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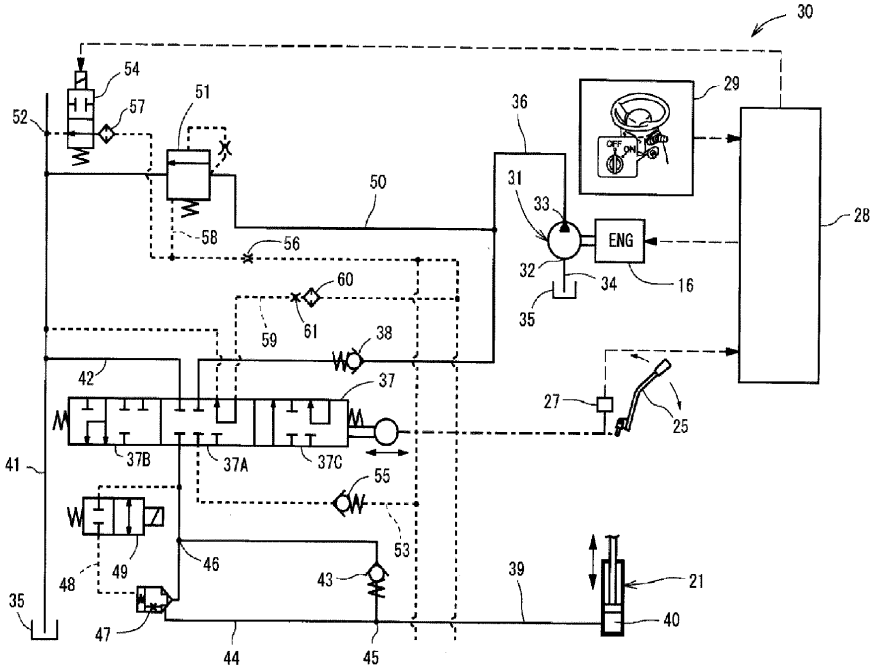
(54) HYDRAULIC CONTROLLER FOR INDUSTRIAL VEHICLE

(57) A hydraulic controller (30) for an industrial vehicle (10) includes a hydraulic pump (31) configured to pump hydraulic oil, an actuator (21, 24), a hydraulic oil passage that connects the hydraulic pump (31) and the actuator (21, 24), and a control valve (37) configured to control a flow direction of the hydraulic oil. The hydraulic controller (30) further includes a position detector (27) configured to detect a position of an operation lever (25), a key switch (29), an unloading switching valve (54) that is configured to return the hydraulic oil to a tank (35), and a controller (28). The controller (28) sets the unloading switching valve (54) to an open state when the key switch (29) is turned ON, and sets the unloading switching valve (54) to a closed state when the position detector (27) indicates that the operation lever (25) is in a neutral position.

FIG. 2



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Description

BACKGROUND ART

[0001] The present invention relates to a hydraulic controller for an industrial vehicle.

[0002] There is known a load handling lever locking device for an industrial vehicle disclosed in Japanese Patent Application Publication No. 2015-40081 as a conventional technique regarding a hydraulic controller for an industrial vehicle. The load handling lever locking device, which is disclosed in the Publication, includes a load handling lever for operating a load handling device, a hydraulic control valve for a control of the driving of the load handling device, a joint bar coupled to the load handling lever so as to swing relative to the load handling lever, a spool joint coupled between the joint bar and a spool of the hydraulic control valve, a locked portion formed in the spool joint, and a locking portion that is engageable with the locked portion to lock the spool joint when the load handling lever is set to a neutral position. The spool joint is coupled to the spool so as not to swing relative to the spool, whereas the spool joint is coupled to the joint bar so as to swing relative to the joint bar.

[0003] In the load handling lever locking device for the industrial vehicle, which is disclosed in the Publication, while an operator sits in a driver's seat, the locking portion is disengaged from the locked portion against a spring that urges the locking portion toward the locked portion in such a manner that the locking portion and the locked portion are kept in a disengaged state, so that the operator can operate the load handling lever. When the operator leaves the driver's seat in this state, the locking portion is pushed out toward the locked portion and engaged with the locked portion. The spool joint is locked by the locking portion, so that the operator cannot operate the load handling lever.

[0004] The load handling lever locking device, which is disclosed in the Publication, has a configuration in which the spool joint is mechanically locked. With this configuration, the load handling lever locking device may be damaged when the operator operates the load handling lever in a state where the spool joint is locked.

[0005] The present invention has been made in view of the above circumstances and is directed to provide a hydraulic controller for an industrial vehicle, wherein the hydraulic controller is not damaged by an operation of an operation lever since an actuator is not operated even when an operation lever is set to an operational position at a timing when a key switch is turned ON.

SUMMARY

[0006] In accordance with an aspect of the present invention, there is provided a hydraulic controller for an industrial vehicle that includes a hydraulic pump that is driven by an engine, and configured to pump hydraulic oil, an actuator that is operated by the hydraulic oil discharged from the hydraulic pump, a hydraulic oil passage that connects the hydraulic pump and the actuator, and a control valve that is disposed in the hydraulic oil passage, and configured to control a flow direction of the hydraulic oil. The hydraulic controller further includes a position detector that is configured to detect a position of an operation lever operating the actuator, a key switch for starting the engine, an unloading switching valve that is configured to return the hydraulic oil discharged from the hydraulic pump to a tank, and a controller that is configured to control the engine and the unloading switching valve. The controller sets the unloading switching valve to an open state when the key switch is turned ON. The controller sets the unloading switching valve to a closed state when the position detector indicates that the operation lever is in a neutral position.

[0007] Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the embodiments together with the accompanying drawings in which:

FIG. 1 is a side view of a forklift according to a first embodiment of the present invention;

FIG. 2 is a configuration diagram schematically illustrating a hydraulic controller of the forklift according to the first embodiment;

FIG. 3 is a flowchart illustrating a control flow of the hydraulic controller of the forklift according to the first embodiment; and

FIG. 4 is a flowchart illustrating a control flow of a hydraulic controller of a forklift according to a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

(First embodiment)

[0009] The following will describe a hydraulic controller of an industrial vehicle according to a first embodiment of the present invention with reference to the accompanying drawings. In the first embodiment, a hydraulic controller of a forklift as an industrial vehicle (hereinafter, simply referred to as "hydraulic controller") is exemplified.

[0010] As illustrated in FIG. 1, a forklift 10 includes a vehicle body 11 and a load handling device 12 in a front portion of the vehicle body 11. A driver's seat 13 is provided near a middle of the vehicle body 11. The vehicle body 11 has, in the front portion thereof, driving wheels

14 as front wheels and, in a rear portion thereof, steering wheels 15 as rear wheels. The vehicle body 11 has thereon an engine 16 as a driving source for travelling and load handling. The engine 16 is an internal combustion engine such as a diesel engine or a gasoline engine. Torque generated by the engine 16 is transmitted to the driving wheels 14 through a driving force transmitting device (not illustrated).

[0011] The load handling device 12 includes a mast 20 that has a pair of right and left outer masts 18 and a pair of right and left inner masts 19. The pair of right and left inner masts 19 are disposed inward of the pair of right and left outer masts 18, and slide along the outer masts 18, respectively. The mast 20 has a lift cylinder 21 that is a single-acting cylinder and operated by hydraulic oil. The inner masts 19 slide along the outer masts 18 to be lifted and lowered by an operation of the lift cylinder 21. A pair of right and left forks 22 is provided in the mast 20 with a lift bracket 23 interposed between the forks 22 and the mast 20. The lift bracket 23 is lifted and lowered with respect to the inner masts 19. A tilt cylinder 24 is provided between the vehicle body 11 and the outer masts 18. The tilt cylinder 24 is a double-acting cylinder and operated by the hydraulic oil. The mast 20 tilts forward and rearward of the vehicle body 11 around a fulcrum being a lower end portion of the mast 20 by an operation of the tilt cylinder 24.

[0012] A lift lever 25 and a tilt lever are provided in a front portion of the driver's seat 13. The lift lever 25 is configured to operate the lift cylinder 21 to lift and lower the forks 22. The tilt lever (not illustrated) is configured to operate the tilt cylinder 24 to tilt the mast 20. The lift lever 25 is set to a lifting position for lifting the forks 22, a lowering position for lowering the forks 22, or a neutral position between the lifting position and the lowering position. The lift lever 25 is set to the lifting position when the operator pushes the lift lever 25 forward, whereas the lift lever 25 is set to the lowering position when the operator pulls the lift lever 25 rearward. In addition, when the operator pushes the tilt lever forward, the mast 20 tilts forward, whereas when the operator pulls the tilt lever rearward, the mast 20 tilts rearward. The lift lever 25 and the tilt lever are the load handling levers. The lift lever 25 corresponds to an operation lever in the present invention. The lifting position of the lift lever 25 is referred as an operational position of the operation lever.

[0013] FIG. 2 is a configuration diagram schematically illustrating a hydraulic controller 30 of the forklift 10 according to the first embodiment. As illustrated in FIG. 2, the hydraulic controller 30 includes a position detector 27 that detects a position of the lift lever 25 for operating the lift cylinder 21. The position detector 27 outputs an electrical signal corresponding to the position of the lift lever 25 (the lifting position, the neutral position, or the lowering position). The output electrical signal is input to a controller 28 that is mounted on the vehicle body 11. The controller 28 controls each part of the forklift 10 as well as the engine 16. The controller 28 has a processing unit, a storage unit, an input part, and an output part (that are not illustrated). The processing unit executes a variety of operations and control programs. The storage unit stores therein a variety of the control programs and data. Signals from the position detector 27, a key switch 29, and each part of the forklift 10 are input to the input part. The output part outputs signals from the controller 28 to each part of the forklift 10 that is to be controlled.

[0014] The key switch 29 for starting the engine 16 is provided in the driver's seat 13 of the forklift 10. The key switch 29 is connected to the controller 28, which controls the engine 16. When the operator inserts a key into the key switch 29 and turns the key switch 29 ON, an ON signal is transmitted to the controller 28, thereby starting the engine 16. When the operator turns the key switch 29 OFF, the engine 16 stops.

[0015] As illustrated in FIG. 2, the hydraulic controller 30 of the first embodiment controls the lift cylinder 21. The hydraulic controller 30 includes the engine 16 and a hydraulic pump 31 that is driven by the engine 16. The hydraulic pump 31 has an inlet 32 into which the hydraulic oil is drawn and an outlet 33 from which the hydraulic oil is discharged. The hydraulic pump 31 rotates in one direction.

[0016] The inlet 32 of the hydraulic pump 31 is connected to a tank 35 through a first hydraulic pipe 34. The tank 35 stores the hydraulic oil. The hydraulic pump 31 supplies the hydraulic oil to the lift cylinder 21 during an operation in which the forks 22 are lifted by the lift lever 25.

[0017] The outlet 33 of the hydraulic pump 31 is connected to a lift switching valve 37 through a second hydraulic pipe 36. The second hydraulic pipe 36, which connects the outlet 33 and the lift switching valve 37, has therein a check valve 38 that allows the hydraulic oil to flow only in a direction from the outlet 33 toward the lift switching valve 37. The lift switching valve 37 is connected to an oil chamber 40 of the lift cylinder 21 through a third hydraulic pipe 39. The hydraulic controller 30 has a return pipe 41 through which the hydraulic oil is returned to the tank 35 and a fourth hydraulic pipe 42 that connects the return pipe 41 and the lift switching valve 37. Accordingly, the lift switching valve 37 is connected to the tank 35 through the return pipe 41 and the fourth hydraulic pipe 42. The second hydraulic pipe 36 and the third hydraulic pipe 39 constitute a first hydraulic oil passage as a hydraulic oil passage in the present invention. The first hydraulic passage connects the hydraulic pump 31 and the lift cylinder 21, and the hydraulic oil is supplied to the lift cylinder 21 through the first hydraulic oil passage.

[0018] The lift switching valve 37 of the first embodiment corresponds to a control valve that is disposed in the first hydraulic oil passage and controls a flow direction of the hydraulic oil in the present invention, and specifically, the lift switching valve 37 is a 7-port, 3-position directional control valve. The lift switching valve 37 includes a spool (not illustrated) that is movable in accordance with an operation of the lift lever 25. The spool is switchable among a first position 37A, a second position

37B, and a third position 37C by the operation of the lift lever 25. When the spool is in the first position 37A, the lift switching valve 37 is in a closed state in which the hydraulic oil is not allowed to flow through the lift switching valve 37. When the spool is in the second position 37B, the lift switching valve 37 is in an open state in which the lift switching valve 37 is opened at any opening degree. When the spool is in the third position 37C, the lift switching valve 37 is in an open state in which the lift switching valve 37 is opened at any opening degree. The lift switching valve 37 controls an opening degree thereof so as to adjust a flow rate of the hydraulic oil that flows into or from the oil chamber 40 and lift and lower the forks 22. When the spool of the lift switching valve 37 is in the second position 37B, the hydraulic oil flows into the oil chamber 40, thereby extending the lift cylinder 21 and lifting the forks 22. When the spool of the lift switching valve 37 is in the third position 37C, the hydraulic oil is discharged from the oil chamber 40, thereby retracting the lift cylinder 21 and lowering the forks 22.

[0019] The third hydraulic pipe 39 has therein a check valve 43 that allows the hydraulic oil to flow only in a direction from the lift switching valve 37 toward the lift cylinder 21. The hydraulic controller 30 includes a fifth hydraulic pipe 44 that is branched off from the third hydraulic pipe 39 at a branch point 45 so as to bypass the check valve 43 and joined to the third hydraulic pipe 39 at a junction 46. The third hydraulic pipe 39, the return pipe 41, the fourth hydraulic pipe 42, and the fifth hydraulic pipe 44 constitute a second hydraulic oil passage. The second hydraulic oil passage connects the lift switching valve 37 and the tank 35, and the hydraulic oil flows to the tank 35 from the lift cylinder 21 through the second hydraulic oil passage. The fifth hydraulic pipe 44 has therein a pilot check valve 47.

[0020] The pilot check valve 47 allows the hydraulic oil to flow only in a direction from the oil chamber 40 toward the tank 35. The pilot check valve 47 is connected to one end of a pilot line 48. The other end of the pilot line 48 is connected between the junction 46 and the lift switching valve 37. A pilot electromagnetic switching valve 49 is disposed in the pilot line 48. The pilot electromagnetic switching valve 49 is an electromagnetic on-off valve that is switchable between an open position and a closed position. The pilot electromagnetic switching valve 49 is normally in the closed position. In response to an ON signal input to a solenoid operation portion of the pilot electromagnetic switching valve 49, the pilot electromagnetic switching valve 49 is switched from the closed position to the open position.

[0021] The pilot check valve 47 has a plunger that opens and closes a passage between the lift cylinder 21 and the lift switching valve 37 and a spring that urges the plunger so as to close the passage between the lift cylinder 21 and the lift switching valve 37. The plunger has an orifice through which the hydraulic oil is supplied to the pilot line 48 from the lift cylinder 21.

[0022] When the forks 22 are lowered (a lift lowering motion of the forks 22 are performed), the pilot electromagnetic switching valve 49 is switched from the closed position to the open position. During the lift lowering motion of the forks 22, the forks 22 are lowered by self-weight of the load handling device 12 including the forks 22, and the lift cylinder 21 is retracted. Just after the pilot electromagnetic switching valve 49 is switched to the open position, the hydraulic oil flows from the lift cylinder 21 through the pilot line 48 and the lift switching valve 37, and is returned to the tank 35.

[0023] When a flow rate of the hydraulic oil flowing through the orifice of the pilot check valve 47 is increased, a plunger is pushed against the urging force of the spring by a difference in pressure (a differential pressure) between a pressure on an upstream side of the orifice and a pressure on a downstream side of the orifice, so that the passage between the lift cylinder 21 and the lift switching valve 37 is opened. Thus, the hydraulic oil flows from the lift cylinder 21 through the pilot check valve 47, the fifth hydraulic pipe 44, the lift switching valve 37, the fourth hydraulic pipe 42, and the return pipe 41, and is returned to the tank 35. An opening degree of the pilot check valve 47 is determined by the differential pressure between the pressure on the upstream side of the orifice (pressure on an upstream side of the pilot check valve 47 in the fifth hydraulic pipe 44) and the pressure on the downstream side of the orifice (pressure in the pilot line 48).

[0024] The hydraulic controller 30 includes a sixth hydraulic pipe 50 that connects the second hydraulic pipe 36 and the return pipe 41. The sixth hydraulic pipe 50 has therein a relief valve 51. When a pressure of the hydraulic oil in the second hydraulic pipe 36 reaches or exceeds a predetermined pressure, the relief valve 51 is opened to allow the hydraulic oil to flow from the second hydraulic pipe 36 to the return pipe 41 through the sixth hydraulic pipe 50.

[0025] The hydraulic controller 30 of the first embodiment has a configuration in which when the key switch 29 is turned ON from OFF, the lift cylinder 21 is not operated even when the lift lever 25 is in the lifting position.

[0026] As illustrated in FIG. 2, the hydraulic controller 30 includes a seventh hydraulic pipe 53 that is connected to the lift switching valve 37 aside from the fourth hydraulic pipe 42, and joined to the return pipe 41 at a junction 52. The seventh hydraulic pipe 53 is an unloading pipe through which the hydraulic oil that is discharged from the hydraulic pump 31 and supplied to the lift switching valve 37 is returned to the tank 35 even when the spool of the lift switching valve 37 is in the second position 37B. The seventh hydraulic pipe 53 has therein an unloading switching valve 54. The unloading switching valve 54 is an electromagnetic on-off valve that is switchable between an open position and a closed position. The unloading switching valve 54 is of a normally opened type. The unloading switching valve 54 is normally in the open position. In response to an ON signal input to a solenoid operation portion of the unloading switching valve 54, the

unloading switching valve 54 is switched from the open position to the closed position. The unloading switching valve 54 is controlled by the controller 28.

[0027] The seventh hydraulic pipe 53 has therein a check valve 55 that is disposed between the lift switching valve 37 and the unloading switching valve 54 and allows the hydraulic oil to flow only in a direction from the lift switching valve 37 toward the unloading switching valve 54. The seventh hydraulic pipe 53 also has therein an orifice 56 and a filter 57 between the check valve 55 and the unloading switching valve 54. A pilot line 58 is branched off from the seventh hydraulic pipe 53, and connected to the relief valve 51. A pressure in the seventh hydraulic pipe 53 is applied to the relief valve 51, and serves as pilot pressure.

[0028] The hydraulic controller 30 includes an eighth hydraulic pipe 59 through which a residual pressure of the hydraulic oil in the seventh hydraulic pipe 53 is released. The hydraulic oil in the seventh hydraulic pipe 53 flows to the return pipe 41 through the eighth hydraulic pipe 59 when the lift lever 25 is in the neutral position, that is, the spool of the lift switching valve 37 is set to the first position 37A. The eighth hydraulic pipe 59 has therein a filter 60 and an orifice 61.

[0029] The controller 28 stores a program that executes a control flow including a series of steps illustrated in FIG. 3. The following will describe the control flow illustrated in FIG. 3. Firstly, the operator turns the key switch 29 ON (Step S01). An ON signal of the key switch 29 is transmitted to the controller 28, and the controller 28 keeps the unloading switching valve 54 in an open state (Step S02).

[0030] Next, the controller 28 determines whether the lift lever 25 is in the neutral position (Step S03). In response to determining that the lift lever 25 is in the neutral position, that is, the position detector 27 indicates that the lift lever 25 is in the neutral position, the controller 28 turns the unloading switching valve 54 ON, so that the unloading switching valve 54 is closed (Step S04). In response to determining that the lift lever 25 is not in the neutral position, the processing returns to Step S02. When a signal output from the position detector 27 is transmitted to the controller 28, the controller 28 recognizes the position of the lift lever 25.

[0031] In response to determining that the lift lever 25 is in the neutral position, the controller 28 turns the unloading switching valve 54 ON, so that the unloading switching valve 54 is closed. Then, the controller 28 determines whether the lift lever 25 is in the neutral position (Step S05). When the controller 28 determines that the lift lever 25 is in the neutral position, it is impossible to perform the load handling work (Step S06). Specifically, since the lift lever 25 is in the neutral position, the lift cylinder 21 is not operated and the forks 22 are not lifted and lowered. When the controller 28 determines that the lift lever 25 is not in the neutral position, it is possible to perform the load handling work (Step S07). Specifically, since the lift lever 25 is in the lifting position or the lowering position, the lift cylinder 21 is operated and the forks 22 are lifted or lowered. Subsequently to Step S06 or Step S07, the processing returns to Step S05. Note that when the key switch 29 is turned OFF, the present processing in any one of the series of steps ends immediately.

[0032] Of the series of steps illustrated in FIG. 3, Steps S01 to S03 are steps associated with a control for preventing a malfunction of the lift cylinder 21, and Steps S04 to S07 are steps associated with a regular control of the lift cylinder 21.

[0033] The following will describe an operation of the hydraulic controller 30 according to the first embodiment. When the operator starts to drive the forklift 10 in a stop state, the operator firstly inserts the key to the key switch 29 and turns the key switch 29 ON. In response to turning the key switch 29 ON, the engine 16 starts to be driven, thereby driving the hydraulic pump 31. In addition, the unloading switching valve 54 is kept in the open state. The hydraulic pump 31 pumps and discharges the hydraulic oil in accordance with the driving of the engine 16. Here, when a position of the lift lever 25 that is detected by the position detector 27 is the neutral position, the unloading switching valve 54 is turned ON to be closed.

[0034] The relief valve 51 is opened when a differential pressure between a pressure of the hydraulic oil in the second hydraulic pipe 36 and the sixth hydraulic pipe 50 and the pilot pressure in the pilot line 58 exceeds a predetermined value. Thus, when a position of the lift lever 25 is in the neutral position, the spool of the lift switching valve 37 is set to the first position 37A, and the hydraulic oil discharged from the hydraulic pump 31 is supplied to the return pipe 41 through the second hydraulic pipe 36, the sixth hydraulic pipe 50, and the relief valve 51. Then, the hydraulic oil is returned to the tank 35.

[0035] When the unloading switching valve 54 is turned ON to be closed, the lift cylinder 21 is operated correspondingly to the position of the lift lever 25 operated by the operator. Specifically, setting the lift lever 25 to the lifting position by the operator causes the spool of the lift switching valve 37 to be set to the second position 37B. Thus, the hydraulic oil discharged from the hydraulic pump 31 is supplied to the oil chamber 40 of the lift cylinder 21 through the second hydraulic pipe 36, the lift switching valve 37, and the third hydraulic pipe 39. A rod of the lift cylinder 21 is lifted by the hydraulic oil supplied to the oil chamber 40, thereby lifting the forks 22.

[0036] Setting the lift lever 25 to the lowering position by the operator causes the spool of the lift switching valve 37 to be set to the third position 37C. Thus, the hydraulic oil discharged from the hydraulic pump 31 is supplied to the return pipe 41 through the second hydraulic pipe 36, the sixth hydraulic pipe 50, and the relief valve 51. Then, the hydraulic oil is returned to the tank 35. The hydraulic oil in the oil chamber 40 of the lift cylinder 21 is supplied to the return pipe 41 through the third hydraulic pipe 39, the fifth hydraulic pipe 44, the pilot check valve 47, the lift switching valve 37, and the fourth hydraulic pipe 42,

and is returned to the tank 35. As a result, the rod of the lift cylinder 21 is lowered, thereby lowering the forks 22.

[0037] There is a case in which the position of the lift lever 25 that is detected by the position detector 27 is a position excluding the neutral position, that is, a lifting position or a lowering position when the key switch 29 is turned ON. In one example of the case, the lift lever 25 is in the lifting position as the operational position, and the spool of the lift switching valve 37 is in the second position 37B. In such a case in which the lift lever 25 is in the lifting position, the hydraulic oil supplied from the hydraulic pump 31 to the lift switching valve 37 is allowed to flow to the lift cylinder 21. However, the hydraulic oil flows through the seventh hydraulic pipe 53, the unloading switching valve 54, and the return pipe 41, and is returned to the tank 35 since the unloading switching valve 54 is in the open state. Accordingly, a pressure in the oil chamber 40 of the lift cylinder21 is not increased, so that the lift cylinder 21 is not operated. As a result, the forks 22 do not start to be lifted at the same time when the key switch 29 is turned ON.

[0038] Note that a pressure of the hydraulic oil in the second hydraulic pipe 36 and the sixth hydraulic pipe 50 is increased when an amount of the hydraulic oil per unit time flowing to the tank 35 through the seventh hydraulic pipe 53, the unloading switching valve 54, and the return pipe 41 is less than that discharged from the hydraulic pump 31. However, when the differential pressure between the pressure of the hydraulic oil in the sixth hydraulic pipe 50 and the pilot pressure in the pilot line 58 exceeds a predetermined value, the relief valve 51 is opened. With this process, the hydraulic oil flows through the second hydraulic pipe 36, the sixth hydraulic pipe 50, the relief valve 51, and the return pipe 41, and is returned to the tank 35 as well as the hydraulic oil flows through the seventh hydraulic pipe 53, the unloading switching valve 54, and the return pipe 41, and is returned to the tank 35.

[0039] Incidentally, when the lift lever 25 is in the lowering position and the spool of the lift switching valve 37 is in the third position 37C, the relief valve 51 is opened, so that the hydraulic oil discharged from the hydraulic pump 31 flows through the second hydraulic pipe 36, the sixth hydraulic pipe 50, the relief valve 51, and the return pipe 41, and is returned to the tank 35. Note that setting the pilot electromagnetic switching valve 49 to the closed state by any control or means causes the lift cylinder 21 to be not operated even when the lift lever 25 is in the lowering position.

[0040] The hydraulic controller 30 according to the first embodiment provides the following advantageous effects.

(1) When the key switch 29 is turned ON, the unloading switching valve 54 is set to the open state, so that the hydraulic oil discharged from the hydraulic pump 31 flows through the lift switching valve 37, the seventh hydraulic pipe 53, the unloading switching valve 54, and the return pipe 41, and is returned to the tank 35 of the hydraulic oil even when the lift lever 25 is in the lifting position as the operational position. As a result, the lift cylinder 21 as an actuator is not operated even when the lift lever 25 is in the lifting position. This means that the lift cylinder 21 is not operated immediately even when the key switch 29 is turned ON. Accordingly, before turning the key switch 29 ON, the operator does not need to check the position of the lift lever 25 and return the lift lever 25 from the position excluding the neutral position to the neutral position. The operation of the lift lever 25 is not regulated physically, so that the lift lever 25 is not damaged even when the operator operates the lift lever 25 without recognizing that the lift lever 25 is in the lifting position.

(2) The unloading switching valve 54 is disposed in the seventh hydraulic pipe 53 corresponding to an unloading oil passage in the present invention. The seventh hydraulic pipe 53 connects the lift switching valve 37 and the tank 35 of the hydraulic oil. Accordingly, after the hydraulic oil discharged from the hydraulic pump 31 flows through the lift switching valve 37, the hydraulic oil may flow through the seventh hydraulic pipe 53 and the unloading switching valve 54, and be returned to the tank 35 of the hydraulic oil.

(3) Even when the amount of the hydraulic oil per unit time flowing to the tank 35 through the seventh hydraulic pipe 53, the unloading switching valve 54, and the return pipe 41 is less than that discharged from the hydraulic pump 31, the hydraulic oil may flow through the second hydraulic pipe 36, the sixth hydraulic pipe 50, the relief valve 51, and the return pipe 41, and be returned to the tank 35 by the relief valve 51 that is opened when the differential pressure between the pressure of the hydraulic oil in the sixth hydraulic pipe 50 and the pilot pressure in the pilot line 58 exceeds the predetermined value. As a result, the malfunction of the lift cylinder 21 may be surely prevented.

(Second embodiment)

[0041] The following will describe a hydraulic controller according to the second embodiment of the present invention. A series of steps in a control program stored in a controller in the second embodiment is different from that in the first embodiment. Thus, the configuration as a device of the hydraulic controller in the second embodiment is the same as that in the first embodiment, and the same or equivalent elements are denoted by the same reference numerals.

[0042] In the second embodiment, the controller 28 stores a program that executes a control flow including a series of steps illustrated in FIG. 4. Of the series of steps illustrated in FIG. 4, Steps S11 to S17 are the same

as Steps S01 to S07 in the first embodiment, respectively. In the second embodiment, in response to determining that the lift lever 25 is not in the neutral position, that is, the position detector 27 does not indicate that the lift lever 25 is in the neutral position in Step S13, the controller28 determines whether N seconds have passed since turning ON of the key switch 29. In response to determining that N seconds have passed since turning ON of the key switch 29, the controller 28 turns the unloading switching valve 54 ON to be closed (Step S14). Whereas, in response to determining that N seconds have not passed since turning ON of the key switch 29, the processing returns to Step S12. The controller 28 has a function of a timer that is used for determining whether N seconds have passed. N seconds correspond to a predetermined time, for example, may be set to 60 seconds.

[0043] Of the series of the steps illustrated in FIG. 4, Steps S11 to S13 and S18 are steps associated with a control for preventing a malfunction of the lift cylinder 21, and Steps S14 to S17 are steps associated with a regular control of the lift cylinder 21.

[0044] There is a case in which when the key switch 29 is turned ON, despite the lift lever 25 that is actually in the neutral position, the lifting position of the lift lever 25 is detected due to, for example, a trouble of the position detector 27. In this case, the neutral position of the lift lever 25 is not detected in the first embodiment, so that the unloading switching valve 54 is not turned ON. That is, even when the lift lever 25 is set to the lifting position by the operation of the operator, the lift cylinder 21 is not operated, and a state in which the load handling work is not performed is continued.

[0045] In the second embodiment, when the key switch 29 is turned ON, the controller 28 sets the unloading switching valve 54 to the open state. Then, when the position detector 27 indicates that the lift lever 25 is in the neutral position, the controller 28 sets the unloading switching valve 54 to the closed state after the predetermined time (N seconds) has passed. That is, despite the trouble of the position detector 27, the unloading switching valve 54 is turned OFF to be closed after N seconds have passed since turning ON of the key switch 29. When the unloading switching valve 54 is turned ON, setting the lift lever 25 to the lifting position by the operation of the operator causes the hydraulic oil to be supplied to the lift cylinder 21 to lift the rod of the lift cylinder 21, so that the forks 22 are lifted. That is, even when the neutral position of the lift lever 25 is detected due to the trouble of the position detector 27, it is possible to perform the load handling work after N seconds have passed since turning ON of the key switch 29.

[0046] The present invention is not limited to the embodiments described above, and may appropriately be modified within the gist of the present invention. For example, the following modification may be allowed.

[0047] In the above-described embodiment, the lift lever in the forklift is described as an example of the operation lever. However, the operation lever is not limited to the lift lever. The operation lever may include a tilt lever operating the tilt cylinder and a lever operating an actuator that is disposed in an attachment.

[0048] In the above-described embodiment, the unloading switching valve is of the normally opened type. However, the unloading switching valve may be of the normally closed type. Here, the unloading switching valve is normally closed, and in response to an ON signal input to the solenoid operation portion, the unloading switching valve is switched from the closed state to an open state. Preferably, when the key switch is turned ON, the controller immediately turns the unloading switching valve ON to set the unloading switching valve to the open state.

[0049] In the above-described embodiments, the present invention is applied to the forklift as the industrial vehicle. However, the industrial vehicle is not limited to the forklift. The industrial vehicle may include a skid-steer loader and a vehicle for a high lift work.

Claims

1. A hydraulic controller (30) for an industrial vehicle (10) comprising:

a hydraulic pump (31) that is driven by an engine (16), and configured to pump hydraulic oil;
an actuator (21, 24) that is operated by the hydraulic oil discharged from the hydraulic pump (31);
a hydraulic oil passage that connects the hydraulic pump (31) and the actuator (21, 24); and
a control valve (37) that is disposed in the hydraulic oil passage, and configured to control a flow direction of the hydraulic oil, **characterized in that**
the hydraulic controller (30) further includes:

a position detector (27) that is configured to detect a position of an operation lever (25) for operating the actuator (21, 24);
a key switch (29) for starting the engine (16);
an unloading switching valve (54) that is configured to return the hydraulic oil discharged from the hydraulic pump (31) to a tank (35); and
a controller (28) that is configured to control the engine (16) and the unloading switching valve (54),

the controller (28) sets the unloading switching valve (54) to an open state when the key switch (29) is turned ON, and
the controller (28) sets the unloading switching valve (54) to a closed state when the position detector (27) indicates that the operation lever (25) is in a neutral position.

2. The hydraulic controller (30) for the industrial vehicle (10) according to claim 1, **characterized in that**
the controller (28) sets the unloading switching valve (54) to the open state when the key switch (29) is turned ON, and
the controller (28) sets the unloading switching valve (54) to the closed state after a predetermined time has passed when the position detector (27) does not indicate that the operation lever (25) is in the neutral position.

3. The hydraulic controller (30) for the industrial vehicle (10) according to claim 1 or 2, **characterized in that** the unloading switching valve (54) is disposed in an unloading oil passage (53) that connects the control valve (37) and the tank (35).

FIG. 1

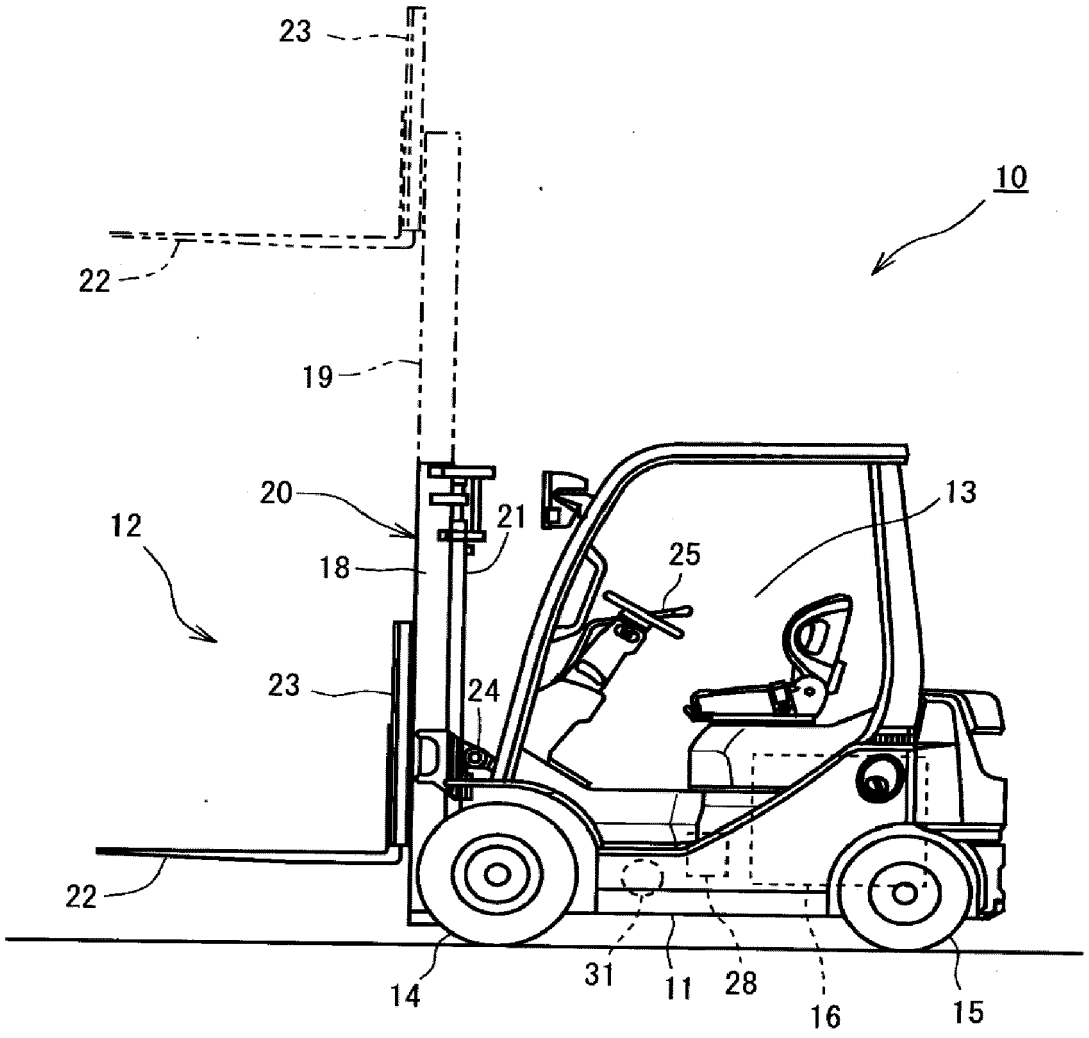
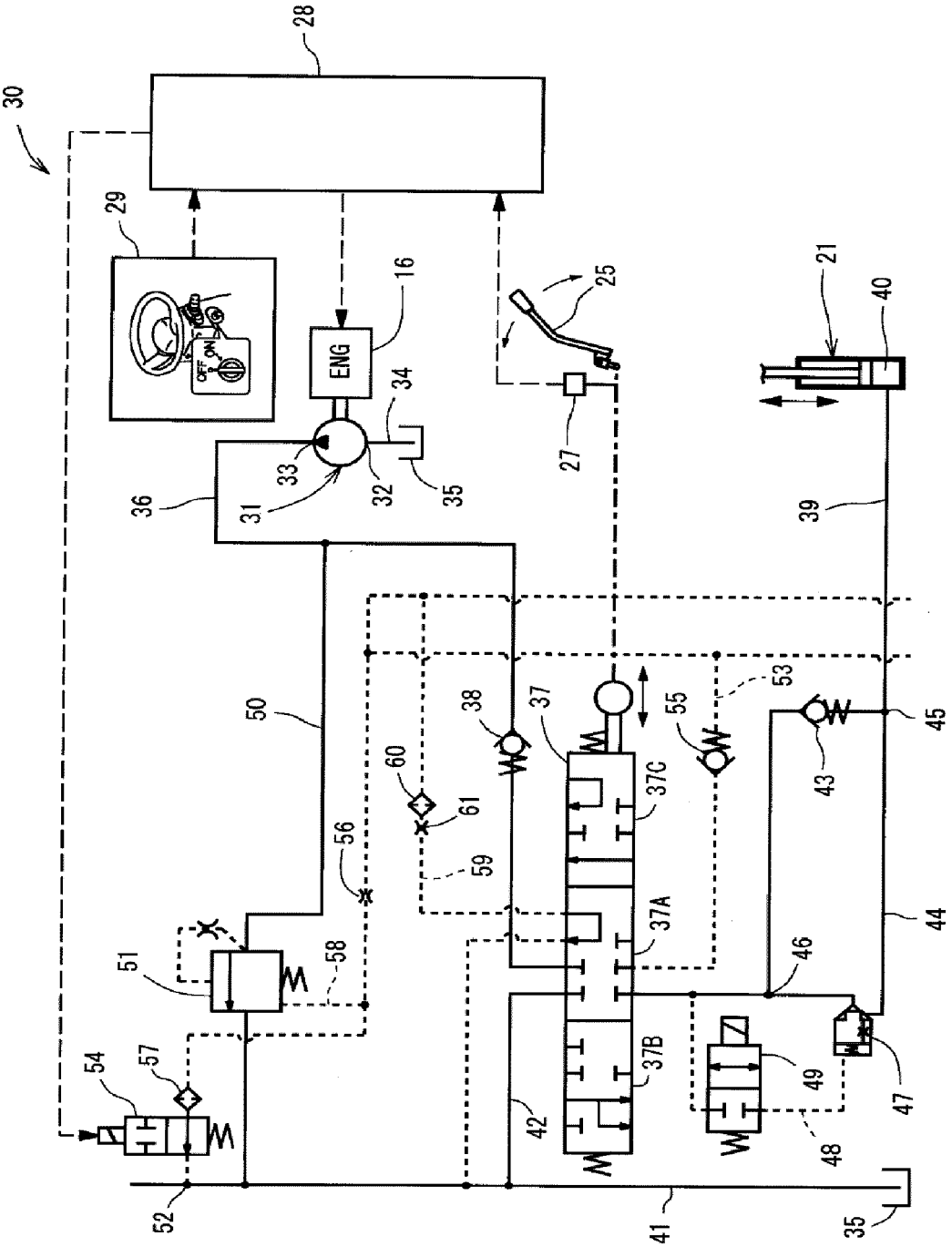


FIG. 2


28
30
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ENG
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38
37
55
53
45
60
61
43
56
59
37C
37A
44
51
58
46
54
57
37B
49
47
42
48
52
41
35

FIG. 3

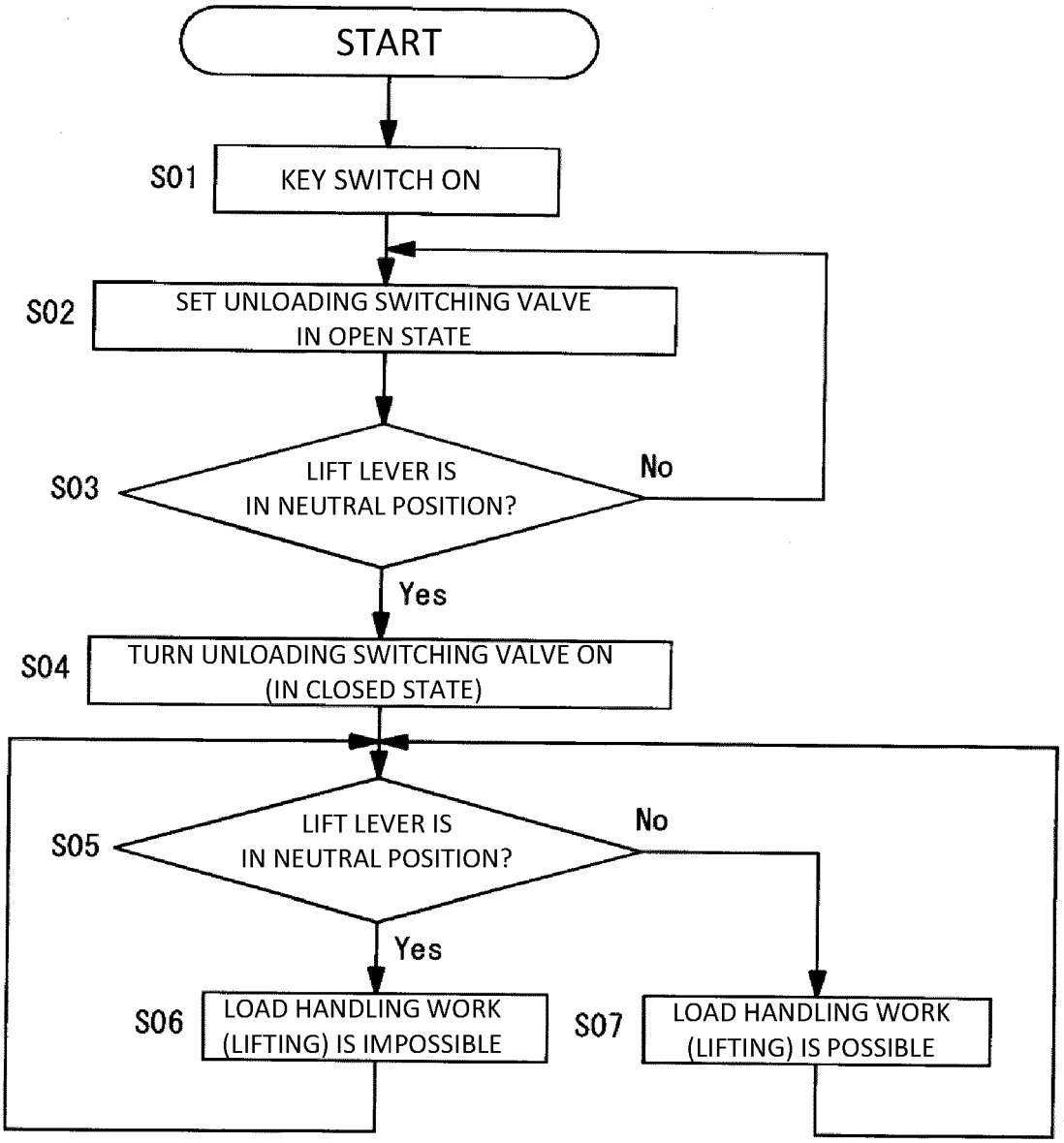
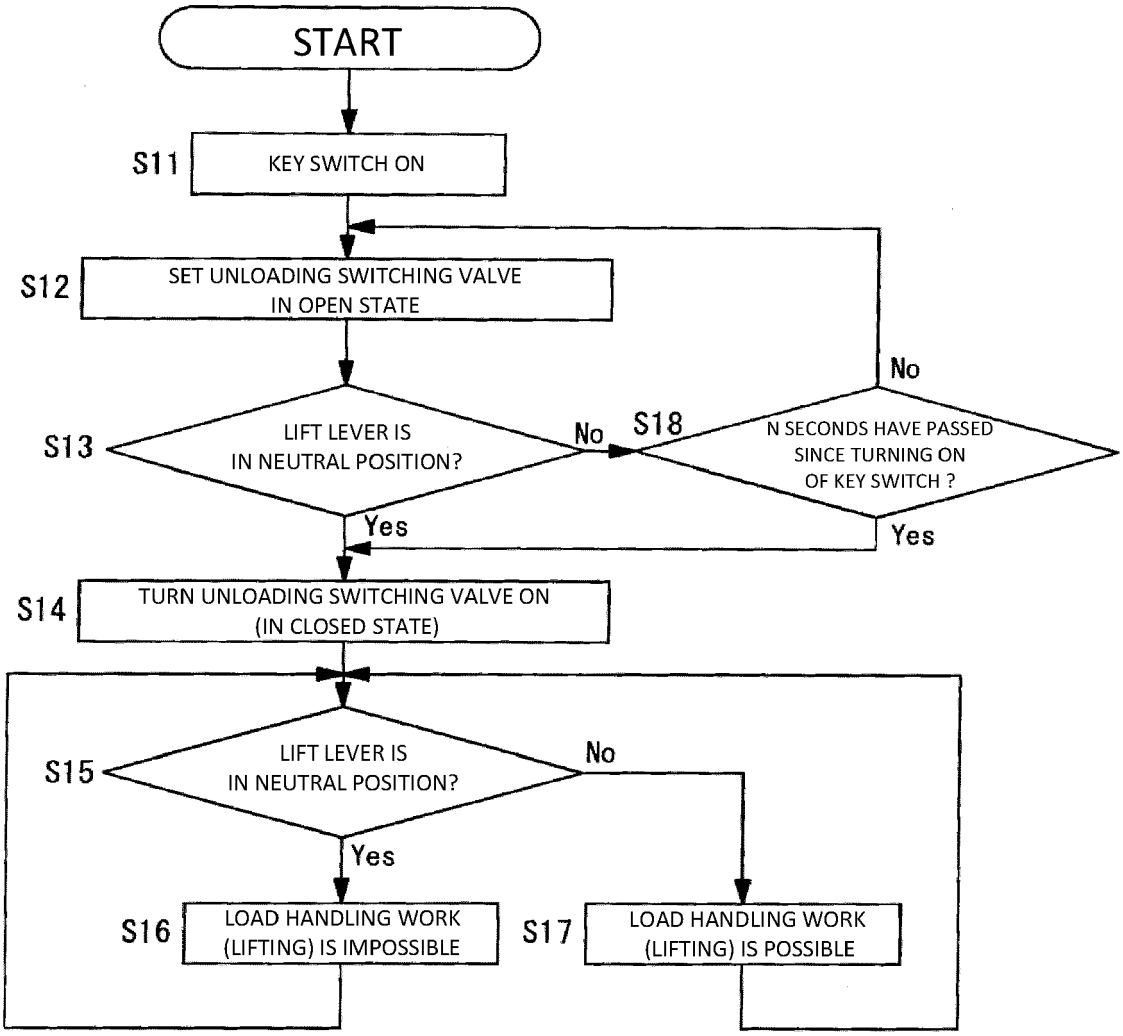

START
S01
KEY SWITCH ON
S02
SET UNLOADING SWITCHING VALVE IN OPEN STATE
S03
LIFT LEVER IS IN NEUTRAL POSITION?
No
Yes
S04
TURN UNLOADING SWITCHING VALVE ON (IN CLOSED STATE)
S05
LIFT LEVER IS IN NEUTRAL POSITION?
No
Yes
S06
LOAD HANDLING WORK (LIFTING) IS IMPOSSIBLE
S07
LOAD HANDLING WORK (LIFTING) IS POSSIBLE

FIG. 4


START
S11
KEY SWITCH ON
S12
SET UNLOADING SWITCHING VALVE IN OPEN STATE
S13
LIFT LEVER IS IN NEUTRAL POSITION?
No
S18
N SECONDS HAVE PASSED SINCE TURNING ON OF KEY SWITCH ?
No
Yes
Yes
S14
TURN UNLOADING SWITCHING VALVE ON (IN CLOSED STATE)
S15
LIFT LEVER IS IN NEUTRAL POSITION?
No
Yes
S16
LOAD HANDLING WORK (LIFTING) IS IMPOSSIBLE
S17
LOAD HANDLING WORK (LIFTING) IS POSSIBLE

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EUROPEAN SEARCH REPORT

Application Number
EP 21 18 4356

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B66F

1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	3 December 2021	Popescu, Alexandru

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