DESCRIPTION

Title of the Invention

WINDLASS

Technical Field

[0001] The present invention relates to a windlass which winds up an anchor chain with a hydraulic motor.

Background Art

[0002] There is conventionally known a windlass which uses a hydraulic motor to lower an anchor from a vessel and wind it up onto the vessel (see, for example, Patent Literature 1). A hydraulic circuit of a windlass according to Patent Literature 1 includes a first hydraulic path connected to a primary side of a hydraulic motor, a second hydraulic path connected to a secondary side of the hydraulic motor, and a selector valve for selecting whether to supply hydraulic pressure from a hydraulic pump to the first hydraulic path or the second hydraulic path.

[0003] In this windlass, when an anchor chain is wound up, if the hydraulic motor goes into a rendering state in which it is reversed by an excessive force, the hydraulic motor is reversed by selecting the selector valve so as to supply the hydraulic pressure to the second hydraulic path. Thus, the hydraulic motor in the rendering state is prevented from being damaged.

Citation List

Patent Literature

[0004] Patent Literature 1: Japanese Patent Application Laid-Open No. 2002-60185

Summary of Invention

Technical Problem

[0005] However, when a vessel is anchored in stormy weather, if an anchor chain is subjected to shock, a surge pressure may be generated inside a hydraulic motor. In such a case, according to the above-described conventional windlass, there is a possibility that the body of the hydraulic motor may be damaged, and thus an anchor or the anchor chain may be lost.

[0006] In view of these problems of the conventional technology, the purpose of the present invention is to provide a windlass which enables a hydraulic motor not to be damaged by a surge pressure generated inside the hydraulic motor.

Solution to Problem

[0007] The windlass according to the present invention is a windlass which winds up an anchor chain with a hydraulic motor driven by hydraulic pressure supplied from a hydraulic pump through a hydraulic supply path, and includes: an accumulator which is connected to the hydraulic supply path, and damps a serge shock generated in the hydraulic pressure; a veer amount measuring unit which measures a veer amount of the anchor chain from a reference position; and a first setting unit which selectively sets a connection state of the accumulator with respect to the hydraulic supply path to an on-state in which the accumulator is connected to the hydraulic supply path or an off-state in which the connection is released in accordance with the veer amount. The hydraulic supply path includes: a first hydraulic path connected to a primary side of the hydraulic motor; a second hydraulic path connected to a secondary side of the hydraulic motor; a forward/reverse selector valve for selecting whether to supply the hydraulic pressure from the hydraulic pump to the first hydraulic path or the second hydraulic path; and one relief valve, or two or more relief valves disposed in parallel, which relieve hydraulic pressure of the first hydraulic path into the second hydraulic path in a case where the hydraulic pressure of the first hydraulic path becomes a predetermined value or higher.

[0008] In this configuration, when a vessel is anchored in stormy weather, a surge pressure significantly beyond an allowable pressure is generated momentarily inside the hydraulic motor by the anchor chain being subjected to shock, and there is a possibility that the hydraulic motor may be damaged by this.

[0009] In this regard, according to the present invention, the first setting unit sets it in the on-state in which the accumulator is connected to the hydraulic circuit in advance, and thereby the surge pressure is damped by the accumulator; therefore, it is possible to effectively prevent damage on the hydraulic motor.

[0010] Meanwhile, if the connection state of the accumulator is kept in the on-state, when the anchor chain is wound up to the reference position, and the winding up is

completed, there is a possibility that the winding up of the anchor chain by release of the hydraulic pressure from the accumulator and veering out of the anchor chain by absorption of the hydraulic pressure into the accumulator, may cause the anchor to repeat an up-and-down movement and then come to rest.

[0011] About this, before the completion of winding up, in a case where the veer amount of the anchor chain from the reference position becomes less than a predetermined value, the first setting unit releases the connection of the accumulator to the hydraulic circuit, and shuts of the going in and out of the hydraulic pressure into the accumulator and therefore it is possible to prevent the up-and-down movement of the anchor at the time of completion of winding up.

[0012] Therefore, according to the present invention, since the windlass includes the first setting unit, it is possible to prevent the up-and-down movement of the anchor at the time of completion of winding up while preventing damage of the hydraulic motor by the accumulator.

[0013] Furthermore, according to the present invention, the hydraulic pressure is supplied to the primary side of the hydraulic motor from the first hydraulic path to cause the hydraulic motor to make forward rotation, and, when the anchor chain is wound up, even if a high pressure is generated in the first hydraulic path for a relatively long term, the pressure can be effectively released into the second hydraulic path through the one or more relief valves. Therefore, along with a damper effect of the accumulator, it is possible to prevent the damage on the hydraulic pump with more certainty.

[0014] In the present invention, it is preferable that the windlass include a first control unit which changes a setting state of the first setting unit from the off-state to the on-state in a case where the veer amount from the reference position exceeds a first veer amount, and changes the setting state of the first setting unit from the on-state to the off-state in a case where the veer amount becomes equal to or lower than the first veer amount. According to this, it is possible to automatically achieve prevention of damage on the hydraulic motor by the damper effect of the accumulator and prevention of the up-and-down movement of the anchor at the time of completion of winding up.

[0015] In the present invention, it is preferable that the windlass include: a flow divider

which serves as a booster configured to increase the hydraulic pressure of the hydraulic supply path; a second setting unit for setting an on-state in which the hydraulic supply path goes through the flow divider and an off-state in which the hydraulic supply path does not go through the flow divider; and a second control unit which switches a setting state of the second setting unit from the off-state to the on-state in a case where the veer amount exceeds a second veer amount, and switches the setting state of the second setting unit from the on-state to the off-state in a case where the veer amount becomes equal to or lower than the second veer amount.

[0016] According to this, in a case where the vessel is anchored in deep water which causes the veer amount to exceed the second veer amount, the second control unit sets the on-state in which the flow divider serves as a booster of the hydraulic supply path. Therefore, at the start of subsequent heaving up of the anchor, it is possible to increase a heaving force of the hydraulic motor while reducing loads on an electric motor, etc. which drive the hydraulic pump.

[0017] Accordingly, although heaving speed is reduced by an increase in the heaving force, it is possible to prevent the electric motor, etc. from being driven for a long time in an overload state, and is possible to heave up the anchor without hindrance in a case where the veer amount exceeds the second veer amount. After that, if the veer amount becomes equal to or lower than the second veer amount, a pressure boosting function of the flow divider goes into an off-state, and thus, although the heaving force is low, the anchor is heaved up at high heaving speed.

[0018] Therefore, when the vessel is anchored in deep water, it is possible to automatically prevent the electric motor, etc. from being driven for a long time in an overload state when the anchor is heaved up, and is possible to heave up the anchor promptly at appropriate heaving speed.

Brief Description of Drawings

[0019] FIG. 1 is a hydraulic circuit diagram showing a hydraulic circuit of a windlass according to a specific configuration of the present invention.

FIG. 2 is a perspective view showing how the windlass shown in FIG. 1 is applied to a vessel.

FIG. 3 is a perspective view showing a main section of the windlass shown in FIG. 1.

Description of a specific configuration (Embodiments)

[0020] In the following, a specific configuration (an embodiment) of the present invention is described with the drawings. FIG. 1 shows a hydraulic circuit of a windlass according to the specific configuration of the present invention. As shown in FIG. 1, this hydraulic circuit 1 includes a hydraulic motor 4 which is driven to run by hydraulic pressure supplied from a hydraulic pump 2 through a hydraulic supply path 3 thereby winding up an anchor chain. The hydraulic motor 4 is a variable-capacitance, forward/reverse rotation type one.

[0021] The hydraulic supply path 3 includes a first hydraulic path 5 connected to a primary side of the hydraulic motor 4, a second hydraulic path 6 connected to a secondary side of the hydraulic motor 4, and a forward/reverse selector valve 7 for switching whether to supply the hydraulic pressure from the hydraulic pump 2 to the first hydraulic path 5 or the second hydraulic path 6. Between the first hydraulic path 5 and the second hydraulic path 6, two relief valves 8 are provided in parallel. In a case where the hydraulic pressure of the first hydraulic path 5 becomes a predetermined value or higher, the relief valves 8 relieve the hydraulic pressure into the second hydraulic path 6. Instead of the two relief valves 8, one high capacity relief valve, or three or more relief valves may be provided in parallel.

[0022] A supply connection path 9 connects between the forward/reverse selector valve 7 and the hydraulic pump 2. A collection connection path 11 connects between the forward/reverse selector valve 7 and a reservoir tank 10. The forward/reverse selector valve 7 has a function of switching between a forward rotation state and a reverse rotation state. In the forward rotation state, the hydraulic pressure of the supply connection path 9 is supplied to the first hydraulic path 5, and the hydraulic pressure is collected from the second hydraulic path 6. In the reverse rotation state, the hydraulic pressure of the supply connection path 9 is supplied to the second hydraulic path 6, and the hydraulic pressure is collected from the first hydraulic path 5.

[0023] In the supply connection path 9, a pressure reducing valve 12 is provided on the

hydraulic pump 2 side of the forward/reverse selector valve 7. In a case where the supply connection path 9 is connected to the first hydraulic path 5 or the second hydraulic path 6, the hydraulic pressure of the supply connection path 9 that has passed through the forward/reverse selector valve 7 is introduced into the hydraulic path through a balancing circuit 13 when the supply connection path 9 is connected to the hydraulic path, so that the pressure reducing valve 12 does not function.

[0024] In the first hydraulic path 5 and the second hydraulic path 6, a counter-balance valve 14 is provided on the hydraulic motor 4 side of the forward/reverse selector valve 7. The counter-balance valve 14 keeps the primary-side hydraulic pressure when the hydraulic motor 4 makes forward rotation to prevent reverse rotation of the hydraulic motor 4.

[0025] Furthermore, an accumulator 15 is connected to the hydraulic supply path 3. The accumulator 15 buffers shock generated in the hydraulic pressure of the hydraulic supply path 3. That is, between the first hydraulic path 5 and the second hydraulic path 6 of the hydraulic supply path 3, a high pressure selection valve 16 is provided. The first hydraulic path 5 and the second hydraulic path 6 are connected to both inlets of the high pressure selection valve 16. The hydraulic pressure of the one on the high pressure side of the first hydraulic path 5 and the second hydraulic path 6 selected by the high pressure selection valve 16 is introduced into the accumulator 15 from an outlet of the high pressure selection valve 16 through a high pressure import path 17.

[0026] In the high pressure import path 17, an electric-operated valve 18 which serves as an on-off valve is provided. The electric-operated valve 18 serves as a first setting unit which selectively sets a connection state of the accumulator 15 with respect to the hydraulic supply path 3 to an on-state in which the accumulator 15 is connected to the hydraulic supply path 3 or an off-state in which the connection is released.

[0027] The hydraulic motor 4 is provided with a speed changing valve 19 which changes whether to drive the hydraulic motor 4 to rotate at low speed or at high speed. The speed changing valve 19 changes whether to supply the hydraulic pressure selected by the high pressure selection valve 16 to a low-capacity-side port or a high-capacity-side port of the hydraulic motor 4. In a case of supplying the hydraulic pressure to the high-capacity-side port, the speed changing valve 19 changes to drive the hydraulic motor 4 to rotate at low

speed, and the hydraulic motor 4 can be driven by a high driving force suitable for heaving up the anchor.

[0028] Furthermore, the hydraulic supply path 3 is provided with a flow divider 20 which serves as a booster configured to increase the hydraulic pressure of the hydraulic supply path 3. An introduction circuit 21 and a derivation circuit 22 are connected to the flow divider 20. The introduction circuit 21 introduces the hydraulic pressure from the hydraulic pump 2 into the flow divider 20 from the supply connection path 9 of the hydraulic supply path 3. The derivation circuit 22 derives the boosted hydraulic pressure from the flow divider 20 into the hydraulic supply path 3.

[0029] The introduction circuit 21 and the derivation circuit 22 are provided with electric-operated valves 23 and 24, respectively. Furthermore, an electric-operated valve 25 is provided between a branch point into the introduction circuit 21 and a merging point from the derivation circuit 22 on the hydraulic supply path 3. The electric-operated valves 23, 24, and 25 compose a second setting unit for setting an on-state in which the hydraulic supply path 3 goes through the flow divider 20 and an off-state in which it does not go through the flow divider 20.

[0030] FIG. 2 shows how a windlass 26 to which this hydraulic circuit 1 is applied heaves up the anchor. The windlass 26 includes a cable holder 28 for the hydraulic circuit 1 shown in FIG. 1 to wind up an anchor chain 27 and a chain locker 29 in which the wound anchor chain 27 is stored. The cable holder 28 is rotated by the hydraulic motor 4 of the hydraulic circuit 1.

[0031] The anchor chain 27 includes multiple reels of anchor chain; a length of each reel is 27.5 m. When the anchor is heaved up, the anchor chain 27 is wound up by the windlass 26, and, as shown in FIG. 2, a shank 31 of an anchor 30 reaches an end of a hawsepipe 33 of a vessel 32, and thereby the anchor 30 is fished out. In a case where the anchor 30 is cast into the deep sea at a depth of over 100 m, it is necessary to veer out three or more reels of the anchor chain 27.

[0032] FIG. 3 shows a main section of the windlass 26. As shown in FIG. 3, the windlass 26 includes a chain counter 34 which serves as a veer amount measuring unit configured to measure a veer amount of the anchor chain 27 with the above-described state

in which the anchor is fished out as a reference position. The chain counter 34 includes a drive sprocket wheel 35 which integrally rotates with the cable holder 28, a driven sprocket wheel 37 driven by the drive sprocket wheel 35 through a roller chain 36, and a pointer 38 moved along a rotating shaft of the driven sprocket wheel 37. The rotating shaft is screwed to the pointer 38, and composes a screw shaft 39 which moves the pointer 38 in accordance with its amount of rotation.

[0033] On a moving path of the pointer 38, first and second limit switches 40 and 41 are provided. The first and second limit switches 40 and 41 are put into an on-state or an off-state by contact with the pointer 38 and output a predetermined signal.

[0034] When a veer amount R of the anchor chain 27 from the reference position exceeds a first veer amount r1, the first limit switch 40 sends a signal to switch the setting state of the first setting unit from the off-state to the on-state (open the electric-operated valve 18). Furthermore, when the veer amount R becomes equal to or lower than the first veer amount r1, the first limit switch 40 sends a signal to switch the setting state of the first setting unit from the on-state to the off-state (close the electric-operated valve 18).

[0035] If the electric-operated valve 18 is switched to an open state or an obstructed state on the basis of these signals, the accumulator 15 is connected to or cut off from the hydraulic supply path 3, and fulfills or stops its function. Therefore, the first limit switch 40 composes a first control unit which switches the setting state of the first setting unit from the off-state to the on-state and vice versa.

[0036] In FIG. 2, "ACC ON" denotes an area whose state set by the first setting unit is the on-state; and "ACC OFF" denotes an area of the off-state.

[0037] When the veer amount R exceeds a second veer amount r2, the second limit switch 41 sends a signal to switch the setting state of the second setting unit from the off-state to the on-state (open the electric-operated valves 23 and 24, and close the electric-operated valve 25). When the veer amount R becomes equal to or lower than the second veer amount r2, the second limit switch 41 sends a signal to switch the setting state of the second setting unit from the on-state to the off-state (close the electric-operated valves 23 and 24, and open the electric-operated valve 25). On the basis of these signals, the electric-operated valves 23 and 24 are switched to an open state, and the electric-operated

valve 25 is switched to an obstructed state, and vice versa.

[0038] Thus, the flow divider 20 is switched from a state in which it does not serve as a booster to a state in which it serves as a booster and vice versa. Therefore, the second limit switch 41 composes a second control unit which switches the setting state of the second setting unit from the off-state to the on-state and vice versa.

[0039] In FIG. 2, "FD ON" denotes an area whose state set by the second setting unit is the on-state; and "FD OFF" denotes an area of the off-state.

[0040] In this configuration, if the anchor is cast, and the veer amount of the anchor chain 27 reaches a length of one reel (27.5 m), the pointer 38 of the chain counter 34 comes in contact with the first limit switch 40. At this time, the electric-operated valve 18 is opened on the basis of a signal output from the first limit switch 40, and the accumulator 15 is set to a connected state. Thus, a buffer function of the accumulator 15 is enabled.

[0041] If the veer amount from the reference position (the state in which the anchor is fished out) reaches a length of three reels (82.5 m), the pointer 38 of the chain counter 34 comes in contact with the second limit switch 41. On the basis of a signal output from the second limit switch 41 at this time, the electric-operated valves 23 and 24 are opened, and the electric-operated valve 25 is closed.

[0042] Thus, the boosting function of the flow divider 20 is set to an on-state. Accordingly, the hydraulic motor 4 can be driven by a higher torque than a case where the flow divider 20 does not serve as a booster. In a case where the vessel is anchored in a location at a water depth of over 100 m, the anchor chain 27 is veered out further to cast the anchor.

[0043] After that, when the anchor is heaved up, the forward/reverse switching valve 7 is set so that the supply connection path 9 is connected to the first hydraulic path 5, and the collection connection path 11 is connected to the second hydraulic path 6, and the supply of hydraulic pressure by the hydraulic pump 2 is started. Thus, the hydraulic motor 4 starts forward rotation, and winding up of the anchor chain 27 is started.

[0044] When the anchor chain 27 is wound up, in a case where the vessel rolls in stormy weather, and the anchor chain 27 is subjected to momentary shock, there is a possibility that a high surge pressure may be generated inside the hydraulic motor 4; however, such

shock is instantly absorbed by the accumulator 15, and therefore the hydraulic motor 4 is not damaged by that surge pressure.

[0045] Furthermore, even if the anchor chain 27 is veered out a length of three reels (82.5 m) or more from the state in which the anchor is fished out, the flow divider 20 serves as a booster, and thus, although the rotation speed is reduced, the hydraulic motor 4 is driven by a higher torque than a case where the flow divider 20 does not serve as a booster. Therefore, the hydraulic motor 4 can wind up the anchor chain 27 veered out longer than three reels (82.5 m) without going into an overload state.

[0046] If the veer amount R of the anchor chain 27 becomes equal to or lower than three reels (82.5 m) which is the second veer amount r2, the pointer 38 reaches the second limit switch 41, and the flow divider 20 goes into an off-state in which it does not serve as a booster. Thus, although the driving torque is reduced, the number of revolutions of the hydraulic motor 4 is increased, and therefore, the hydraulic motor 4 can efficiently wind up the anchor chain 27 whose veer amount R is equal to or lower than the second veer amount r2 without being overloaded.

[0047] During this time, the accumulator 15 is in a connected state; thus, even in a case where the anchor chain 27 is subjected to momentary shock due to stormy weather, and a high surge pressure is generated inside the hydraulic motor 4, that surge pressure is instantly absorbed by the accumulator 15, and therefore the hydraulic motor 4 is not damaged.

[0048] Incidentally, if the accumulator 15 is kept in a connected state until the anchor is fished out, i.e., the veer amount R is zero, when the winding up is completed, there is a possibility that the winding up of the anchor chain 27 by release of the hydraulic pressure from the accumulator 15 and veering out of the anchor chain 27 by absorption of the hydraulic pressure into the accumulator 15, may cause the anchor 30 to repeat an up-and-down movement and then come to rest.

[0049] Accordingly, if the veer amount R of the anchor chain 27 becomes equal to or lower than the first veer amount r1, the pointer 38 reaches the first limit switch 40, and thus the electric-operated valve 18 is obstructed on the basis of a signal output from the first limit switch 40, and the connection state of the accumulator 15 is set to the off-state. Accordingly, when fished out, the anchor 30 is prevented from repeating an up-and-down

movement.

[0050] It is to be noted that this stops the buffer function of the accumulator 15; however, the veer amount R is equal to or lower than the first veer amount r1, and thus the shock the anchor chain 27 is subjected to by rolling of the vessel is not very big. Accordingly, there is no possibility that the hydraulic motor 4 may be damaged by such shock.

[0051] As described above, according to the present embodiment, there is provided the first setting unit (the electric-operated valve 18) which sets the connection state of the accumulator 15 with respect to the hydraulic supply path 3 to the on-state or the off-state in accordance with the veer amount R; therefore, it is possible to prevent the hydraulic motor 4 from being damaged by a surge pressure. Furthermore, between the first hydraulic path 5 and the second hydraulic path 6, two relief valves 8 are provided, or, instead of the two relief valves 8, one high capacity relief valve, or three or more relief valves are provided in parallel; therefore, it is possible to prevent damage on the hydraulic pump 2 with more certainty.

[0052] Moreover, the electric-operated valve 18 is connected to the outlet of the high pressure selection valve 16 connected to the first hydraulic path 5 and the second hydraulic path 6; therefore, in a case where a surge pressure is generated in, either one of the first hydraulic path 5 and the second hydraulic path 6 which supplies the hydraulic pressure to the hydraulic pump 2, the accumulator 15 can certainly absorb this surge pressure.

[0053] Furthermore, the electric-operated valve 18 is configured to be switched on the basis of a signal from the first limit switch 40 when the veer amount R becomes less than the first veer amount r1; therefore, it is possible to automatically prevent the up-and-down movement of the anchor 30 when the winding up is completed.

[0054] Moreover, the hydraulic supply path 3 is provided with the second setting unit which sets the on-state in which the hydraulic supply path 3 goes through the flow divider 20 or the off-state in which it does not go through the flow divider 20; therefore, even in a case where the vessel is anchored in deep water, it is possible to increase the heaving force of the hydraulic motor 4 while reducing loads on an electric motor, etc. which drive the hydraulic pump 2.

[0055] Furthermore, there is provided the second control unit which switches the setting

state of the second setting unit from the off-state to the on-state and vice versa in accordance with the veer amount R; therefore, even in a case where the vessel is anchored in deep water, it is possible to automatically prevent the electric motor, etc. from being driven for a long time in an overload state, and is possible to heave up the anchor without problem.

[0056] The embodiment of the present invention is described above; however, the present invention is not limited to this. For example, the chain counter 34 may be one which electronically measures the veer amount of the anchor chain 27.

Description of Reference Numerals

[0057]

1	hydraulic circuit
2	hydraulic pump
3	hydraulic supply path
4	hydraulic motor
5	first hydraulic path
6	second hydraulic path
7	forward/reverse selector valve
8	relief valve
9	supply connection path
10	reservoir tank
11	collection connection path
12	pressure reducing valve
13	balancing circuit
14	counter-balance valve
15	accumulator
16	high pressure selection valve
17	high pressure import path
18	electric-operated valve
19	speed changing valve
20	flow divider
21	introduction circuit
22	derivation circuit

23, 24, 25 electric-operated valve

26 windlass

27 anchor chain

28 cable holder

29 chain locker

30 anchor

31 shank

32 vessel

33 hawsepipe

34 chain counter

35 drive sprocket wheel

36 roller chain

37 driven sprocket wheel

38 pointer

39 screw shaft

40 first limit switch

41 second limit switch

CLAIMS

1. A windlass which winds up an anchor chain with a hydraulic motor driven by hydraulic pressure supplied from a hydraulic pump through a hydraulic supply path, the windlass comprising:

an accumulator which is connected to the hydraulic supply path, and damps shock generated in the hydraulic pressure;

a veer amount measuring unit which measures a veer amount of the anchor chain from a reference position; and

a first setting unit which selectively sets a connection state of the accumulator with respect to the hydraulic supply path to an on-state in which the accumulator is connected to the hydraulic supply path or an off-state in which connection of the accumulator to the hydraulic supply path is released in accordance with the veer amount,

wherein the hydraulic supply path includes

a first hydraulic path connected to a primary side of the hydraulic motor,

a second hydraulic path connected to a secondary side of the hydraulic motor,

a forward/reverse selector valve for selecting whether to supply the hydraulic pressure from the hydraulic pump to the first hydraulic path or the second hydraulic path; and

one relief valve, or two or more relief valves disposed in parallel, which relieve hydraulic pressure of the first hydraulic path into the second hydraulic path in a case where the hydraulic pressure of the first hydraulic path becomes a predetermined value or higher.

2. The windlass according to claim 1, further comprising a first control unit which switches a setting state of the first setting unit from the off-state to the on-state in a case where the veer amount from the reference position exceeds a first veer amount, and switches the setting state of the first setting unit from the on-state to the off-state in a case where the veer amount becomes equal to or lower than the first veer amount.

3. The windlass according to claim 1 or 2, further comprising:

a flow divider which serves as a booster configured to increase the hydraulic pressure of the hydraulic supply path;

a second setting unit for setting an on-state in which the hydraulic supply path goes through the flow divider and an off-state in which the hydraulic supply path does not go through the flow divider; and

a second control unit which switches a setting state of the second setting unit from the off-state to the on-state in a case where the veer amount exceeds a second veer amount, and switches the setting state of the second setting unit from the on-state to the off-state in a case where the veer amount becomes equal to or lower than the second veer amount.