



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 819 646 A1

(12)

EUROPEAN PATENT APPLICATION

published in accordance with Art. 158(3) EPC

(43) Date of publication:

21.01.1998 Bulletin 1998/04

(21) Application number: **95910783.0**

(22) Date of filing: **10.03.1995**

(51) Int. Cl.⁶: **B66D 1/44**

(86) International application number:

PCT/JP95/00394

(87) International publication number:

WO 96/28377 (19.09.1996 Gazette 1996/42)

(84) Designated Contracting States:
DE

(71) Applicants:

- **KOMATSU LTD.**
Minato-ku, Tokyo 107 (JP)
- **KOMATSU MEC KABUSHIKI KAISHA**
Tokyo 107 (JP)

(72) Inventor:

MORI, Kinya,
Komatsu Mec Main Plant
Kawagoe-shi, Saitama 350-11 (JP)

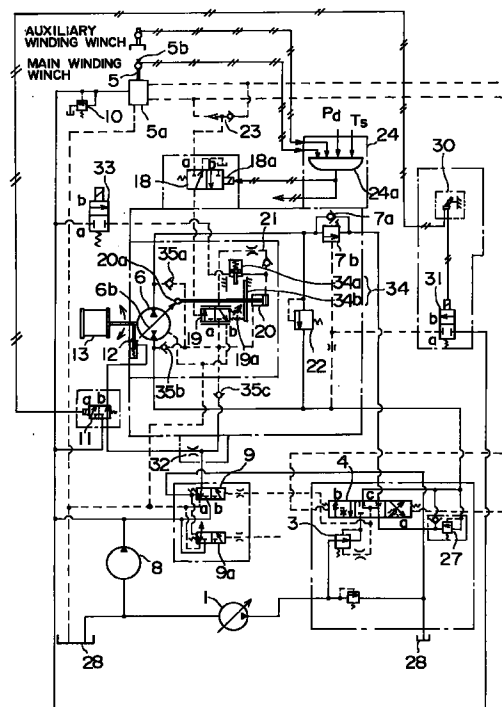
(74) Representative:

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

(54) METHOD AND SYSTEM FOR CONTROLLING THE SPEED OF A WINCH

(57) The present invention relates to a method and a system for controlling the speed of a winch, whereby safety and operability are improved without being put into a free fall state and, at the same time, a lowering speed equal to that of the free fall state can be obtained. To this end, a rotation speed of a winch drum (13) is substantially a direct and exclusive speed with respect to the stroke of an operating lever (5) until a predetermined stroke of the operating lever (5), while the speed is a different speed with respect to the same stroke of the operating lever (5) in response to a speed mode selected from a plurality of speed modes at strokes over the predetermined stroke.

F I G . 1



EP 0 819 646 A1

Description

DISCLOSURE OF THE INVENTION

TECHNICAL FIELD

The present invention relates to a method and a system for controlling the speed of a winch, and more particularly, to a method and a system for controlling the speed of a winch which drives a winch drum by oil pressure.

BACKGROUND ART

Hitherto, winch devices for use in a crane, etc. have been designed to consist of, for example, a main winding winch 50 and an auxiliary winding winch 60, as shown in Fig. 5. The main winding winch 50 driven by oil pressure is comprised of a hydraulic motor 51, a reduction gear 52 driven by the hydraulic motor 51, an output axis 52a of the reduction gear 52, and a clutch 53 provided on a driving shaft 55 fixed to a main drum 56. In addition, a brake drum 54a is fixed to a flange of the main drum 56, and a band brake 54 is wound around the brake drum 54a.

By the described arrangements, the rotation of the hydraulic motor 51 is decelerated by the reduction gear 52 and transferred to the output shaft 52a, and when the clutch 53 is engaged, the rotation is transferred to the main drum 56 through the driving shaft 55. By controlling the rotation of the hydraulic motor 51 with a known method, the rotation of the main drum 56 can be controlled in response to the rotation of the hydraulic motor 51. In addition, when a light load, such as a hook, is lowered in a short period of time, or when an impactful force of a hammer due to a free fall is required, such as a piling operation in construction work, the winch is used in a free fall state. In these cases, disengagement of the clutch 53 puts the suspended load of the main winding winch 50 into a free fall state. In the case of controlling the falling speed, the brake 54 is pressed against the brake drum 54a, and braking force is adjusted by a degree of pressing. Therefore, when the winch is used in the free fall state, the light load can be lowered in a short period of time, and a large impactful force by a heavy article such as a hammer can be obtained. Incidentally, the arrangement and operation of the auxiliary winding winch 60 are the same as those of the main winding winch 50, and an explanation thereof is omitted.

However, according to the above prior art, when the winch is used in the free fall state, the lowering speed of the suspended load increases considerably regardless of an operator's intention so that it becomes difficult to stop the suspended load at a predetermined position. In addition, there is a danger that a wrong operation of a lever will suddenly put the winch into the free fall state, and the suspended load will fall, so the operator is forced to strain considerably.

The present invention has been made to solve the problems of the prior art, and its object is to provide a method of and a system for controlling the speed of a winch which connects the driving device of a winch drum to the winch drum at all times, thereby eliminating a free fall state, and improving safety and operability for the operator.

According to the present invention, there is provided a method of controlling the speed of a winch which is operated by controlling a rotation of a winch drum with an operating lever, wherein the rotation speed of the winch drum is substantially a direct and exclusive speed with respect to the stroke of an operating lever until a predetermined stroke of the operating lever, while the speed is a different speed with respect to the same stroke of the operating lever in response to a speed mode selected from a plurality of speed modes at strokes over the predetermined stroke. In addition, the selected speed mode may be switched to another speed mode at the stroke in the middle of the strokes over the predetermined stroke. The speed mode may be switched, when switching from a low-speed speed mode to a high-speed speed mode, under previously set conditions. Further, the winch drum rotation speed until the predetermined stroke may gradually increase in response to an increase in the stroke of the operating lever, and may be the same among the plurality of speed modes.

According to the described arrangements, the winch drum rotation speed until the predetermined stroke is equal in each speed mode, so that the operator's sense of operation at the beginning of the operation is common, thus offering good operability. In addition, at the strokes over the predetermined stroke, the selection of, for example, a high-speed speed mode increases the rotation speed and improves working efficiency. Further, in the case of gradually increasing the winch drum rotation speed, a reduction in the rotation speed at the beginning of the operation improves fine operability. As described above, different speed modes can be selected as needed, thus offering high operability.

A first aspect of a system for controlling the speed of a winch according to the present invention comprises a pilot pipe for connecting a regulator for supplying control pressure corresponding to pilot pressure to a control cylinder of a variable hydraulic motor and a pilot valve for supplying pilot pressure to a pilot-type operating valve, and a mode switching open/close valve for communicating or shutting off the pilot pipe. The regulator may be provided with a setting means, and the setting means may stop an operation of the regulator until a predetermined pilot pressure, and may reduce a specific capacity of the variable hydraulic motor in response to control pressure of the regulator at pilot pressures over the predetermined pilot pressure. In addition, the

mode switching open/close valve may be a solenoid-operated mode switching open/close valve having a solenoid, and an operating lever knob of the pilot valve may be provided with a switch so as to output an electric signal from the switch to the solenoid. The control pressure pipe for connecting the regulator and the control cylinder may be provided with a restriction device. Further, the system may comprise a capacity control means for the variable hydraulic motor, a connecting means for connecting the capacity control means and a piston rod of the control cylinder, and a capacity setting means including a capacity setting member and a stopper, wherein the capacity setting member is fixed to any one of the capacity control means, the piston rod, and the connecting means so as to set a minimum capacity of the variable hydraulic motor, and wherein the stopper restricts or releases the movement of the capacity setting member.

According to the described arrangements, in a state where the regulator and the pilot valve are in communication with each other, the winch drum rotation speed is controlled by the pilot-type operating valve and the variable hydraulic motor of which the specific capacity is reduced by the control cylinder. On the other hand, in a state where the regulator and the pilot valve are shut off, the regulator is not operated, so that the control pressure of the regulator is not supplied to the control cylinder of the variable hydraulic motor. Therefore, the winch drum rotation speed is controlled by only the pilot-type operating valve which is operated in response to pilot pressure.

In addition, when the above setting means (for example, a spring attached to the regulator) is provided, control pressure of the regulator is not supplied to the control cylinder until a predetermined stroke of the operating lever, so that the winch drum rotation speed is controlled by the pilot-type operating valve. On the other hand, when the operating lever exceeds the predetermined stroke, the specific capacity of the variable hydraulic motor is reduced by the control pressure of the regulator responsive to the pilot pressure. Therefore, the winch drum rotation speed is controlled by the reduced specific capacity and the pilot-type operating valve. At this time, if the mode switching open/close valve is shut off, the winch drum rotation speed is controlled by only the pilot-type operating valve, so that the speed reduces with respect to the same stroke of the operating lever.

As described above, the winch drum rotation speed is substantially directly and exclusively determined with respect to the stroke of the operating lever until the predetermined stroke regardless of communication and shut-off of the mode switching open/close valve. On the other hand, when exceeding the predetermined stroke, the winch drum rotation speed becomes the speed corresponding to each mode even at the same stroke of the operating lever.

In addition, when a switch is attached to the operat-

ing lever knob, the speed mode can be switched by the switch while controlling the winch drum rotation speed by the operating lever. In addition, when the above restriction device is provided, the specific capacity of the variable hydraulic motor does not change abruptly, so that abrupt changes in the winch drum rotation speed can be prevented, thereby improving safety and durability of the device. Further, by providing the above capacity setting means, the variable hydraulic motor has a predetermined minimum specific capacity when the stopper restricts the movement of the capacity setting member. On the other hand, when the movement restriction is released, the specific capacity of the variable hydraulic motor can be reduced to 0, and the winch can be operated into a free fall state.

Next, a second aspect of the system for controlling the speed of a winch is characterized in that a selective valve is attached, and that the selective valve selects higher pressure of predetermined pressure of a pressure source and driving pressure of the variable hydraulic motor so as to supply the pressure as the main pressure of the regulator.

According to the described arrangements, the control pressure supplied to the control cylinder of the variable hydraulic motor employs a predetermined pressure of the pressure source as the main pressure while the driving pressure of the variable hydraulic motor is low. On the other hand, when the driving pressure is increased, the driving pressure is supplied as the main pressure of the regulator to the control cylinder of the variable hydraulic motor, so that the specific capacity of the variable hydraulic motor can reliably be controlled.

Next, a third aspect of the system for controlling the speed of a winch is characterized in that a directional control valve is provided between a relief valve for controlling a return oil pressure of the hydraulic motor at the time of lowering the winch drum and a negative brake provided on a connected portion of the hydraulic motor and the winch drum, and that the directional control valve passes therethrough or shuts off function releasing pilot pressure for the relief valve, and opening pilot pressure for the negative brake.

According to the described arrangements, when the directional control valve is switched to a passing position, the function releasing pilot pressure and the opening pilot pressure are supplied, and the winch drum can be freely rotated, so that maintenance and examination of the winch can be easily effected.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a control circuit diagram for a main winding winch and for a part of an auxiliary winding winch according to an embodiment of the present invention;

Fig. 2 is a chart for illustrating a Hi/rating mode, a Hi/high-speed mode, a Lo/rating mode, and a Lo/high-speed mode which are speed modes

according to the embodiment;

Fig. 3 is an illustration of a system for controlling the speed of a winch according to the embodiment which shows a relationship between operating stroke of the main winding winch and rotation speed of a winch drum;

Fig. 4 is a sectional view of the main winding winch according to the embodiment; and

Fig. 5 is a schematic diagram of a winch device according to the prior art.

BEST MODE FOR CARRYING OUT THE INVENTION

The preferred embodiment of a method and a system for controlling the speed of a winch according to the present invention will now be described in detail with reference to the attached drawings.

Referring to Fig. 1, numeral 1 denotes a winch pump for driving a winch, 3 denotes a pressure compensating valve, 4 denotes a pilot-type operating valve, 5 denotes an operating lever for operating the winch, 5a denotes a pilot valve for supplying pilot pressure to the pilot-type operating valve 4, etc., and 5b denotes a high-speed mode switching button. Numeral 6 denotes a hydraulic motor (a variable hydraulic motor is used in this embodiment), 6b denotes a swash plate (a capacity control means) provided in the hydraulic motor 6, 7a denotes a check valve, 7b denotes a relief valve, 8 denotes a control pump (pressure source) for supplying control pressure of this speed control system, 9 denotes a directional control valve for supplying the control pressure of the motor, 9a is a directional control valve for supplying control pressure of an auxiliary winding winch, 11 denotes a directional control valve for pilot main pressure of the pilot pump 8 which is held in constant pressure by the relief valve 10, 12 denotes a negative brake contained in the hydraulic motor 6, and 13 denotes a winch drum driven by the hydraulic motor 6.

In addition, numeral 18 denotes a high-speed mode switching valve for switching pilot pressure of the pilot valve 5a output through a shuttle valve 23, 19 denotes a regulator for controlling capacity of the hydraulic motor 6 with a difference between the pilot pressure supplied through the high-speed mode switching valve 18 and spring force of a setting spring (setting means) 19a, 20 denotes a control cylinder of the hydraulic motor 6, 20a denotes a link (linking means) for linking between a piston rod of the control cylinder 20 and the swash plate 6b, 21 denotes a restrictor (restriction device) provided on a control pressure pipe to the control cylinder 20, and 22 denotes a relief valve provided on a driving main pipe of the hydraulic motor 6.

Further, numeral 24 denotes a controller, and 24a denotes an AND circuit which constitutes the controller 24. The AND circuit 24 outputs an excitation signal to a solenoid 18a of the high-speed mode switching valve 18 when predetermined conditions, for example, in the case of this embodiment, (i) an ON signal of the high-

speed mode switching button 5b, (ii) a pilot pressure signal Pd of a lowering side of the pilot valve 5, and (iii) a predetermined rope tension signal Ts are inputted at the same time. The reasons for setting the above conditions (ii) and (iii) for restricting a switching to the high-speed mode are as follows. That is, the condition (ii) is set to avoid a problem which arises in the case of speeding up a hoisting operation, such as irregular winding of a rope due to deterioration of rope winding properties over the drum, or the generation of excessive shock due to a sudden stop at the time of excessively hoisting a hook.

In addition, the condition (iii) is set to avoid falling of a suspended load even if it exceeds the holding capacity of the hydraulic motor. Moreover, since the above (iii) hardly hoists and lowers a heavy load at a high speed during a normal operation, it has an object to prevent an excessive load on the entire device by restricting a high-speed operable load to a light load below a predetermined amount, and to enhance safety. Here, the rope tension is an input signal corresponding to the suspended load, and a load which directly acts on the winch device from the outside becomes the input signal. The rope tension can be obtained, for example, by dividing the suspended load obtained through an overload protection device by the previously input number of falls of the rope over the hook.

In addition, numeral 27 denotes a low-pressure relief valve provided on a winch-lowering pipe, 28 denotes a tank, 30 denotes a drum-free switch, 31 denotes a drum-free directional control valve, 32 denotes a restrictor provided on a pipe which supplies a pilot main pressure of the pilot pump 8 to the negative brake 12 through the brake valve 11, 33 denotes a solenoid open/close valve, 34 denotes a capacity setting means including a capacity setting cylinder 34a and a capacity setting member 34b fixed to a piston rod of the control cylinder 20, and 35a, 35b, and 35c denote check valves.

Next, an operation of the above arrangement will be described.

The speed mode of this embodiment includes the following four modes: a Hi/rating mode and a Hi/high-speed mode in a high-speed engine, and a Lo/rating mode and a Lo/high-speed mode in a low-speed engine.

First, an operation of the main winding winch which is common to each speed mode in this embodiment will be described. Incidentally, the operation of the auxiliary winding winch is the same as that of the main winding winch, and an explanation thereof is omitted. Referring to Fig. 1, when the operating lever 5 is operated, pilot pressure responsive to an operating amount of the operating lever 5 is outputted from the pilot valve 5a to operate the pilot-type operating valve 4. The flow rate responsive to an operating amount of the pilot-type operating valve 4 is supplied from the winch pump 1 and a boom pump (not shown) to the hydraulic motor 6 and,

at the same time, the directional control valve 9 is switched to a position b by load pressure taken out of the pilot-type operating valve 4, whereby control pressure of the pilot pump 8 is supplied to the brake valve 11 through the position b of the directional control valve 9 and the restrictor 32, so that braking of the negative brake 12 is released. This release causes the winch drum 13 to be rotated at rotation speed responsive to the operating amount of the operating lever 5.

In the case of abruptly operating the above operating lever 5 is abruptly operated to the lowering side, the winch drum 13 is going to rotate abruptly to the lowering side. However, working fluid of the lowering side pipe is relieved by the relief valve 27 which is set to a predetermined pressure, so that an abrupt increase in the rotation speed to the lowering side is prevented, whereby an irregular winding of the wire can be prevented.

Incidentally, in the case of freely rotating the winch drum 13, by turning the drum-free switch 30 on, the drum-free directional control valve 31 is changed into the position b, and the brake valve 11 is changed into the position a, whereby the negative brake 12 is opened by control pressure of the control pump 8, and the control pressure of the control pump 8 is supplied to the relief valve 7b, so that the winch drum 13 can rotate freely also to the lowering side.

In addition, as another free rotational operation, an electric signal of a non-illustrated switch is first outputted to a solenoid of the brake valve 11, and the brake valve 11 is changed into the position a so as to open the negative brake 12. At the same time, the electric signal is also outputted to a solenoid of the solenoid open/close valve 33, and the solenoid open/close valve 33 is changed into the position b, whereby the control pressure of the control pump 8 is supplied to a rod chamber of the capacity setting cylinder 34a and the control cylinder 20. This causes a rod (stopper) of the capacity setting cylinder 34a to constrict, thereby releasing movement restrictions of the capacity setting member 34b. The released capacity setting member 34b moves the swash plate 6b through the piston rod of the control cylinder 20 and the link 20a to set the capacity of the hydraulic motor 6 to 0 cc/rev. Therefore, when the lowering speed faster than that of the Hi/high-speed mode is required, setting the capacity of the hydraulic motor 6 to 0cc/rev as described above enables a free fall operation even if the clutch is omitted.

Fig. 2 shows four kinds of speed modes in this embodiment. Here, in order to simplify the description, the speed mode is represented by two states: a Hi state in which the engine speed is equivalent to a high-idle rotating state, and a Lo state in which the engine speed is equivalent to a low-idle rotation state. As the actual operating conditions, the speed mode may naturally be set to a state equivalent to a middle of them. In addition, even if the engine speed is kept constant, it is possible to change a maximum flow rate to the hydraulic motor so as to set the speed mode to the above Hi, Lo and the

middle state by a method of changing the number of hydraulic pumps which supplies working fluid to the hydraulic motor in response to the specific capacity of the hydraulic pump or the speed mode. Further, although the specific capacity of the hydraulic motor is changed from V to 0.5 V in the high-speed mode, a minimum specific capacity is not limited to 0.5 V. Therefore, it is a matter of course that the specific capacity of the hydraulic motor can suitably be selected, and that the above high-speed mode is pluralized by setting the minimum specific capacity in the plural.

Fig. 3 is an illustration of the system for controlling the speed of a winch according to the above-described arrangements. Each mode at the time of lowering by the main winding winch shown in the right of Fig. 3 will be described with reference to the operating conditions of Fig. 2, and Fig. 1.

(1) In the case of Hi/rating mode

A section between lever strokes N and S1 is a dead zone due to leakage oil of hydraulic equipment such as the hydraulic pump 1 and the hydraulic motor 6, and the winch drum 13 does not rotate. Incidentally, the winch drum 13 in the section between the lever strokes N and S1 does not rotate in any mode of the Hi/high-speed mode, Lo/rating mode, and Lo/high-speed mode to be described later. Next, the drum rotation speed between lever strokes S1 and S6 is increased up to N6 by a flow rate determined by opening properties of the pilot-type operating valve 4. Incidentally, the drum rotation speed is illustrated taking the rated rotation speed N6 as 100 %.

(2) In the case of Hi/high-speed mode

In a state where the pilot pressure signal Pd output from a pressure switch (provided on the pilot pipe of the lowering side of the pilot-type operating valve 4) and the rope load signal TS which is a predetermined safe load are inputted in the AND circuit 24a of the controller 24, when the high-speed mode switching button 5b of the operating lever 5 is pushed, the high-speed mode switching valve 18 is changed into the position b by signals from the AND circuit 24a.

Therefore, pilot pressure of the pilot valve 5a is supplied to the capacity controlling regulator 19 in response to the lever stroke of the operating lever 5. However, pressing force due to the pilot pressure is set smaller than spring force of the setting spring 19a between the lever strokes S1 and S4, so that the capacity controlling regulator 19 remains in the position b.

The drum rotation speed between the lever strokes S1 and S4 is increased up to N4 by opening properties of the pilot-type operating valve 4. The drum rotation speed between the lever strokes S1 and S4 is the same as that in the Hi/rating mode. When the lever stroke reaches S4, the pressing force of the capacity control-

ling regulator 19 becomes larger than the spring force of the setting spring 19a, so that the capacity controlling regulator 19 is started to operate in the a direction.

The specific capacity of the hydraulic motor 6 is decreased from V to 0.5 V by the pilot pressure responsive to the lever stroke between the lever strokes S4 and S5, and the rotation speed of the winch drum 13 is increased up to N7 in response to an increase in flow rate by the pilot-type operating valve 4. That is, the winch drum rotation speed between S4 and S5 becomes twice the speed of the Hi/rating mode. The specific capacity of the hydraulic motor 6 is constant between the lever strokes S5 and S6, and the flow rate determined by opening properties of the pilot-type operating valve 4 due to the lever stroke slightly increases, so that the winch drum rotation speed remains constant at N7.

Incidentally, between the lever strokes S4 and S6, by releasing press of the high-speed mode switching button 5, the rotation speed is switched from the position P to the position Q. Conversely, by pressing the high-speed mode switching button 5b, the switching from the position Q to the position P can be done.

In addition, as regards the main pressure of the capacity controlling regulator 19, the higher oil pressure of the higher driving pressure of the hydraulic motor 6 selected by the check valves 35a and 35b, and discharge pressure of the control pump 8 which is held at a predetermined pressure by the relief valve 10 is selected by the check valve 35c (selective valve). The main pressure is reduced in response to the operating amount of the regulator 19 responsive to the lever stroke, and is supplied to the control cylinder 20 of the hydraulic motor 6. Therefore, the control pressure supplied to the control cylinder 20 is, while the driving pressure of the hydraulic motor 6 is low, secured by the discharge pressure of the control pump 8 held at a predetermined pressure. On the other hand, when the driving pressure of the hydraulic motor 6 increases, the driving pressure is supplied to the control cylinder 20 as the main pressure of the capacity controlling regulator 19, so that the capacity of the hydraulic motor 6 can reliably be controlled.

(3) In the case of Lo/rating mode

The winch rotation speed between the lever strokes S1 and S3 is increased up to N3 by opening properties of the pilot-type operating valve 4. Next, the winch drum rotation speed between the lever strokes S3 and S6 remains constant at N3 because the flow rate flowing into the pilot-type operating valve 4 is a predetermined maximum flow rate (constant) corresponding to the Lo rating mode.

(4) In the case of Lo/high-speed mode

The winch drum rotation speed is increased up to

N3 by the pilot-type operating valve 4 between the lever strokes S1 and S3, and is constant at N3 between the lever strokes S3 and S4. Therefore, the winch drum rotation speed between S1 and S4 is the same as that of the Lo/rating mode. The rotation speed of the winch drum 13 between the lever strokes S4 and S5 is, similar to the Hi/high-speed mode, increased up to N5 by the decrement of the capacity of the hydraulic motor responsive to the lever stroke and the increment of the flow rate determined by opening properties of the pilot-type operating valve 4. The winch drum rotation speed between the lever strokes S5 and S6 is the constant rotation speed N5 because the specific capacity of the hydraulic motor 6 is constant, and the flow rate is slightly increased by the increase in the lever stroke.

In addition, as in the case of the Hi/high-speed mode, between the lever strokes S4 and S6, by releasing the high-speed mode switching button 5, the rotation speed is switched from the position T to the position S, and by pushing the high-speed mode switching button 5b, the switching from the position S to the position T can be done.

Incidentally, when a change from the Lo/high-speed mode to the Hi/rating mode is required, the engine speed is increased in advance and then, the mode can be switched to the Hi/rating mode.

Although each mode at the time of lowering by the main winding is described above, the relationship between lever stroke and winch drum rotation speed on the hoisting side (the left of Fig. 3) of the main winding winch is such that the absolute values are equal and only the direction of rotation is reversed with respect to the Hi/rating mode and the Lo/rating mode on the lowering side, so an explanation thereof is omitted. In addition, the operation of the auxiliary winding winch is the same as that of the main winding winch, so an explanation thereof is omitted.

Referring to Fig. 4, numeral 6a denotes a main shaft of the hydraulic motor 6, 12 denotes a negative brake, 13a denotes a planetary reduction gear of the winch drum 13, and 16 denotes a rope wound around the winch drum 13. An operation of the described arrangements will be described. When working fluid is supplied from a hydraulic pipe (not shown) to the hydraulic motor 6, the main shaft 6a rotates at a speed determined by the flow rate of the working fluid and the specific capacity of the hydraulic motor 6. The rotation of the main shaft 6a is decelerated by the planetary reduction gear 13a to rotate the winch drum 13 in the direction of hoisting or in the direction of lowering, whereby the rope 16 performs hoisting or lowering of a suspended load. Incidentally, the auxiliary winding winch has a construction of axial symmetry with respect to the main winding winch of Fig. 4, so it is omitted.

INDUSTRIAL APPLICABILITY

The present invention is useful as a method and a

system for controlling the speed of a winch which connects dynamically a winch drum to a driving source at all times, thereby improving safety and operability without being put into a free fall state and, at the same time, offering a lowering speed equal to that of the free fall state.

Claims

1. A method of controlling the speed of a winch which is operated by controlling a rotation of a winch drum with an operating lever, wherein the rotation speed of said winch drum is substantially a direct and exclusive speed with respect to the stroke of an operating lever until a predetermined stroke of the operating lever, while the speed is a different speed with respect to the same stroke of the operating lever in response to a speed mode selected from a plurality of speed modes at strokes over the predetermined stroke.
2. A method of controlling the speed of a winch according to claim 1, wherein said selected speed mode is switched to another speed mode at the stroke in the middle of said strokes over the predetermined stroke.
3. A method of controlling the speed of a winch according to claim 2, wherein said speed mode can be switched, when switching from a low-speed speed mode to a high-speed speed mode, under previously set conditions.
4. A method of controlling the speed of a winch according to claim 1, wherein the winch drum rotation speed until said predetermined stroke gradually increases in response to an increase in the stroke of the operating lever, and is the same among said plurality of speed modes.
5. A system for controlling the speed of a winch including a hydraulic pump, a variable hydraulic motor for driving a winch drum, a pilot-type operating valve provided between said hydraulic pump and said variable hydraulic motor for operating the rotation speed of said winch drum, a pilot valve for supplying pilot pressure to said pilot-type operating valve, and a regulator for supplying control pressure corresponding to said pilot pressure to a control cylinder of said variable hydraulic motor, said system comprising a pilot pipe for connecting said regulator and said pilot valve, and a mode switching open/close valve for communicating or shutting off said pilot pipe.
6. A system for controlling the speed of a winch according to claim 5, wherein said regulator is provided with a setting means, and said setting means stops an operation of said regulator until a predetermined pilot pressure, and reduces a specific capacity of said variable hydraulic motor in response to control pressure of said regulator at pilot pressures over the predetermined pilot pressure.
7. A system for controlling the speed of a winch according to claim 5, wherein said mode switching open/close valve is a solenoid-operated mode switching open/close valve having a solenoid, and wherein an operating lever knob of said pilot valve is provided with a switch so that an electric signal is outputted from said switch to said solenoid.
8. A system for controlling the speed of a winch according to claim 5, wherein said control pressure pipe for connecting said regulator and said control cylinder is provided with a restriction device.
9. A system for controlling the speed of a winch according to claim 5, further comprising a capacity control means for said variable hydraulic motor, a connecting means for connecting said capacity control means and a piston rod of said control cylinder, and a capacity setting means including a capacity setting member and a stopper, wherein said capacity setting member is fixed to any one of said capacity control means, said piston rod, and said connecting means so as to set a minimum capacity of said variable hydraulic motor, and wherein said stopper restricts or releases the movement of said capacity setting member.
10. A system for controlling the speed of a winch including a hydraulic pump, a variable hydraulic motor for driving a winch drum, a pilot-type operating valve provided between said hydraulic pump and said variable hydraulic motor for operating the rotation speed of said winch drum, a pilot valve for supplying pilot pressure to said pilot-type operating valve, and a regulator for supplying control pressure corresponding to said pilot pressure to a control cylinder of said variable hydraulic motor, wherein a selective valve is attached to said system, and wherein said selective valve selects higher pressure of predetermined pressure of a pressure source and driving pressure of said variable hydraulic motor so as to supply the pressure as the main pressure of said regulator.
11. A system for controlling the speed of a winch including a hydraulic pump, a hydraulic motor for driving a winch drum, an operating valve provided between said hydraulic pump and said hydraulic motor for operating the rotation speed of said winch drum, a hydraulic driving pipe for connecting these components, a relief valve provided on the winch drum hoisting side of said hydraulic driving pipe for

controlling a return oil pressure of said hydraulic
motor at the time of lowering the winch drum, and a
negative brake provided on a connected portion of
said hydraulic motor and said winch drum, wherein
a directional control valve is provided between said
relief valve and said negative brake, and wherein
said directional control valve passes therethrough
or shuts off function releasing pilot pressure for said
relief valve, and opening pilot pressure for said neg-
ative brake.

5

10

15

20

25

30

35

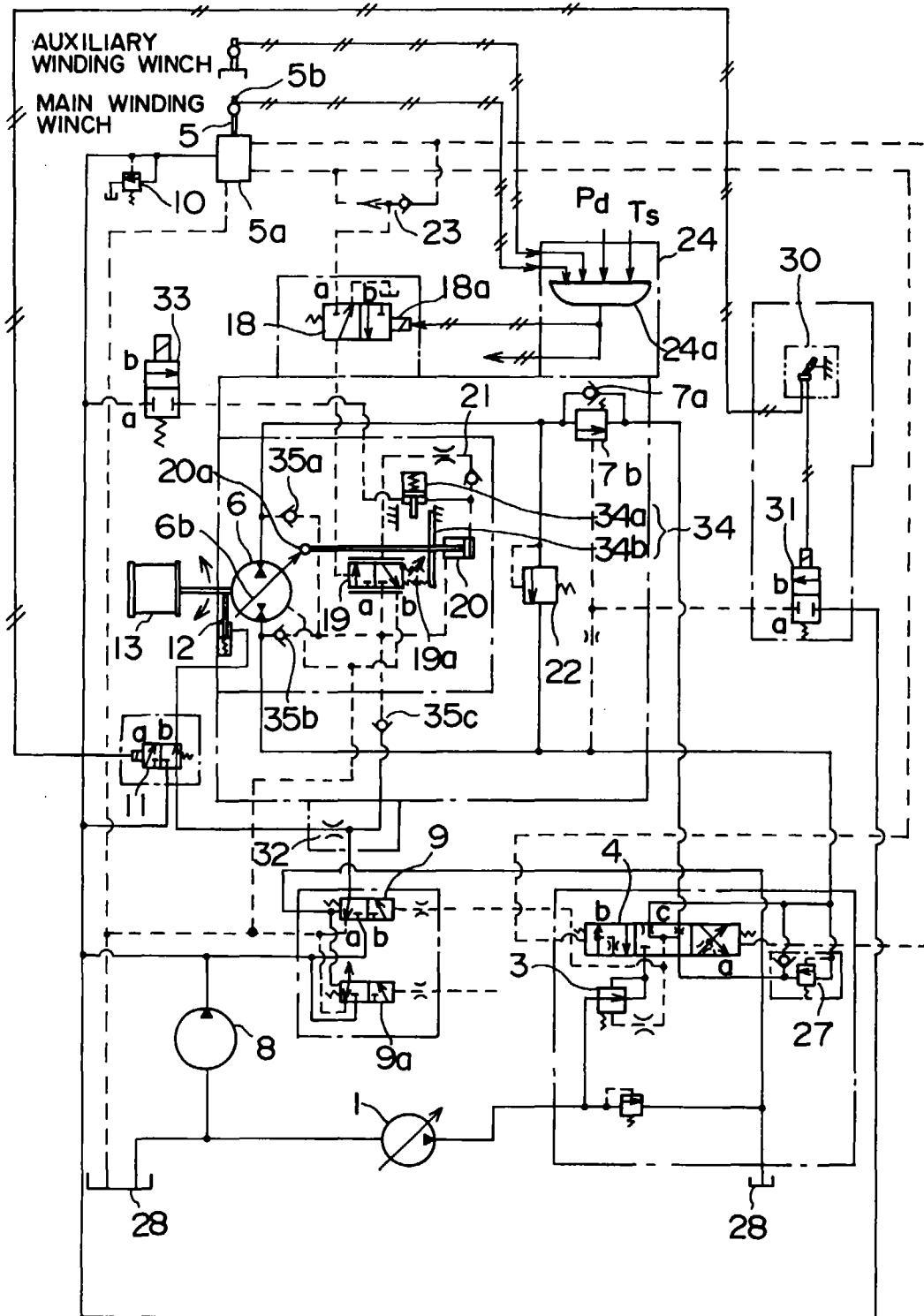
40

45

50

55

FIG. 1



F I G . 2

DIREC- TION	MODE	OPERATING LEVER STROKE	SPECIFIC CAPACITY OF HYDRAULIC MOTOR	ENGINE SPEED
LOW- ERING	Hi/HIGH-SPEED MODE	N ~ S4	V	H i
		S4 ~ S5	V ~ 0.5 V	
		S5 ~ S6	0.5 V	
	Hi/RATING MODE	N ~ S6	V	L o
	Lo/HIGH-SPEED MODE	N ~ S4	V	
		S4 ~ S5	V ~ 0.5 V	
		S5 ~ S6	0.5 V	
	Lo/ RATING MODE	N ~ S6	V	
HOIST- ING	Hi/RATING MODE	N ~ S6	V	H i
	Lo/ RATING MODE	N ~ S6	V	L o

FIG. 3

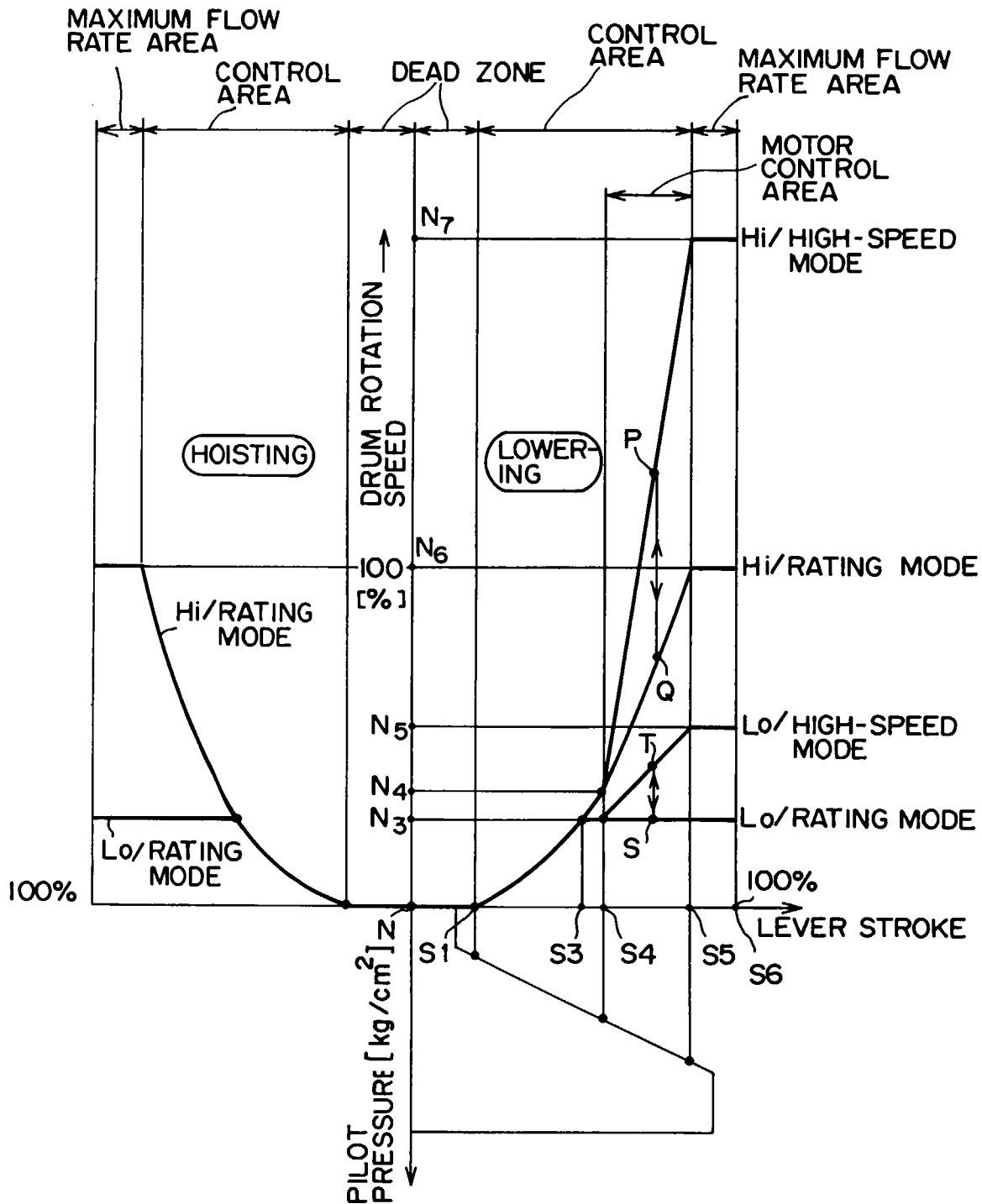


FIG. 4

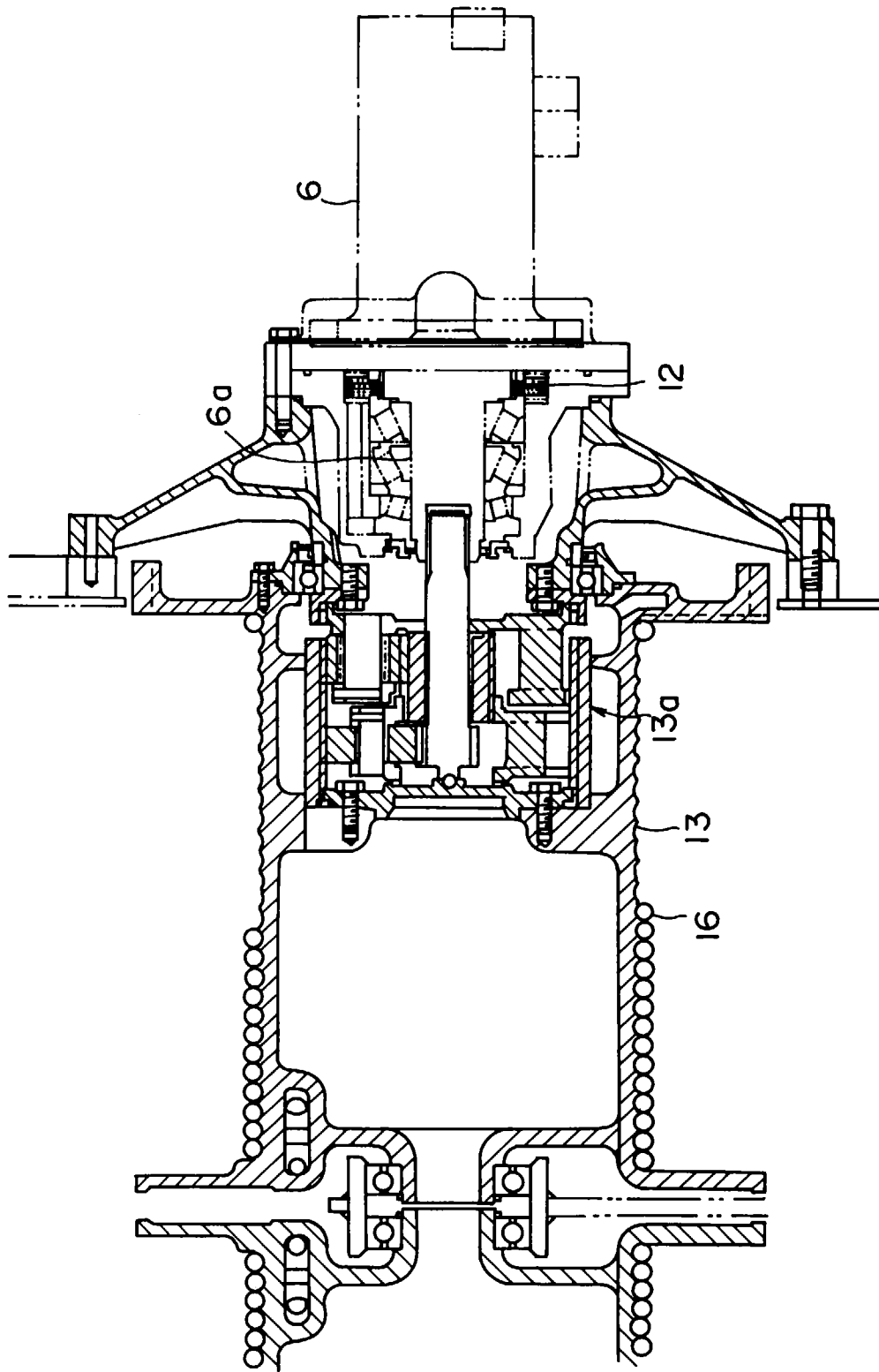
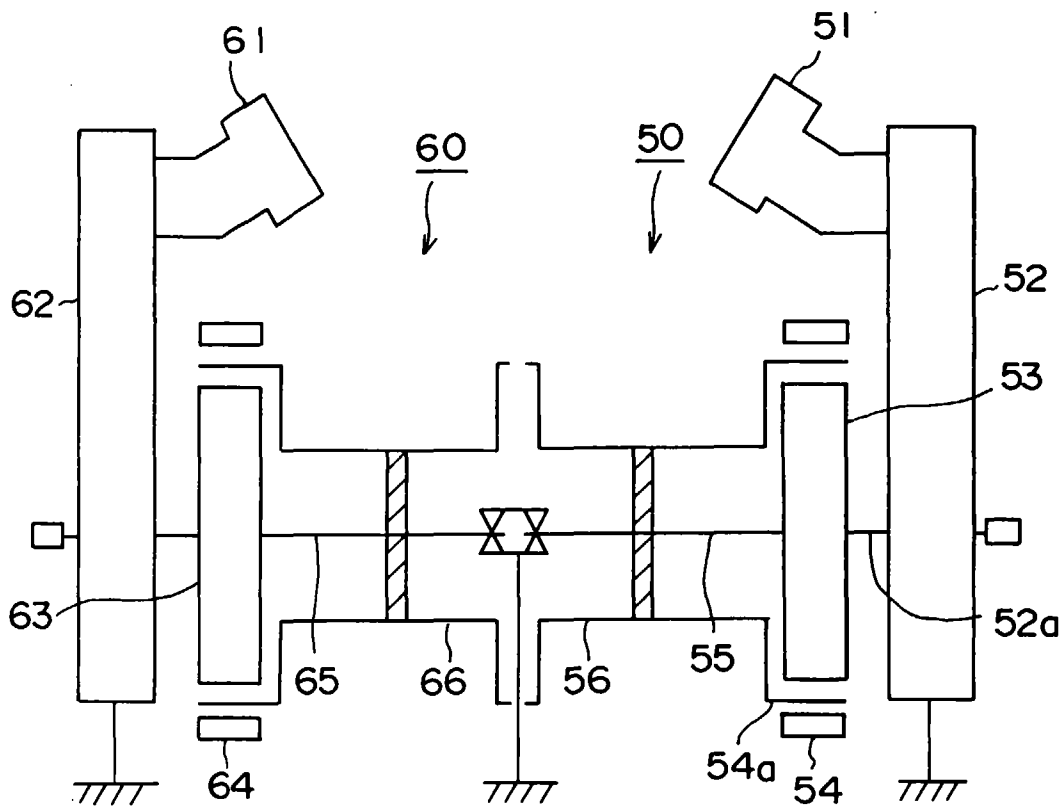


FIG. 5
PRIOR ART



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP95/00394

A. CLASSIFICATION OF SUBJECT MATTER		
Int. Cl ⁶ B66D1/44		
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 B66D1/44, B66D1/54		
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.
A	JP, 55-54712, Y (Nippon Globe K.K.), December 17, 1980 (17. 12. 80) (Family: none)	1 - 4
A	JP, 3-7599, B2 (Nippon Air Brake K.K.), February 1, 1991 (01. 02. 91) (Family: none)	1 - 4
A	JP, 61-127968, A (Hitachi Construction Machinery Co., Ltd.), June 16, 1986 (16. 06. 86) (Family: none)	1 - 4
A	JP, 62-105895, A (Sumitomo Heavy Industries, Ltd.), May 16, 1987 (16. 05. 87) (Family: none)	5 - 9
A	JP, 3-57033, B2 (Hitachi Construction Machinery Co., Ltd.), August 29, 1991 (29. 08. 91) (Family: none)	10, 11
A	JP, 59-58203, A (Yanase & Co., Ltd.), April 3, 1984 (03. 04. 84) (Family: none)	10, 11
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "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 "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "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 "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search June 5, 1995 (05. 06. 95)		Date of mailing of the international search report June 20, 1995 (20. 06. 95)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.		Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP95/00394

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 61-53318, B2 (Hitachi, Ltd.), November 17, 1986 (17. 11. 86) (Family: none)	10, 11

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