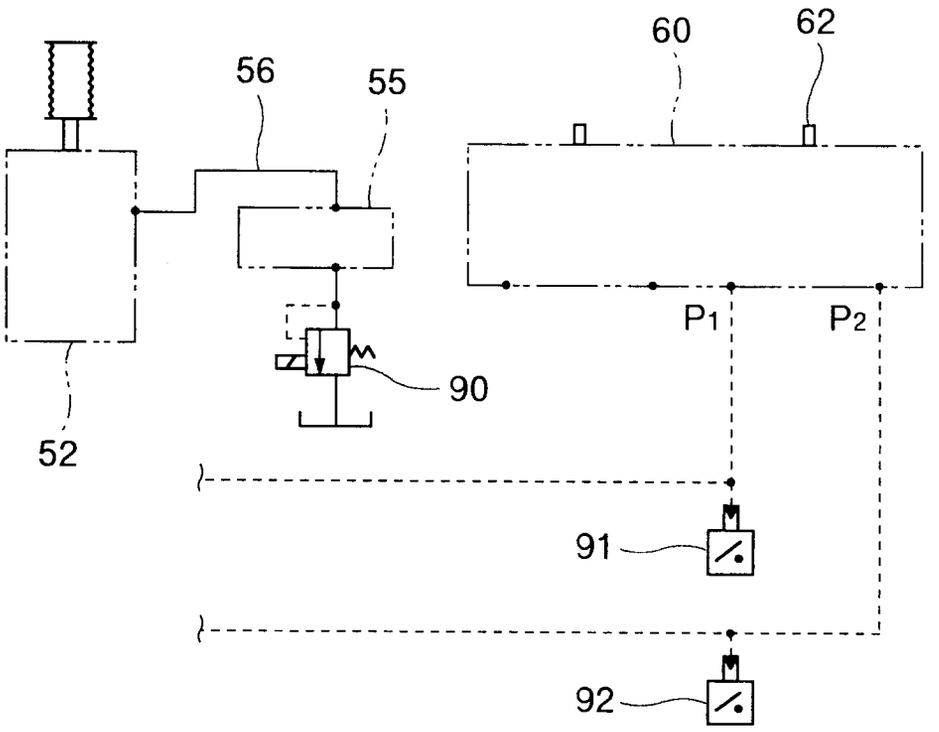



FIG.10

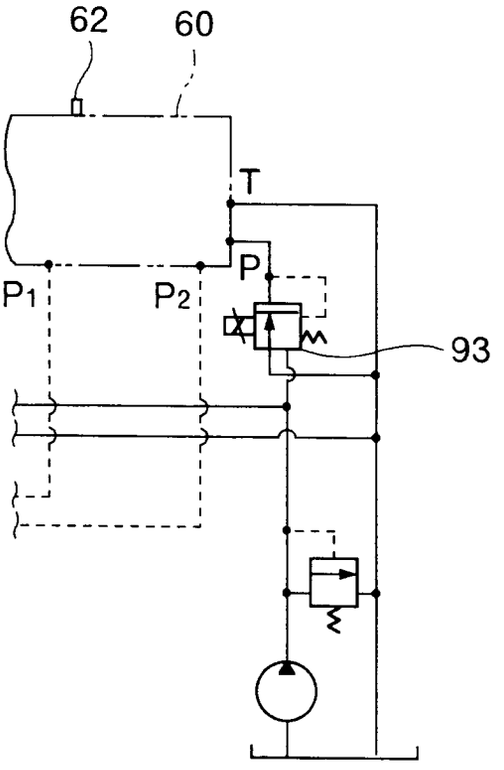


FIG.11

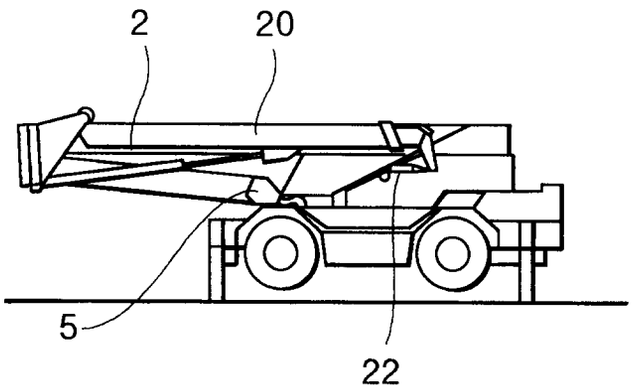



FIG.12

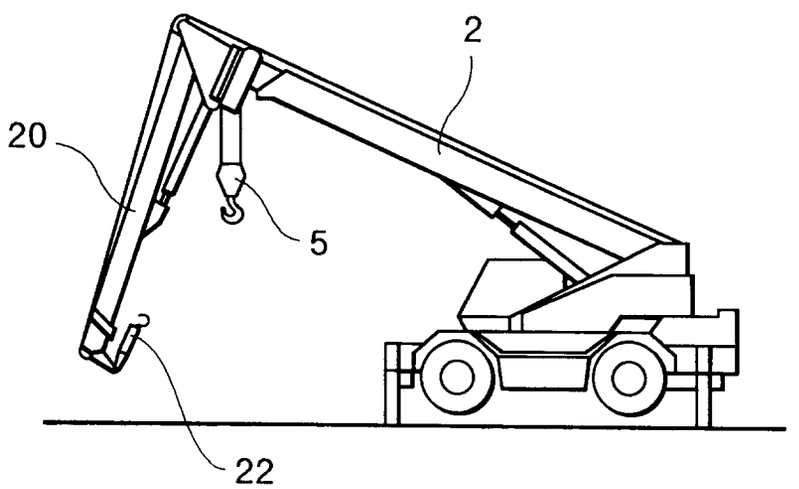


FIG.13

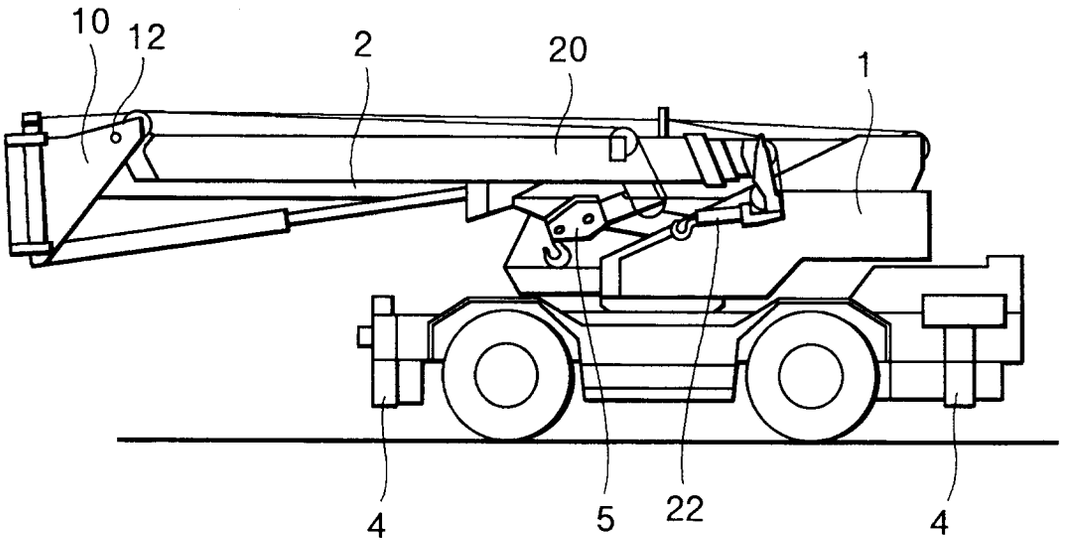



FIG.14

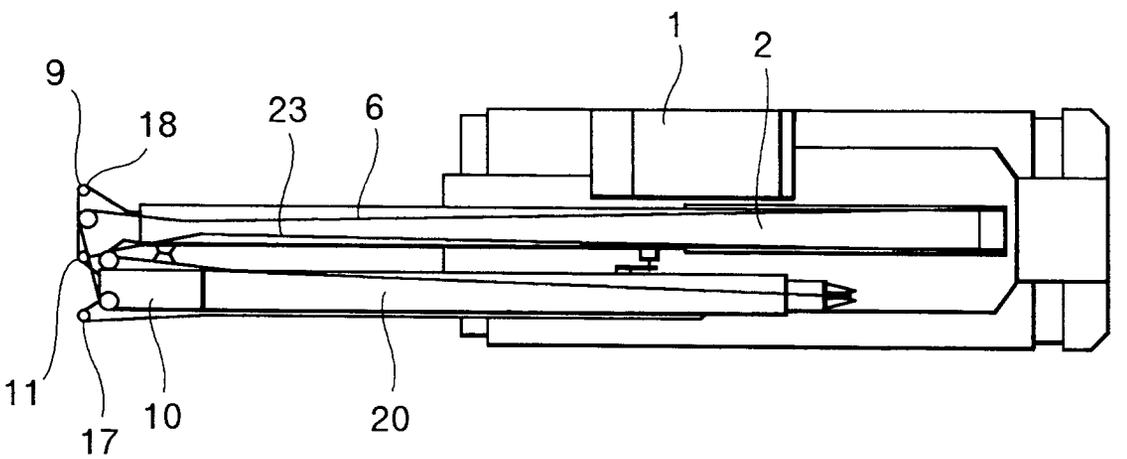


FIG.15

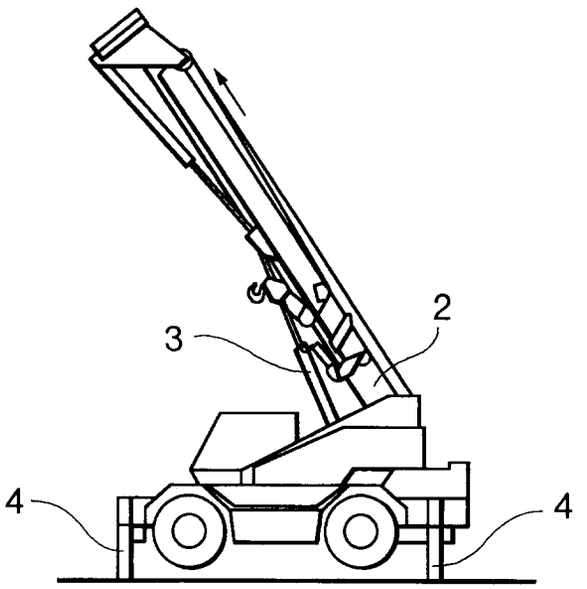



FIG.16

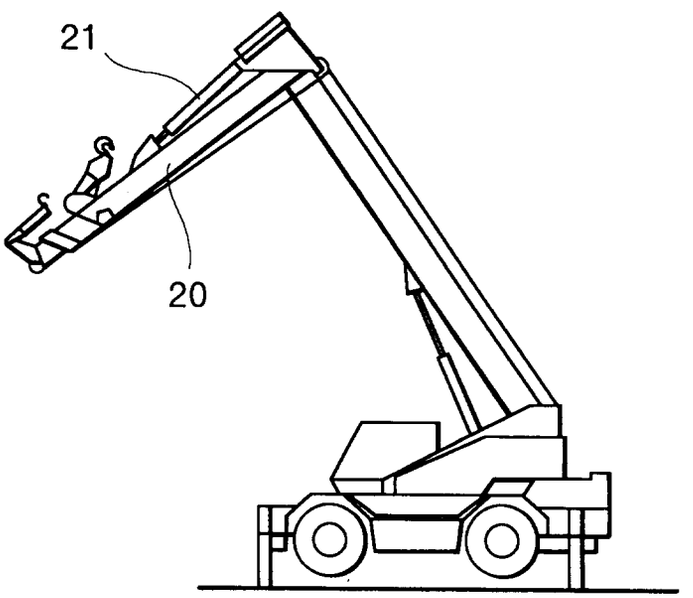


FIG.17

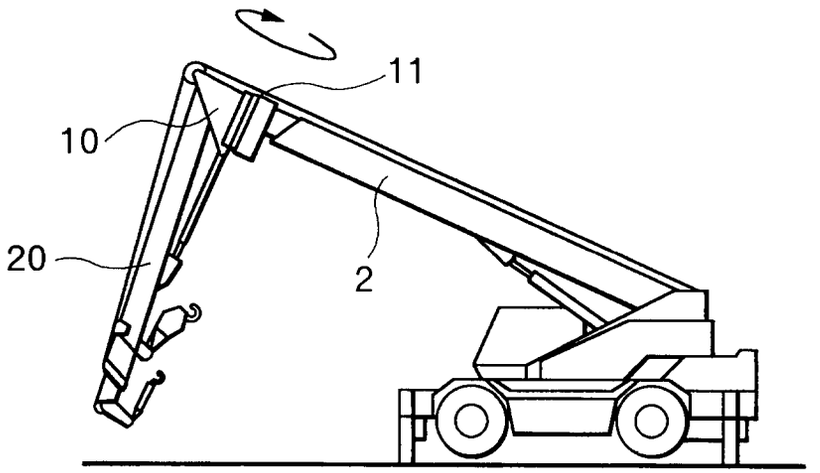



FIG.18

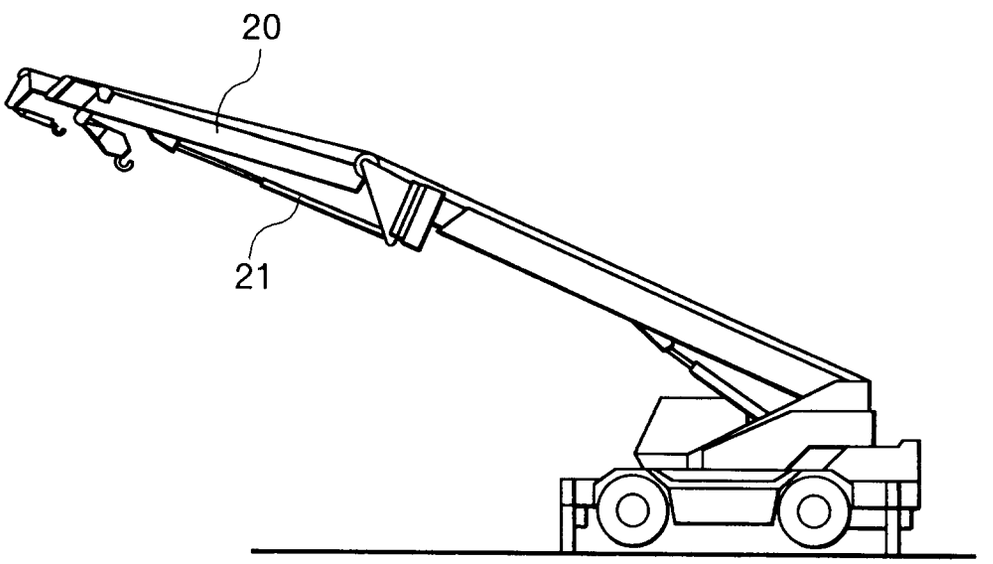
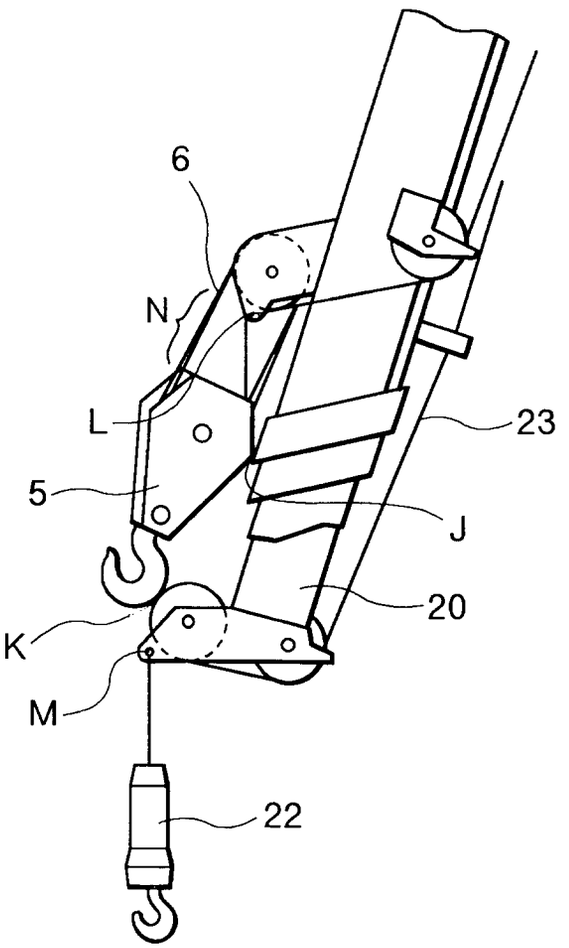


FIG.19

PRIOR ART



## INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP95/01271

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl$^6$ B66C23/88, B66C23/70

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl$^6$ B66C23/88, B66C23/70

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1926 - 1995
Kokai Jitsuyo Shinan Koho 1971 - 1995

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | JP, 63-27396, A (Tadano Tekkosho K.K.), February 5, 1988 (05. 02. 88) | 1 - 4 |
| Y | JP, 6-16389, A (Kobe Steel, Ltd.), January 25, 1994 (25. 01. 94) | 1 - 4 |
| Y | JP, 3-267298, A (Kobe Steel, Ltd.), November 28, 1991 (28. 11. 91) | 3 |

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| September 1, 1995 (01. 09. 95) | September 19, 1995 (19. 09. 95) |
| Name and mailing address of the ISA/ Japanese Patent Office | Authorized officer |
| Facsimile No. | Telephone No. |

Form PCT/ISA/210 (second sheet) (July 1992)