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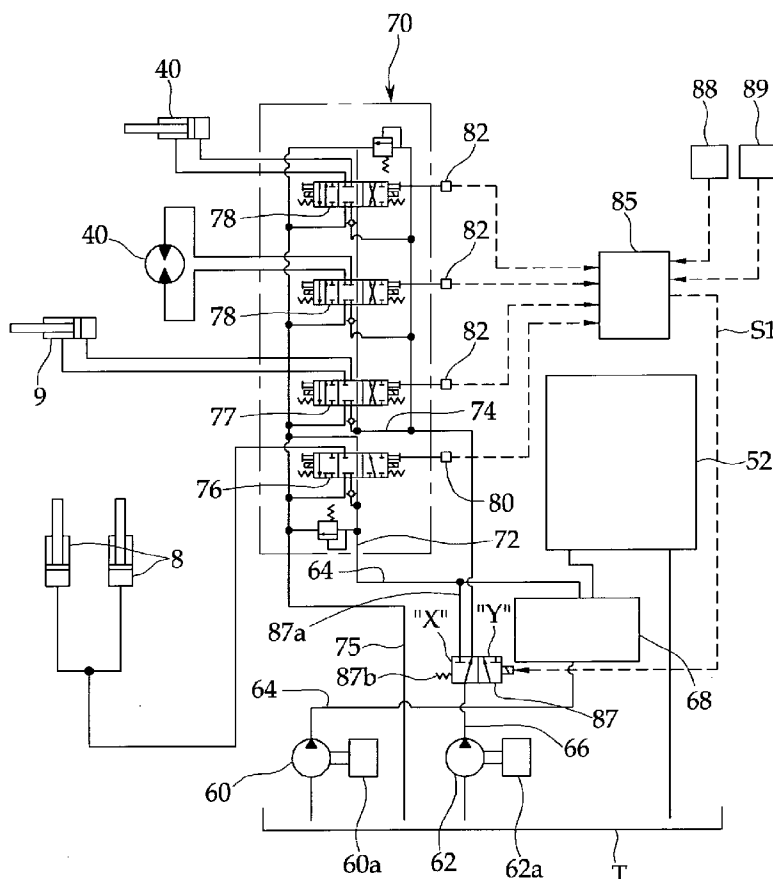
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(54) Title: HYDRAULIC SYSTEM OF FORKLIFT TRUCK



(57) Abstract: Disclosed is a hydraulic system of a forklift truck. According to the hydraulic system, an optimum amount of hydraulic operating fluid is supplied to a working machine other than a lift cylinder, so that a large amount of hydraulic operating fluid is prevented from being unnecessarily supplied to the working machine, thereby preventing pressure loss and overheating of the hydraulic operating fluid caused by excessive hydraulic operating fluid.



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【DESCRIPTION】

【Invention Title】

HYDRAULIC SYSTEM OF FORKLIFT TRUCK

【Technical Field】

5 The present invention relates to a hydraulic system of a forklift truck, more particularly, to a hydraulic system of a forklift truck, which prevents a large amount of hydraulic operating fluid from being unnecessarily supplied to another working machine other than a lift cylinder by allowing an optimum
10 amount of hydraulic operating fluid to be supplied to a cylinder of another working machine, thereby preventing pressure loss and overheating of hydraulic operating fluid caused by excessive hydraulic operating fluid.

【Background Art】

15 A forklift truck is used for lifting heavy freight up and down or transferring the heavy freight to a desired position. Such a forklift truck comprises a truck body 1 supported by front driving wheels 3 and rear steering wheels 4 as illustrated in FIG. 1. A mast assembly 5 is installed in front of the truck body
20 1.

The mast assembly 5 has a carriage 7, which is movable upward and downward. The carriage 7 can be lifted up and down by a lift cylinder 8, which is uprightly installed at the mast assembly 5.

25 The carriage 7 is equipped with various attachments, such as a hinged bucket, a side shift, a road stabilizer and a rotating fork, in addition to a pair of forks 7a. Further, the mast assembly 5 can slantingly move forward or backward by a tilt cylinder 9.

30 Such a forklift truck has a hydraulic system for operating the mast assembly 5 and working machines such as the lift cylinder 8, the tilt cylinder 9 and various attachments.

For example, a conventional hydraulic system of a forklift

truck comprises a hydraulic pump 10 as illustrated in FIG. 2. The hydraulic pump 10 is driven by a power source 10a, such as an internal combustion engine or an electric motor. The hydraulic pump 10 intakes hydraulic operating fluid from an oil tank T and
5 discharges the hydraulic operating fluid at a high pressure.

In general, the hydraulic system comprises a main hydraulic line 20 and a drain line 22. The main hydraulic line 20 is connected with the hydraulic pump 10 to send high pressure of hydraulic operating fluid. The drain line 22 drains the hydraulic
10 operating fluid of the main hydraulic line 20 to the oil tank T.

A control valve unit 30 for a working machine is installed between the main hydraulic line 20 and the drain line 22. The control valve unit 30 has an internal passage 32 provided with an intake port 32a connected with the main hydraulic line 20 and a
15 drain port 32b connected with the drain line 22.

Further, a lift control valve 34, a tilt control valve 35 and one or more option control valves 36 and 38 are installed at the internal passage 32 of the control valve unit 30.

The lift control valve 34 is switched through the
20 manipulation of a driver so as to supply hydraulic operating fluid of the internal passage 32 to the lift cylinder 8, thereby operating the lift cylinder 8.

The tilt control valve 35 is switched through the manipulation of a driver to supply hydraulic operating fluid of
25 the internal passage 32 to the tilt cylinder 9, thereby operating the tilt cylinder 9.

The option control valves 36 and 38 are switched through the manipulation of a driver to supply hydraulic operating fluid of the internal passage 32 to various attachments 40, thereby
30 operating said various attachments 40.

Referring to FIG. 2, a priority valve 50 is installed at the main hydraulic line 20 of the hydraulic system.

The priority valve 50 is connected with a steering unit 52

to primarily supply hydraulic operating fluid of the main hydraulic line 20 to the steering unit 52. In general, the priority valve 50 sufficiently supplies hydraulic operating fluid necessary for operation of the steering unit 52, and then
5 supplies the hydraulic operating fluid to the control valve unit 30.

In such a conventional hydraulic system, the hydraulic pump 10 has high capacity corresponding to the capacity of the lift cylinder 8 requiring high capacity. However, in a case in which
10 only the tilt cylinder 9 and/or the attachment 40 operates except for the lift cylinder 8, the hydraulic pump 10 discharges a large amount of hydraulic operating fluid but the tilt cylinder 9 and the attachments 40 require a small amount of hydraulic operating fluid, only a small amount of hydraulic operating fluid is
15 supplied to the tilt cylinder 9 and the attachments 40. As a result, pressure loss occurs while the hydraulic operating fluid discharged in a large amount is passing through the tilt control valve 35, the option control valves 36 and 38, various orifices and a relief valve 39. In addition, the hydraulic operating fluid
20 is overheated due to the pressure loss. In particular, if the hydraulic operating fluid is overheated, the life span of the hydraulic operating fluid is shortened and the life span of various hydraulic parts is also shortened.

In order to solve such problems, there has been proposed a
25 method for additionally installing an oil cooler (not shown) for cooling the overheated hydraulic operating fluid. However, in such a case, the manufacturing cost is increased due to installation of the oil cooler.

【Disclosure】

30 **【Technical Problem】**

Accordingly, the present invention has been made in an effort to solve the problems occurring in the conventional art, and an object of the present invention is to provide a hydraulic

system of a forklift truck, which can prevent pressure loss and overheating of hydraulic operating fluid caused by excessive hydraulic operating fluid by preventing a large amount of hydraulic operating fluid from being unnecessarily supplied to a working machine other than a lift cylinder.

【Technical Solution】

In order to achieve the above object, according to one aspect of the present invention, the present invention provides a hydraulic system of a forklift truck for operating a steering unit 52, a lift cylinder 8 and a tilt cylinder 9. According to one aspect of the present invention, the forklift truck can selectively comprise at least one attachment 40.

The hydraulic system according to the present invention comprises: a first hydraulic pump 60, which supplies hydraulic operating fluid to the lift cylinder 8 and the steering unit 52 through a first hydraulic line 64; a second hydraulic pump 62, which supplies hydraulic operating fluid to the tilt cylinder 9 through a second hydraulic line 66; a first detector 80, which generates a detection signal by detecting if the lift cylinder 8 operates; at least one second detector 82, which generates a detection signal by detecting if the tilt cylinder 9 operates; a bypass valve 87, which is installed between the first hydraulic line 64 and the second hydraulic line 66 to allow the first hydraulic line 64 to selectively communicate with the second hydraulic line 66; and a controller 85, which controls the bypass valve 87 such that the hydraulic operating fluid discharged from the first and second hydraulic pumps 60 and 62 joins with each other and then is supplied to the first hydraulic line 64 when the controller 85 determines that only the lift cylinder 8 among the lift cylinder 8 and the tilt cylinder 9 operates by recognizing the detection signals input from the first and second detectors 80 and 82.

According to one embodiment of the present invention, when

an operation signal is detected from only the first detector 80, the controller 85 determines that only the lift cylinder 8 operates, and controls the bypass valve 87 such that the hydraulic operating fluid discharged from the second hydraulic pump 62 flows into the first hydraulic line 64.

According to one embodiment of the present invention, the detector 80 detects one of a switching position of a lift control valve 76 for controlling flow of the hydraulic operating fluid supplied to the lift cylinder 8, hydraulic pressure applied to the lift cylinder 8, and displacement of the lift cylinder 8. Further, the second detector 82 detects one of a switching position of a tilt control valve 77 for controlling flow of the hydraulic operating fluid supplied to the tilt cylinder 9, hydraulic pressure applied to the tilt cylinder 9, and displacement of the tilt cylinder 9.

According to another embodiment of the present invention, the forklift truck can further comprise at least one attachment 40. Thus, the hydraulic system also supplies hydraulic operating fluid to the attachment 40.

That is, according to one embodiment of the present invention, the second hydraulic pump 62 also supplies hydraulic operating fluid to the attachment 40 via the second hydraulic line 66.

In such a case, the hydraulic system can further comprise another second detector for outputting a detection signal by detecting if the attachment 40 operates in addition to the second detector 82 for outputting a detection signal by detecting if the tilt cylinder 9 operates. Accordingly, controller 85 recognizes the operations of the lift cylinder 8, the tilt cylinder 9 and the attachment 40, and when the controller 85 determines that only the lift cylinder 8 operates, the controller 85 controls the bypass valve 87 such that the hydraulic operating fluid discharged from the first and second hydraulic pumps 60 and 62

joins with each other and then is supplied to the first hydraulic line 64.

Further, two or more second detectors 82 can be provided. Such second detectors 82 detects one of a switching position of an option control valve 78 for controlling the hydraulic operating fluid supplied to the attachment 40, hydraulic pressure applied to the attachment 40, and displacement of the attachment 40 in order to detect if the attachment 40 operates as well as the tilt cylinder 9.

According to another embodiment of the present invention, the hydraulic system of the forklift truck comprises a manipulation device J for outputting a manipulation signal corresponding to manipulation of a driver. In such a case, the controller 85 can determine if the hydraulic operating fluid discharged from the first and second hydraulic pumps 60 and 62 joins with each other by analyzing the manipulation signal. That is, when it is determined that only the lift cylinder 8 is to operate by analyzing the manipulation signal, the controller 85 can control the bypass valve 87 such that the hydraulic operating fluid discharged from the first and second hydraulic pumps 60 and 62 can join with each other.

According to one embodiment of the present invention, when a signal is detected from only the first detector 80, the controller 85 outputs a control signal S1 by determining that only the lift cylinder 8 operates. When a signal is detected from only the second detector 82, the controller 85 deletes the control signal S1. Only when the control signal S1 is effectively output, the controller 85 can control the bypass valve 87 such that the hydraulic operating fluid discharged from the second hydraulic pump 62 can also flow into the first hydraulic line 64.

According to one embodiment of the present invention, the hydraulic system of the forklift truck further comprises: a second power source 62a, which supplies power to the second

hydraulic pump 62; and a clutch 90, which is installed between the power source and the second hydraulic pump 62 to selectively prevent power from being transmitted to the second hydraulic pump 62. The controller 85 can control the clutch 90 according to the
5 detection signals input from the first and second detectors 80 and 82. According to one embodiment of the present invention in relation to the clutch 90, the controller 85 can control the clutch 90 to prevent power from being transmitted to the second hydraulic pump 62 when no detection signal is input from any one
10 of the first and second detectors 80 and 82. In such a case, operations of all working machines are stopped.

According to one embodiment of the present invention, the hydraulic system of the forklift truck further comprises: a third detector 88, which detects an RPM of an engine of the forklift
15 truck; and a fourth detector 89, which detects a traveling speed of the forklift truck. The controller 85 can control the clutch 90 to prevent power from being transmitted to the second hydraulic pump 62 when the RPM of the engine is smaller than a preset reference value or when the traveling speed of the truck
20 deviates from a preset range while the lift cylinder 8 is operating.

According to another embodiment of the present invention, the hydraulic system of the forklift truck further comprises: a third detector 88, which detects an RPM of an engine of the
25 forklift truck; and a fourth detector 89, which detects a traveling speed of the forklift truck. The controller 85 can control the bypass valve 87 such that the connection between the first and second hydraulic lines 64 and 66 is blocked when the RPM of the engine is less than a preset reference value or when
30 the traveling speed of the truck deviates from a preset range while the lift cylinder 8 is operating.

【Advantageous Effects】

According to the hydraulic system of a forklift truck based on the present invention as described above, a hydraulic operating fluid supply source and a hydraulic operating fluid passage for a lift cylinder requiring a small amount of hydraulic operating fluid are different from those for working machines other than the lift cylinder, so that an optimum amount of hydraulic operating fluid can be supplied to the working machines. Thus, a large amount of hydraulic operating fluid is prevented from being unnecessarily supplied to the working machines, thereby preventing pressure loss and overheating of the hydraulic operating fluid caused by excessive hydraulic operating fluid.

Further, according to the hydraulic system of a forklift truck based on the present invention, a hydraulic operating fluid supply source and a hydraulic operating fluid passage for a lift cylinder are different from those for working machines other than the lift cylinder, and the hydraulic operating fluid of the hydraulic operating fluid supply source different from each other joins with each other and then is supplied to the lift cylinder if the situation requires, thereby facilitating an operation of the lift cylinder.

【Description of Drawings】

FIG. 1 is a side view illustrating a typical forklift truck;

FIG. 2 is a hydraulic circuit diagram illustrating a typical hydraulic system of a forklift truck;

FIG. 3 is a hydraulic circuit diagram illustrating a hydraulic system of a forklift truck according to one embodiment of the present

FIG. 4 is a hydraulic circuit diagram illustrating a hydraulic system of a forklift truck according to another embodiment of the present; and

FIG. 5 is a hydraulic circuit diagram illustrating a

hydraulic system of a forklift truck according to further another embodiment of the present.

<Brief description of the indications>

	1 truck body	5 mast assembly
5	7 carriage	8 lift cylinder
	9 tilt cylinder	40 attachments
	60 a first hydraulic pump	60a first power source
	62 second hydraulic pump	62a second power source
	64 first hydraulic line	66 second hydraulic line
10	68 priority valve	70 control valve unit
	72 first internal passage	74 second internal passage
	75 drain line	76 lift control valve
	77 tilt control valve	78 option control valves
	80 first detector	82 second detector
15	85 controller	87 bypass valve
	90 clutch	J manipulation device

【Best Mode】

【Mode for Invention】

20 Hereinafter, a preferred embodiment of a hydraulic system of a forklift truck according to the present invention will be described in detail with reference to the accompanying drawings. The same reference numerals are used to designate the same elements shown in the prior art.

25 FIG. 3 is a circuit diagram illustrating a hydraulic system of a forklift truck according to one embodiment of the present invention. The hydraulic system illustrated in FIG. 3 can operate a steering unit 52, a lift cylinder 8, a tilt cylinder 9 and at least one attachment 40.

30 Referring to FIG. 3, the hydraulic system according to one embodiment of the present invention comprises a first hydraulic pump 60, a second hydraulic pump 62, a first detector 80, at least one second detector 82, a bypass valve 87 and a controller

85. The first hydraulic pump 60 supplies hydraulic operating fluid to the lift cylinder 8 and the steering unit 52 through a first hydraulic line 64. The second hydraulic pump 62 supplies hydraulic operating fluid to the tilt cylinder 9 and the attachment 40 through a second hydraulic line 66. The first detector 80 generates a detection signal by detecting if the lift cylinder 8 operates. The second detector 82 generates a detection signal by detecting if at least one of the tilt cylinder 9 and the attachment 40 operates. The bypass valve 87 is installed between the first hydraulic line 64 and the second hydraulic line 66 to allow the first hydraulic line 64 to selectively communicate with the second hydraulic line 66. The controller 85 recognizes the detection signals input from the first and second detectors 80 and 82 to determine if the lift cylinder 8, the tilt cylinder 9 and the attachment 40 operate. When it is determined that only the lift cylinder 8 of them operates, the controller 85 controls the bypass valve 87 such that the hydraulic operating fluid discharged from the first and second hydraulic pumps 60 and 62 joins with each other and then is supplied to the first hydraulic line 64.

In detail, the hydraulic system according to one embodiment of the present invention comprises the first hydraulic pump 60 driven by a first power source 60a, and the second hydraulic pump 62 of small capacity driven by a second power source 62a. The first and second power sources 60a and 62a can be prepared in the form of an electric motor, an internal combustion engine and the like.

The first and second hydraulic pumps 60 and 62 are fixed capacity-type gear pumps, and can intake hydraulic operating fluid from an oil tank T to discharge the hydraulic operating fluid, respectively. According to one embodiment of the present invention, the sum of the amount of hydraulic operating fluid discharged from the first hydraulic pump 60 and the amount of

hydraulic operating fluid discharged from the second hydraulic pump 62 is equal to the amount of hydraulic operating fluid discharged from the conventional hydraulic pump 2 of high capacity (see FIG. 2). In particular, the sum of the amount of hydraulic operating fluid discharged from the first hydraulic pump 60 and the amount of hydraulic operating fluid discharged from the second hydraulic pump 62 is sufficient for operating the lift cylinder 8.

According to one embodiment of the present invention, the first and second power sources 60a and 62a receive power from a single electric motor or internal combustion engine through a predetermined power distributor. If the situation requires, the first and second power sources 60a and 62a may also receive power from electric motors or internal combustion engines different from each other.

Meanwhile, the first hydraulic pump 60 is connected with the first hydraulic line 64 and the second hydraulic pump 62 is connected with the second hydraulic line 66. A priority valve 68 is installed at the first hydraulic line 64 of the first hydraulic pump 60. The priority valve 68 is connected with the steering unit 52 and primarily supplies the steering unit 52 with the hydraulic operating fluid discharged from the first hydraulic pump 60.

Referring to FIG. 3, the hydraulic system of the present invention comprises a control valve unit 70. The control valve unit 70 comprises a first internal passage 72 and a second internal passage 74.

The first internal passage 72 is connected with the first hydraulic line 64 of the first hydraulic pump 60 to introduce the hydraulic operating fluid of the first hydraulic pump 60. The second internal passage 74 is connected with the second hydraulic line 66 of the second hydraulic pump 62 to introduce the hydraulic operating fluid of the second hydraulic pump 62. The

end portions of the first internal passage 72 and the second internal passage 74 are connected with the oil tank T through a drain line 75, so that the introduced hydraulic operating fluid can be drained to the oil tank T.

5 Meanwhile, a lift control valve 76 is installed at the first internal passage 72, and a tilt control valve 77 and a plurality of option control valves 78 are sequentially installed at the second internal passage 74.

10 The lift control valve 76 is switched through manipulation of a driver so as to supply the hydraulic operating fluid of the first hydraulic pump 60, which is introduced to the first internal passage 72, to the lift cylinder 8, thereby operating the lift cylinder 8.

15 The tilt control valve 77 is switched through manipulation of a driver so as to supply the hydraulic operating fluid of the second hydraulic pump 62, which is introduced to the second internal passage 74, to the tilt cylinder 9, thereby operating the tilt cylinder 9.

20 The option control valves 78 are switched through manipulation of a driver so as to supply the hydraulic operating fluid of the second hydraulic pump 62, which is introduced to the second internal passage 74, to the attachments 40, thereby operating the attachments 40.

25 According to the control valve unit 70 having the construction as described above, since the hydraulic operating fluid of the first hydraulic pump 60 introduced to the first internal passage 72 is used to drive the lift cylinder 8, and the hydraulic operating fluid of the second hydraulic pump 62 introduced to the second internal passage 74 is used to drive the
30 tilt cylinder 9 and the attachments 40, the hydraulic operating fluid supply source and the hydraulic operating fluid passage for the lift cylinder 8 are different from those for working machines, such as the tilt cylinder 9 and the attachments 40.

Accordingly, the amount of the hydraulic operating fluid supplied to the lift cylinder 8 and the working machines, other than the lift cylinder 8, can be optimally adjusted according to the capacities of the lift cylinder 8 and the working machines.

5 In particular, a small amount of hydraulic operating fluid is optimally supplied to the tilt cylinder 9 and the attachments 40, so that a large amount of hydraulic operating fluid exceeding the required amount can be prevented from being supplied to the tilt cylinder 9 and the attachments 40, thereby preventing pressure

10 loss and overheating phenomena of hydraulic operating fluid caused by excessive hydraulic operating fluid.

Referring to FIG. 3, the hydraulic system of the present invention comprises the first detector 80 for detecting if the lift cylinder 8 operates, and the second detectors 82 for

15 detecting if at least one of the tilt cylinder 9 and one or more attachments 40 operates.

According to one embodiment of the present invention, the first detector 80 detects one of a switching position of the lift control valve 76, hydraulic pressure applied to the lift cylinder

20 8, and displacement of the lift cylinder 8, thereby detecting the operation of the lift cylinder 8.

The second detector 82 detects one of the switching positions of the tilt control valve 77 and the option control valves 78, hydraulic pressure applied to the tilt cylinder 9 and

25 the attachments 40, and displacements of the tilt cylinder 9 and the attachments 40, thereby detecting the operation of the tilt cylinder 9 and the attachments 40.

According to another embodiment of the present invention, the hydraulic system of the forklift truck can further comprise a

30 manipulation device (not shown) for outputting a manipulation signal corresponding to the manipulation of a driver. In such a case, it is possible to detect if the lift cylinder 8, the tilt cylinder 9 and the attachments 40 operate by analyzing the

manipulation signal.

Further, the hydraulic system of the present invention comprises the bypass valve 87 installed between the first hydraulic line 64 and the second hydraulic line 66 to allow the
5 first hydraulic line 64 to selectively communicate with the second hydraulic line 66. According to the hydraulic system of the present invention as described above, the hydraulic operating fluid supply source and the hydraulic operating fluid passage for the lift cylinder can be different from those for the working
10 machines other than the lift cylinder. If the situation requires, the hydraulic operating fluid of supply sources different from each other can join with each other under the control of the bypass valve 87. Consequently, a sufficient amount of hydraulic operating fluid is supplied to the lift cylinder 8, thereby
15 facilitating an operation of the lift cylinder 8.

Further, the hydraulic system of the present invention comprises the controller 85 for processing signals input from the first detector 80 and the second detectors 82. When the controller 85 determines that only the lift cylinder 8 operates
20 among the lift cylinder 8, the tilt cylinder 9 and the attachments 40 by recognizing detection signals input from the first detector 80 and the second detectors 82, the controller 85 controls the bypass valve 87 such that the hydraulic operating fluid discharged from the first and second hydraulic pumps 60 and
25 62 joins with each other and then is supplied to the first hydraulic line 64.

According to one embodiment of the present invention, the controller 85 determines that only the lift cylinder 8 operates when an operation signal is detected from only the first detector
30 80.

Further, when an operation signal is input from the second detectors 82, the controller 85 controls the bypass valve 87 such that the hydraulic operating fluid discharged from the second

hydraulic pumps 62 is prevented from flowing into the first hydraulic line 64. That is, when a signal is input from only the second detectors 82 or signals are simultaneously input from the first detector 80 and the second detectors 82, the controller 85
5 controls the bypass valve 87 such that the hydraulic operating fluid discharged from the second hydraulic pumps 62 is prevented from flowing into the first hydraulic line 64.

According to one embodiment of the present invention, the controller 85 can comprise a microcomputer driving circuit
10 therein. If a signal is input from only the first detectors 80, the controller 85 outputs a control signal S1 by determining that only the lift cylinder 8 currently operates.

However, if a signal is input from only the second detectors 82 or signals are simultaneously input from the first detector 80
15 and the second detectors 82, the controller 85 deletes the control signal S1 by determining that only the tilt cylinder 9 and the attachment 40 currently operates, or determining that the lift cylinder 8, the tilt cylinder 9 and the attachment 40 simultaneously operate.

20 According to one embodiment of the present invention, if the control signal S1 is output from the controller 85, the hydraulic system controls the bypass valve 87 such that the hydraulic operating fluid of the second hydraulic line 66 can be bypassed and flow into the first hydraulic line 64.

25 According to one embodiment of the present invention, the bypass valve 87 can use a solenoid-type two-way valve. As illustrated in FIG. 3, such a solenoid-type two-way valve permits flow of the hydraulic operating fluid of the second hydraulic line 66 in a return position X and bypasses the hydraulic
30 operating fluid of the second hydraulic line 66 in an operation position Y. In particular, if the control signal S1 is input from the controller 85, the solenoid type 2-way valve is switched from the return position X to the operation position Y to bypass the

hydraulic operating fluid of the second hydraulic line 66, thereby allowing the bypassed hydraulic operating fluid to flow into the hydraulic line 64.

The bypass valve 87 comprises a bypass line 87a for allowing
5 the bypassed hydraulic operating fluid to flow into the hydraulic line 64. If the control signal S1 of the controller 85 is deleted, the bypass valve 87 returns to the return position X by a spring 87b installed at one side of the bypass valve 87, thereby preventing the hydraulic operating fluid from bypassing
10 therethrough.

Further, as the control signal S1 is input from the controller 85, the bypass valve 87 allows the hydraulic operating fluid of the second hydraulic line 66 to flow into the hydraulic line 64, so that the hydraulic operating fluid of the second
15 hydraulic pump 62 can join with the hydraulic operating fluid of the first hydraulic pump 60 according to an operation of the lift cylinder 8. As described above, the hydraulic operating fluid of the second hydraulic pump 62 joins with the hydraulic operating fluid of the first hydraulic pump 60, so that a large amount of
20 hydraulic operating fluid can be introduced to the first internal passage 72 of the control valve unit 70. The hydraulic operating fluid introduced to the first internal passage 72 is supplied to the lift cylinder 8, thereby facilitating the operation of the lift cylinder 8.

25 Referring to FIG. 3, according to another embodiment of the present invention, the hydraulic system can comprise a third detector 88 for detecting the RPM (revolutions per minute) of a truck engine and a fourth detector 89 for detecting the traveling speed of the truck.

30 According to one embodiment of the present invention, the third detector 88 is prepared in the form of a rotation detection sensor, and detects the RPM of the truck engine to transmit the detected RPM to the controller 85.

According to one embodiment of the present invention, the fourth detector 89 is prepared in the form of a vehicle speed detection sensor, and detects the traveling speed of the truck to transmit the detected speed to the controller 85.

5 When the RPM input from the third detector 88 is less than a preset reference value or when the traveling speed input from the fourth detector 89 deviates from a preset range while the lift cylinder 8 is operating, the controller 85 controls the bypass valve 87 such that the connection between the first and second
10 hydraulic lines 64 and 66 can be blocked.

Accordingly, when the RPM of the truck engine (not shown) is less than the preset reference value, for example, when the engine is in an idle state, if a large amount of hydraulic operating fluid is supplied, the engine is overloaded. Thus,
15 engine stall phenomenon may occur. In order to prevent the engine stall phenomenon, the controller 85 blocks the connection between the first and second hydraulic lines 64 and 66 even if a user manipulates a manipulation device J to operate the lift cylinder 8.

20 Further, when the input traveling speed is higher than the preset range, the connection between the first and second hydraulic lines 64 and 66 is blocked by taking safety of the lift cylinder 8 into consideration such that the amount of hydraulic operating fluid supplied to the lift cylinder 8 can be slightly
25 reduced even if a user manipulates the manipulation device.

Further, when the traveling speed of a truck is lower than the preset range, the connection between the first and second hydraulic lines 64 and 66 is blocked by operating the tilt cylinder 9 and the attachment 40, if necessary, such that the
30 engine is not subject to the overload in consideration of engine stall phenomenon.

Hereinafter, an operation of the forklift truck provided with the hydraulic system having the construction according to

one embodiment of the present invention will be described in detail.

First, a case in which the truck is in an idle state will be described. As The first and second power sources 60a and 62a
5 operate to drive the first and second hydraulic pumps 60 and 62, the first and second hydraulic pumps 60 and 62 discharge the hydraulic operating fluid, respectively.

Then, the hydraulic operating fluid discharged from the first and second hydraulic pumps 60 and 62 is introduced to the
10 first and second internal passages 72 and 74 of the control valve unit 70 through the first and second hydraulic lines 64 and 66, respectively. Further, the introduced hydraulic operating fluid is returned to the oil tank T through the drain line 75.

Second, a case in which a driver steers the truck will be
15 described. As the driver steers the truck, the priority valve 68 operates to primarily supply the hydraulic operating fluid of the first hydraulic pump 60 to the steering unit 52. The supplied hydraulic operating fluid drives the steering unit 52, thereby enabling steering of the truck.

20 Third, a case in which a driver manipulates only the lift cylinder 8 will be described. As the driver manipulates the lift control valve 76, the hydraulic operating fluid of the first hydraulic pump 60 introduced to the first internal passage 72 of the control valve unit 70 is supplied to the lift cylinder 8
25 through the lift control valve 76, thereby driving the lift cylinder 8.

Meanwhile, if the driver manipulates the lift control valve 76, the first detector 80 detects that the lift control valve 76 is manipulated and outputs a detection signal. The detection
30 signal is input to the controller 85. Then, the controller 85 determines that only the lift cylinder 8 currently operates and inputs the control signal S1 to the bypass valve 87.

After receiving the control signal S1, the bypass valve 87

is switched from the return position X to the operation position Y, and introduces the hydraulic operating fluid of the second hydraulic pump 62 to the first internal passage 72 of the control valve unit 70 by bypassing the hydraulic operating fluid. The
5 introduced hydraulic operating fluid joins with the hydraulic operating fluid of the first hydraulic pump 60 and then is supplied to the lift cylinder 8, thereby facilitating an operation of the lift cylinder 8.

Fourth, a case in which a driver manipulates working
10 machines other than the lift cylinder 8, such as the tilt cylinder 9 and the attachments 40, will be described. As the driver manipulates the tilt control valve 77 or the option control valves 78, the hydraulic operating fluid of the second hydraulic pump 62 introduced to the second internal passage 74 of
15 the control valve unit 70 is supplied to the tilt cylinder 9 or the attachments 40 through the tilt control valve 77, thereby driving the tilt cylinder 9 or the attachments 40.

Meanwhile, if the driver manipulates the tilt control valve 77 or the option control valves 78, the second detector 82
20 detects that the tilt control valve 77 or the option control valves 78 is manipulated and outputs a detection signal. The detection signal is input to the controller 85. Then, the controller 85 determines that working machine other than the lift cylinder 8 operates and maintains a state in which the control
25 signal S1 is deleted.

Further, as the bypass valve 87 permits flow of the hydraulic operating fluid of the second hydraulic line 66 while maintaining the return position X, the hydraulic operating fluid is supplied to the tilt cylinder 9 or the attachments 40 through
30 the second internal passage 74 of the control valve unit 70, thereby driving the tilt cylinder 9 or the attachments 40.

Last, a case in which a driver simultaneously manipulates the lift cylinder 8 and the working machines, such as the tilt

cylinder 9 and the attachments 40, will be described. First, the driver simultaneously manipulates the lift control valve 76 and the control valve, such as the tilt control valve 77 or the option control valves 78.

5 Then, the hydraulic operating fluid of the first hydraulic pump 60 introduced to the second internal passage 74 of the control valve unit 70 is supplied to the lift cylinder 8, thereby driving the lift cylinder 8. Further, the hydraulic operating fluid of the second hydraulic pump 62 introduced to the second
10 internal passage 74 of the control valve unit 70 is supplied to the tilt cylinder 9 or the attachments 40, thereby driving the tilt cylinder 9 or the attachments 40.

Meanwhile, if the driver simultaneously manipulates the lift control valve 76 and the control valve such as the tilt control
15 valve 77 or the option control valves 78, the first and second detectors 80 and 82 detect that the tilt control valve 77 or the option control valves 78 is manipulated as well as the lift control valve 76 and output detection signals, respectively. The detection signals are input to the controller 85. Then, the
20 controller 85 determines that working machine operates as well as the lift cylinder 8 and maintains a state in which the control signal S1 is deleted.

Further, as the bypass valve 87 permits flow of the hydraulic operating fluid of the second hydraulic line 66 while
25 maintaining the return position X, the hydraulic operating fluid of the second hydraulic pump 62 is introduced to only the second internal passage 74 of the control valve unit 70 and the hydraulic operating fluid of the first hydraulic pump 60 is introduced to the first internal passage 72 of the control valve
30 unit 70.

Thus, the hydraulic operating fluid of the first hydraulic pump 60 drives only the lift cylinder 8 and the hydraulic operating fluid of the second hydraulic pump 62 drives only the

tilt cylinder 9 or the attachments 40.

According to the present invention as described above, the hydraulic operating fluid supply source and the hydraulic operating fluid passage for the lift cylinder 8 are different
5 from those for the working machines such as the tilt cylinder 9 and the attachments 40, so that an optimum amount of hydraulic operating fluid can be supplied to the tilt cylinder 9 and the attachments 40 that require a relatively small amount of hydraulic operating fluid. Consequently, it is possible to
10 fundamentally prevent a large amount of hydraulic operating fluid from being unnecessarily supplied to the tilt cylinder 9 and the attachments 40.

Further, in a case in which the lift cylinder 8 requiring a large amount of hydraulic operating fluid operates, the hydraulic
15 operating fluid of supply sources different from each other joins with each other and then is supplied to the lift cylinder 8, thereby facilitating an operation of the lift cylinder 8 according to the hydraulic system of the present invention.

FIG. 4 is a circuit diagram illustrating a hydraulic system
20 according to another embodiment of the present invention.

The hydraulic system according to another embodiment of the present further comprises a clutch 90 installed between the second hydraulic pump 62 and the power source for supplying power to the second hydraulic pump 62 to selectively prevent power from
25 being transmitted to the second hydraulic pump 62. The controller 85 controls the clutch 90 according to detection signals from the first and second detectors 80 and 82.

That is, the hydraulic system comprises the clutch 90 that intermittently controls power supplied to the second hydraulic
30 pump 62 from the second power source 62a. According to a detailed example of the present invention, the clutch 90 can use an electronic clutch.

In general, the electronic clutch 90 interconnects the

second power source 62a and the second hydraulic pump 62 to permit power transmission to the second hydraulic pump 62 from the second power source 62a. If an electric signal is applied to the electronic clutch 90, the electronic clutch 90 blocks the
5 connection between second power source 62a and the second hydraulic pump 62 to prevent power from being transmitted to the second hydraulic pump 62 from the second power source 62a.

Further, the hydraulic system according to another embodiment of the present invention further comprises the
10 controller 85 for processing signals input from the first detector 80, the second detectors 82, the third detector 88 and the fourth detector 89. If no signals are simultaneously input from the first detector 80 and the second detectors 82, the controller 85 outputs a power interruption signal S2 by
15 determining that all working machines 8, 9 and 40 of the truck currently do not operate. That is, if no signal is input from any one of the first detector 80 and the second detectors 82, the controller 85 outputs the power interruption signal S2. Thus, the clutch 90 blocks the connection between second power source 62a
20 and the second hydraulic pump 62 to prevent power from being transmitted to the second hydraulic pump 62 from the second power source 62a.

Further, the controller 85 processes signals input from the third detector 88 and the fourth detector 89. When the RPM of an
25 engine input from the third detector 88 is less than a preset reference value or when the traveling speed of the truck input from the fourth detector 89 deviates from a preset range while the lift cylinder 8 is operating, the controller 85 controls the clutch 90 to prevent power from being supplied to the second
30 hydraulic pump 62.

Accordingly, in a case in which the RPM of the truck engine is less than the preset reference value, e.g. the engine is in an idle state, even if a user manipulates a manipulation device to

operate the lift cylinder 8, the controller 85 stops the operation of the second hydraulic pump 62 or blocks the connection between the first and second hydraulic lines 64 and 66 in order to prevent engine stall phenomenon from occurring due to
5 overload of the engine caused by excessive hydraulic operating fluid.

Further, when the traveling speed of the truck is higher than the preset range, even if a user manipulates the manipulation device, the operation of the second hydraulic pump
10 62 is stopped or connection between the first and second hydraulic lines 64 and 66 is blocked by taking safety of the lift cylinder 8 into consideration such that the amount of hydraulic operating fluid supplied to the lift cylinder 8 can be slightly reduced.

15 Further, when the traveling speed of a truck is lower than the preset range, the operation of the second hydraulic pump 62 is stopped or the connection between the first and second hydraulic lines 64 and 66 is blocked by operating the tilt cylinder 9 and the attachment 40, if necessary, such that the
20 engine is not subject to the overload in consideration of engine stall phenomenon.

When the operation of the second hydraulic pump 62 is stopped by the clutch 90, it may be necessary to prevent back flow of the hydraulic operating fluid to the second hydraulic
25 pump 62 from the first hydraulic line 61. In such a case, according to the embodiment of the present invention, a check valve (not shown) may be additionally installed at the bypass valve 87. Further, it is possible to use a method for switching the bypass valve 87 to the return position X under the control of
30 the controller 85.

According to another embodiment of the present invention as illustrated in FIG. 5, the hydraulic system of the forklift truck comprises a manipulation device J that outputs a manipulation

signal corresponding to the manipulation of a driver, and the controller 85 can determine if the hydraulic operating fluid discharged from the first and second hydraulic pumps 60 and 62 joins with each other by analyzing the manipulation signal. That is, when the analysis result of the manipulation signal exhibits that only the lift cylinder 8 must operate except for the tilt cylinder 9 and the attachments 40, the controller 85 can control the bypass valve 87 such that the hydraulic operating fluid discharged from the first and second hydraulic pumps 60 and 62 can join with each other.

According to another embodiment of the present invention, the operation of the second hydraulic pump 62 is controlled according to the use of the working machines 8, 9 and 40, so that pressure loss of the hydraulic operating fluid due to the operation of the second hydraulic pump 62 can be minimized.

Further, the operation of the second hydraulic pump 62 is controlled according to the use of the working machines 8, 9 and 40, so that operation load applied to the second power source 62a can be minimized, thereby minimizing the energy consumption.

In the drawings and specification, typical exemplary embodiments of the invention have been disclosed, and although specific terms are employed, they are used in a generic and descriptive sense only and are not for the purposes of limitation, the scope of the invention being set forth in the following claims.

【CLAIMS】**【Claim 1】**

A hydraulic system of a forklift truck for operating a steering unit 52, a lift cylinder 8 and a tilt cylinder 9, the
5 hydraulic system comprising:

a first hydraulic pump 60, which supplies hydraulic operating fluid to the lift cylinder 8 and the steering unit 52 through a first hydraulic line 64;

a second hydraulic pump 62, which supplies hydraulic
10 operating fluid to the tilt cylinder 9 through a second hydraulic line 66;

a first detector 80, which generates a detection signal by detecting if the lift cylinder 8 operates;

at least one second detector 82, which generates a detection
15 signal by detecting if the tilt cylinder 9 operates;

a bypass valve 87, which is installed between the first hydraulic line 64 and the second hydraulic line 66 to allow the first hydraulic line 64 to selectively communicate with the second hydraulic line 66; and

a controller 85, which controls the bypass valve 87 such
20 that the hydraulic operating fluid discharged from the first and second hydraulic pumps 60 and 62 joins with each other and then is supplied to the first hydraulic line 64 when the controller 85 determines that only the lift cylinder 8 among the lift cylinder
25 8 and the tilt cylinder 9 operates by recognizing the detection signals input from the first and the second detectors 80 and 82.

【Claim 2】

The hydraulic system according to claim 1, wherein the
30 controller 85 determines that only the lift cylinder 8 operates when an operation signal is detected from only the first detector 80 among the first and the second detectors 80 and 82.

【Claim 3】

The hydraulic system according to claim 1, wherein the detector 80 detects one of a switching position of a lift control valve 76 for controlling flow of the hydraulic operating fluid supplied to the lift cylinder 8, hydraulic pressure applied to the lift cylinder 8, and displacement of the lift cylinder 8, and

the second detector 82 detects one of a switching position of a tilt control valve 77 for controlling flow of the hydraulic operating fluid supplied to the tilt cylinder 9, hydraulic pressure applied to the tilt cylinder 9, and displacement of the tilt cylinder 9.

【Claim 4】

The hydraulic system according to claim 1, wherein the controller 85 controls the bypass valve 87 such that the hydraulic operating fluid discharged from the second hydraulic pumps 62 is prevented from flowing into the first hydraulic line 64 when an operation signal is input from the second detector 82.

【Claim 5】

The hydraulic system according to claim 1, wherein the controller 85 controls the bypass valve 87 such that the hydraulic operating fluid discharged from the second hydraulic pumps 62 is prevented from flowing into the first hydraulic line 64 when a signal is input from only the second detector 82 or signals are simultaneously input from the first and second detectors 80 and 82.

【Claim 6】

The hydraulic system according to claim 1, wherein the controller 85 outputs a control signal S1 by determining that only the lift cylinder 8 operates when a signal is detected from only the first detector 80, and deletes the control signal S1

when a signal is detected from the second detector 82.

【Claim 7】

The hydraulic system according to claim 1, further
5 comprising:

a power source, which supplies power to the second hydraulic
pump 62; and

a clutch 90, which is installed between the power source and
the second hydraulic pump 62 to selectively prevent power from
10 being transmitted to the second hydraulic pump 62,

wherein the controller 85 controls the clutch 90 according
to the detection signals input from the first and second
detectors 80 and 82.

15 **【Claim 8】**

The hydraulic system according to claim 7, wherein the
controller 85 controls the clutch 90 to prevent power from being
transmitted to the second hydraulic pump 62 when no detection
signal is input from any one of the first and second detectors 80
20 and 82.

【Claim 9】

The hydraulic system according to claim 7, further
comprising:

25 a third detector 88, which detects an RPM of an engine of
the forklift truck; and

a fourth detector 89, which detects a traveling speed of the
forklift truck,

wherein the controller 85 controls the clutch 90 to prevent
30 power from being transmitted to the second hydraulic pump 62 when
the RPM of the engine is smaller than a preset reference value or
when the traveling speed of the truck deviates from a preset
range while the lift cylinder 8 is operating.

【Claim 10】

The hydraulic system according to any one of claims 1 through 9, further comprising at least one attachment 40 driven
5 by the hydraulic operating fluid supplied from the second hydraulic pump 62 via the second hydraulic line 66,

wherein the second detector 82 outputs a detection signal by detecting if at least one of the tilt cylinder 9 and the attachment 40 operates, and further detects one of a switching
10 position of an option control valve 78 for controlling the hydraulic operating fluid supplied to the attachment 40, hydraulic pressure applied to the attachment 40, and displacement of the attachment 40, and

the controller 85 controls the bypass valve 87 such that the
15 hydraulic operating fluid discharged from the first and second hydraulic pumps 60 and 62 joins with each other and then is supplied to the first hydraulic line 64 when the controller 85 determines that only the lift cylinder 8 operates.

20 【Claim 11】

The hydraulic system according to claim 10, further comprising:

a third detector 88, which detects an RPM of an engine of the forklift truck; and

25 a fourth detector 89, which detects a traveling speed of the forklift truck,

wherein the controller 85 controls the bypass valve 87 such that the connection between the first and second hydraulic lines 64 and 66 is blocked when the RPM of the engine is less than a
30 preset reference value or when the traveling speed of the truck deviates from a preset range while the lift cylinder 8 is operating.

【Claim 12】

The hydraulic system according to any one of claims 1 through 8, further comprising:

a third detector 88, which detects an RPM of an engine of
5 the forklift truck; and

a fourth detector 89, which detects a traveling speed of the forklift truck,

wherein the controller 85 controls the bypass valve 87 such that the connection between the first and second hydraulic lines
10 64 and 66 is blocked when the RPM of the engine is less than a preset reference value or when the traveling speed of the truck deviates from a preset range while the lift cylinder 8 is operating.

15 【Claim 13】

A hydraulic system of a forklift truck for operating a steering unit 52, a lift cylinder 8, a tilt cylinder 9 and at least one attachment 40, the hydraulic system comprising:

a manipulation device J, which outputs a manipulation signal
20 corresponding to manipulation of a driver;

a first hydraulic pump 60, which supplies hydraulic operating fluid to the lift cylinder 8 and the steering unit 52 through a first hydraulic line 64;

a second hydraulic pump 62, which supplies hydraulic
25 operating fluid to the tilt cylinder 9 and the attachment 40 through a second hydraulic line 66;

a bypass valve 87, which is installed between the first hydraulic line 64 and the second hydraulic line 66 to allow the first hydraulic line 64 to selectively communicate with the
30 second hydraulic line 66; and

a controller 85, which controls the bypass valve 87 such that the hydraulic operating fluid discharged from the first and second hydraulic pumps 60 and 62 joins with each other and then

is supplied to the first hydraulic line 64 when the controller 85 determines that only the lift cylinder 8 is to operate by analyzing the manipulation signal.

5 **【Claim 14】**

The hydraulic system according to claim 13, further comprising:

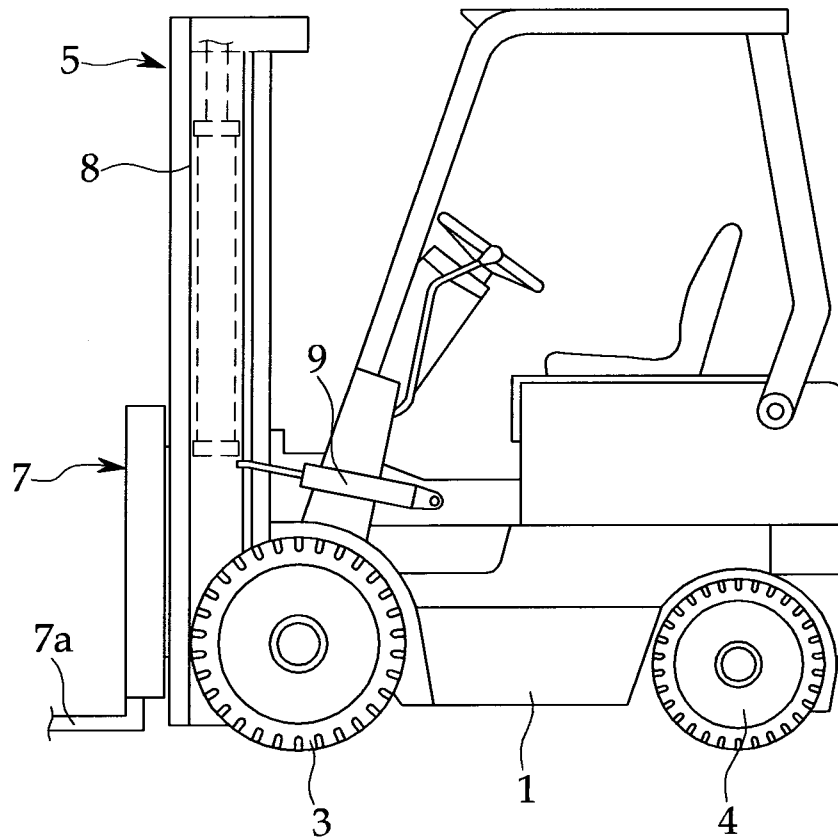
a third detector 88, which detects an RPM of an engine of the forklift truck; and

10 a fourth detector 89, which detects a traveling speed of the forklift truck,

wherein the controller 85 controls the bypass valve 87 such that the connection between the first and second hydraulic lines 64 and 66 is blocked when the RPM of the engine is less than a
15 preset reference value or when the traveling speed of the truck deviates from a preset range while the lift cylinder 8 is operating.

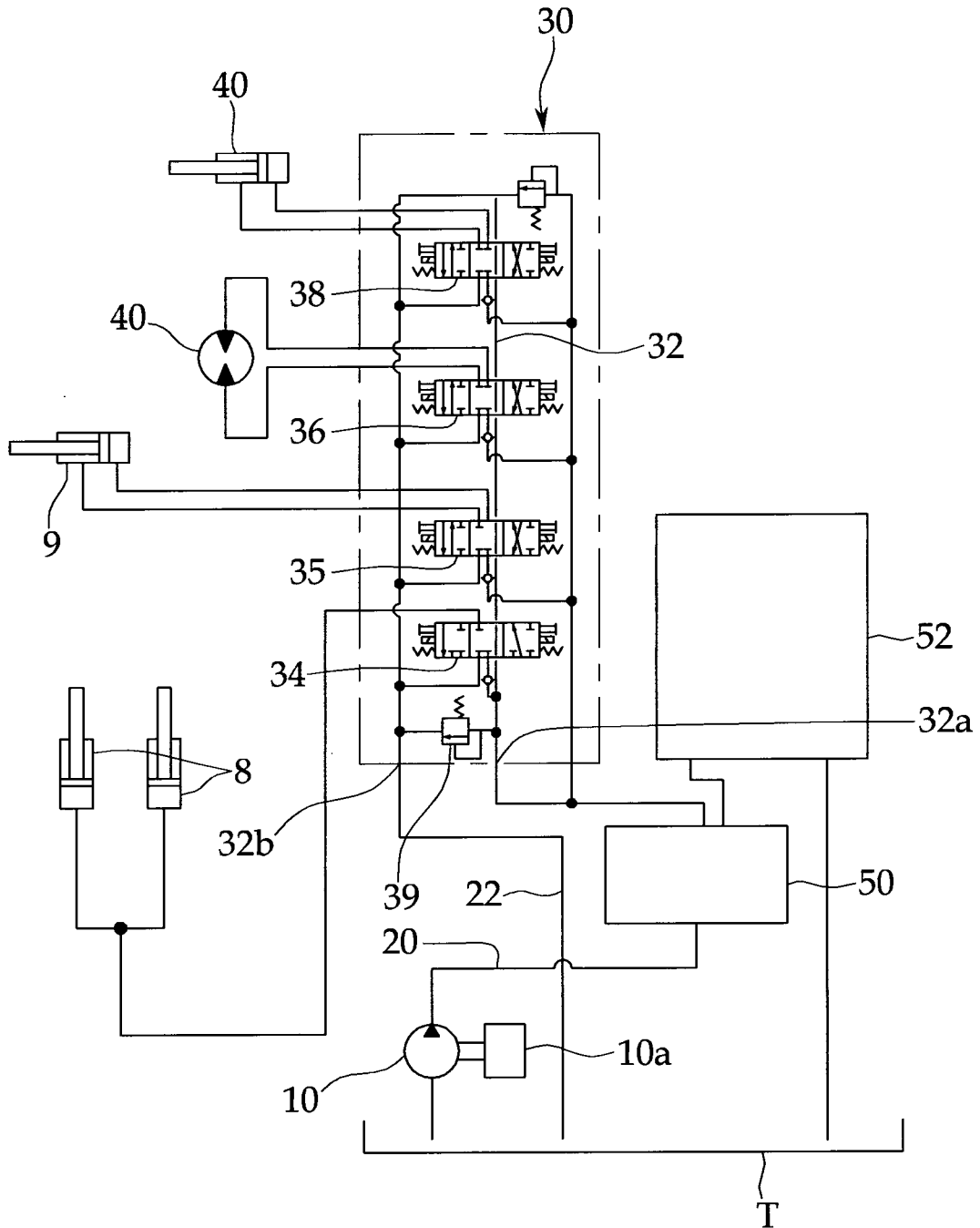
1/5

FIG. 1



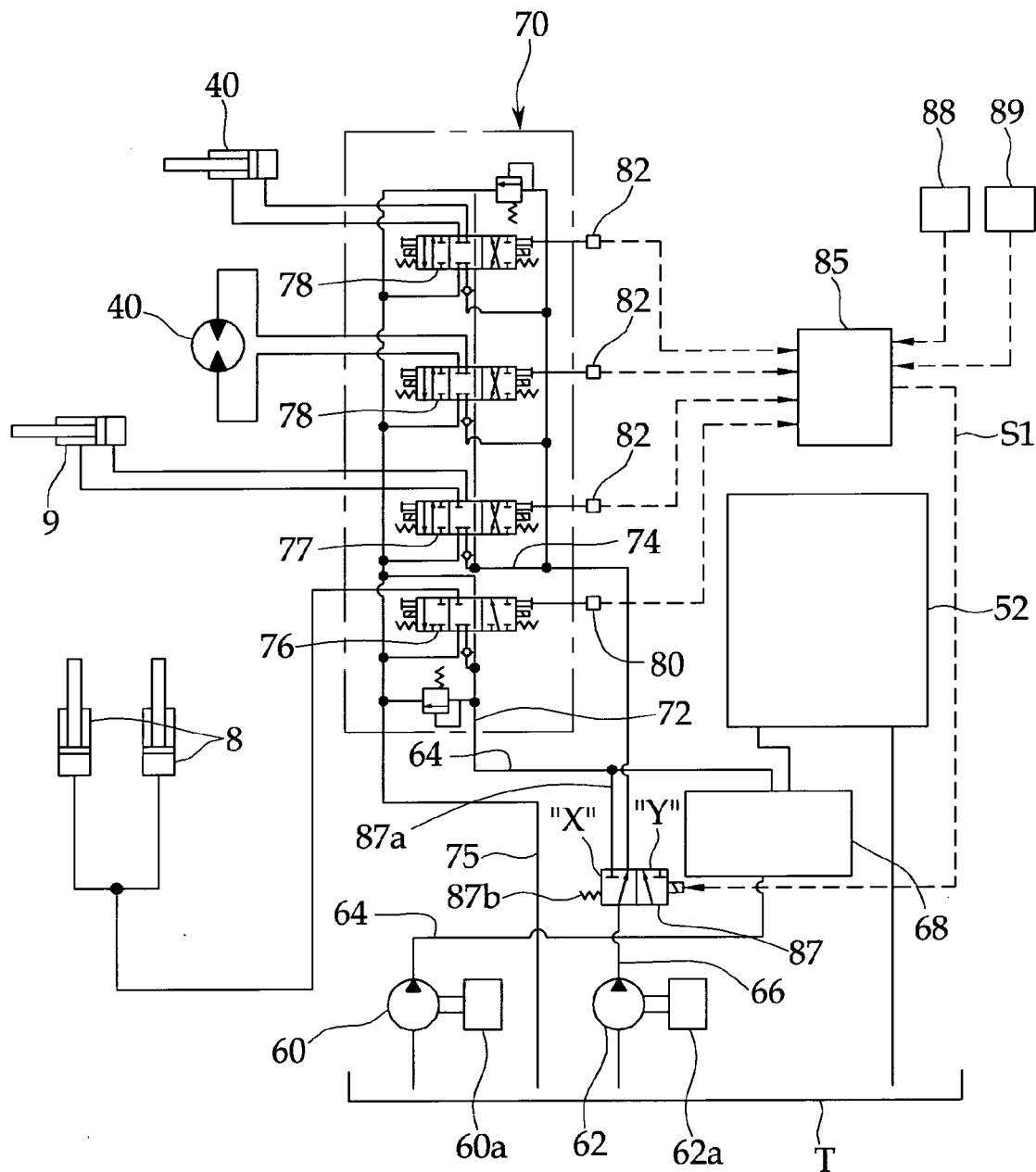
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FIG. 2



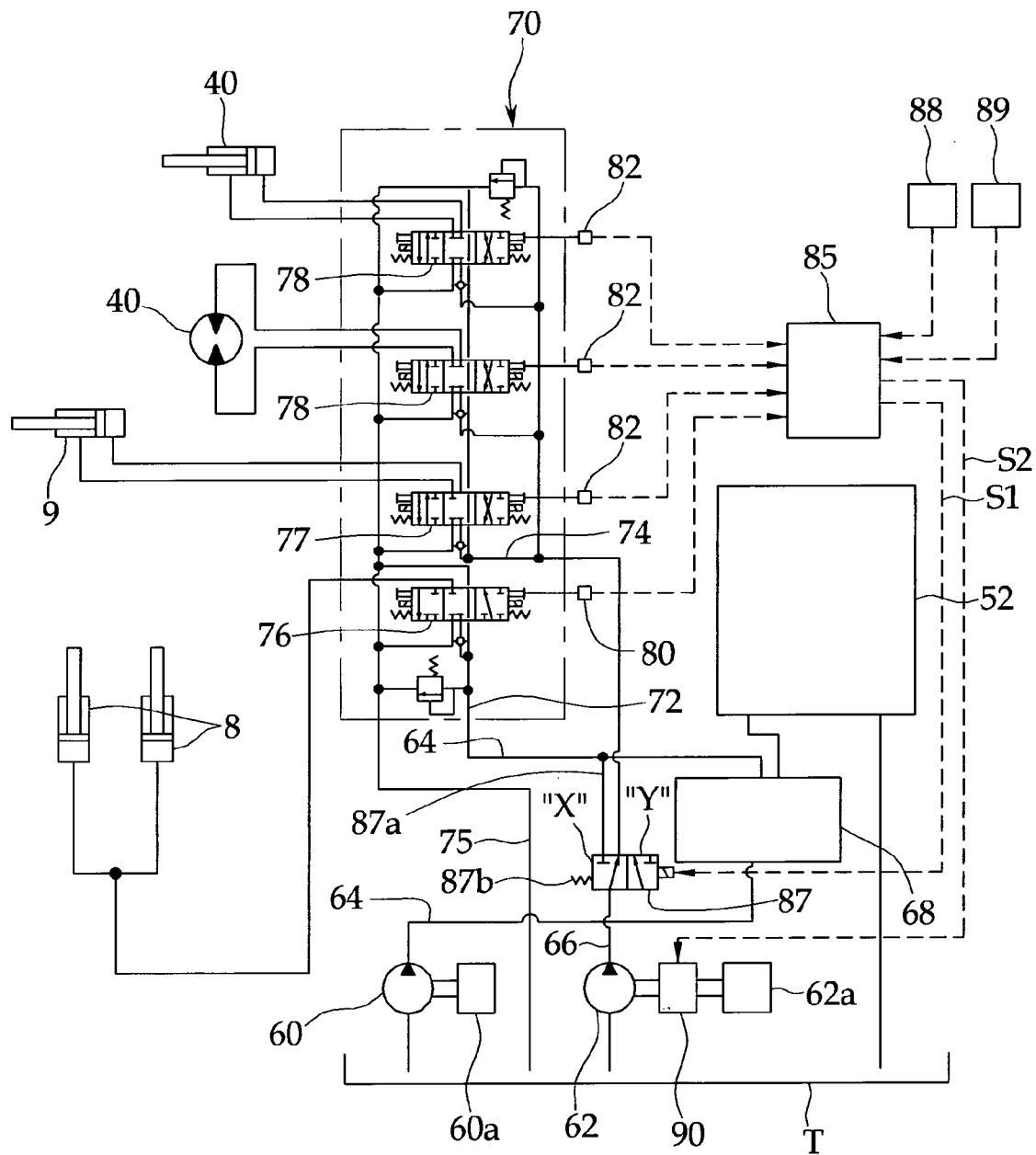
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FIG. 3



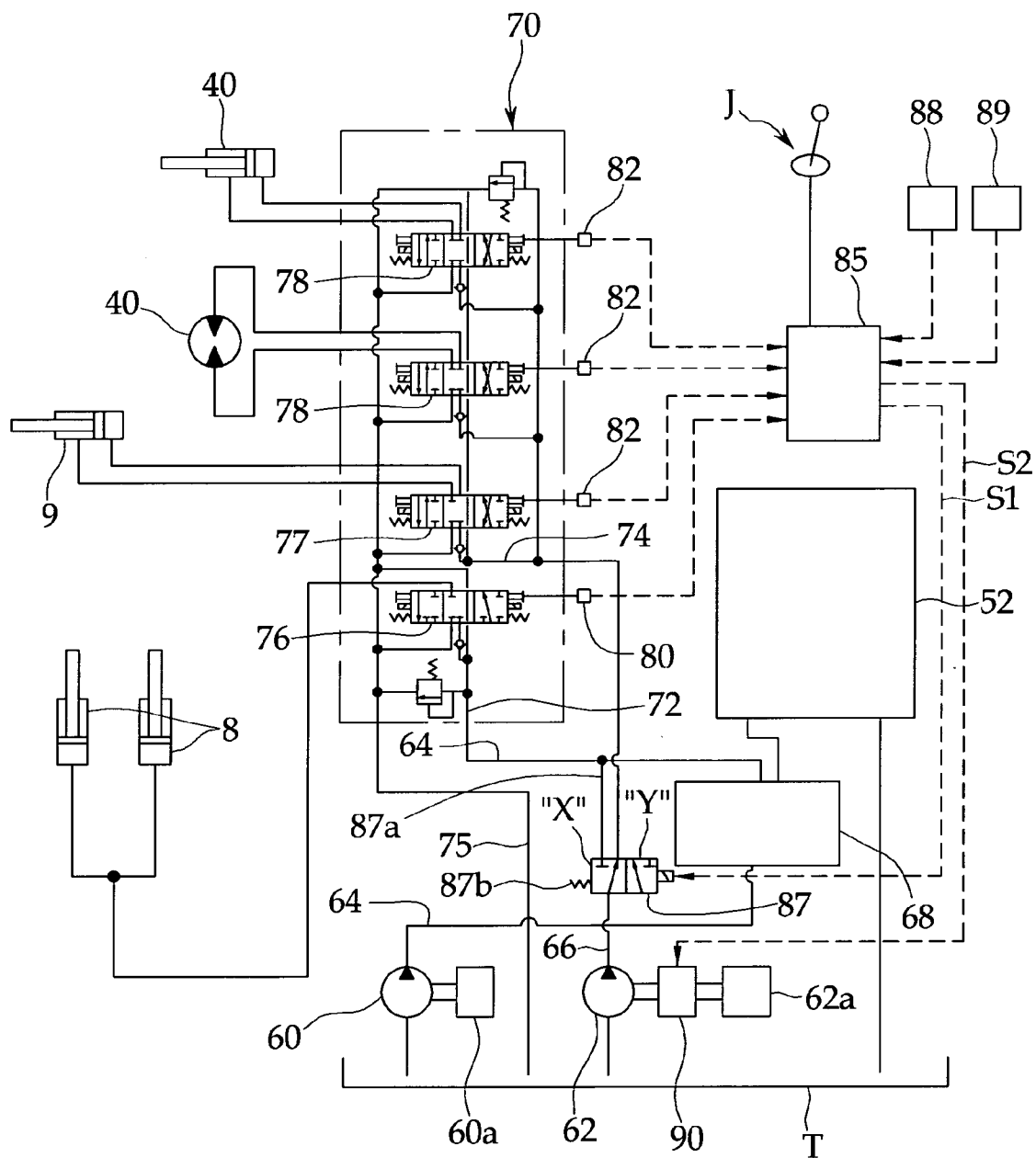
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FIG. 4



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FIG. 5



A. CLASSIFICATION OF SUBJECT MATTER***F15B 11/02(2006.01)i***

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)

IPC 8 B66F 9/22, F15G 11/02

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

Korean Utility models and applications for Utility models since 1975

Japanese Utility models and applications for Utility models since 1975

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

eKIPASS(KIPO internal) "forklift", "hydraulic", "pump", "bypass", "detect"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	KR 10-19998-0059366 A (DAEWOO HEAVY INDUSTRY LTD.) 7 OCTOBER 1998 See page 3, lines 23-36, and figs. 1-2.	1-6, 13 7- 12, 14
Y	KR 20-0165927 Y1 (DAEJIN WORK CO., LTD.) 15 FEBRUARY 2000 See claim 1, and figs. 1-2.	7-12
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A	KR 20-1999-0024015 U (DAEWOO HEAVY INDUSTRY LTD.) 5 JULY 1999 See pages 3-4, and fig 1.	1-14
A	JP 2006-182488 A (TCM CORP.) 13 JULY 2006 See abstract, and fig 2.	1-14



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

27 MARCH 2008 (27.03.2008)

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2007/006782

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KR 20-1999-0024015 U	05.07.1999	None	
JP 2006-182488 A	13.07.2006	None	