

Sept. 21, 1971

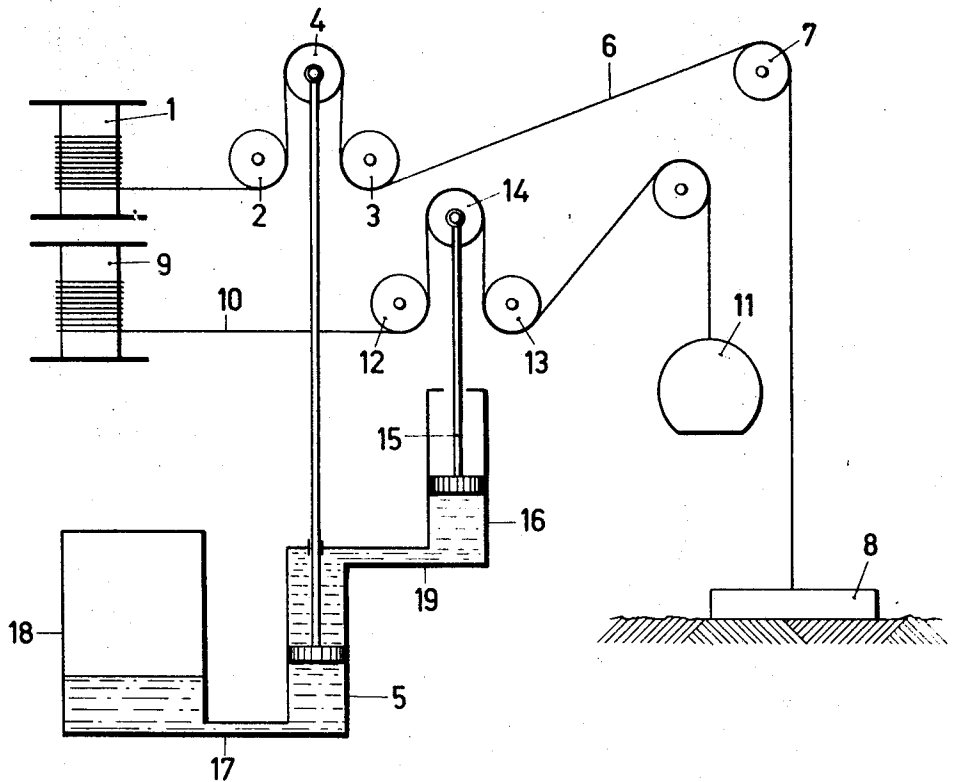
P. J. VAN LUNTEREN
APPARATUS FOR SYNCHONIZING MOVEMENTS IN ANCHOR
CABLE AND A LOAD CABLE

3,606,854

Filed Aug. 11, 1969

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FIG. 1



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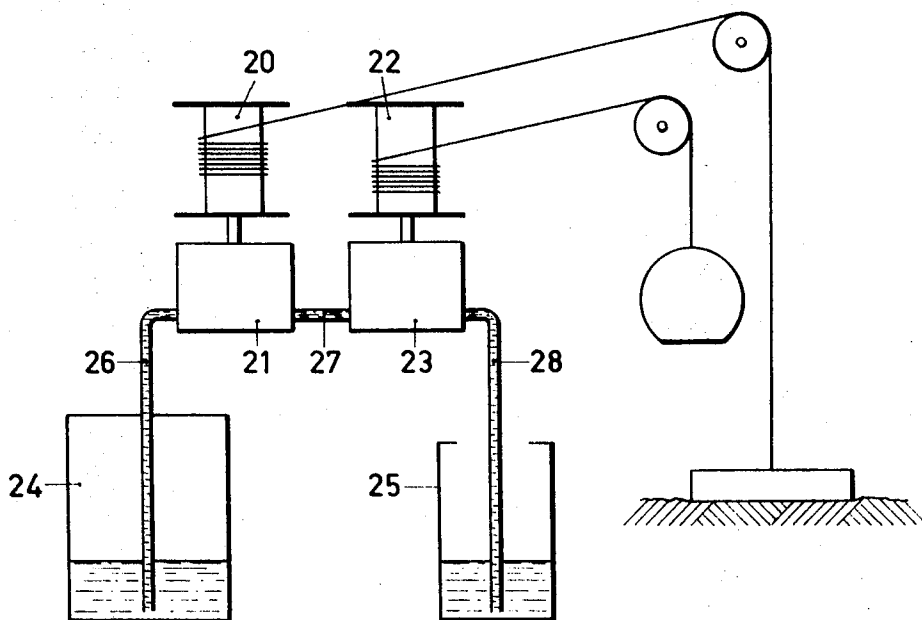
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FIG. 2



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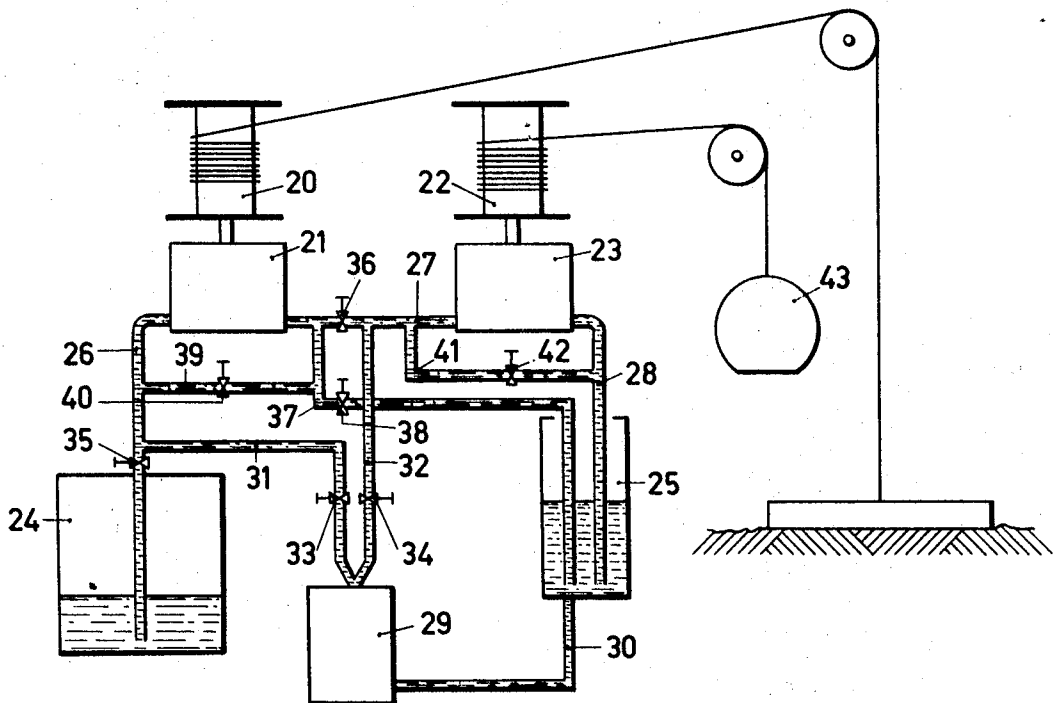
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FIG. 3



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APPARATUS FOR SYNCHRONIZING MOVEMENTS IN ANCHOR CABLE AND A LOAD CABLE

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Filed Aug. 11, 1969, Ser. No. 848,793
Claims priority, application Netherlands, Aug. 12, 1968, 6811457

Int. Cl. B63b 21/24

U.S. Cl. 114—206R

5 Claims

ABSTRACT OF THE DISCLOSURE

Vessel with an anchor whose cable is driven by a first winch and another load such as a diving bell whose cable is driven by a second winch, has a swell compensator for each of the two cables, the compensators being interconnected to prevent movement of the load relative to the anchor. The two swell compensators are coupled hydraulically. That of the anchor cable can comprise a hydraulic cylinder connected to a pressure vessel on one side and to a hydraulic cylinder of the compensator for the load on the other side. Alternatively, the winches can be individually coupled to positive-displacement hydraulic motors with one side of the anchor motor connected to a pressure vessel and the other side of the anchor motor connected to one side of the load motor and with the other side of the load motor connected to a reservoir for hydraulic fluid.

The invention relates to a vessel or other floating structure provided with an anchor which can be lowered to the bottom by means of a winch and with a hydraulic swell compensator for the anchor cable, said compensator cooperating with a pressure vessel, said vessel being also provided with a second device comprising a winch for lowering and hauling another load, such as a diving-bell. Such devices are known. The swell compensator in the anchor cable provides for the tension in the anchor cable to be kept as constant as possible, in spite of the rise and fall motion of the floating structure caused by the swell. There are certain loads which may not be affected either by the swell during lowering and hauling from the floating structure. Such a load is e.g. a diving-bell, which must be able to hang motionless and which must be able to be lowered carefully to the bottom of the sea. If a swell compensator is provided in the path of the cable on which the load is hung, a complete control of the movements of the load is not achieved.

The object of the invention is to provide a device, which makes the above-mentioned control possible and, according to the invention, this object is achieved in that the second device is also provided with a swell compensator, which is coupled to the first swell compensator in such a way that the swell compensator of the second device will follow the movements of the first swell compensator in such a way that the movements of anchor and load are equal relative to the vessel. Thus, according to the invention, the behaviour of the swell compensator of the anchor cable will be used as a reference for the behaviour of a swell compensator in the load cable, said swell compensator following precisely the movements of said load cable, as a result of its being coupled to the swell compensator of the anchor cable. The consequence of this is that the position of the load relative to the anchor is determined and, thus, the load may be controlled accurately. The coupling between the two swell compensators may be mechanical. However, as the swell compensation of the load cable must be able to be disengaged

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when the load breaks surface and said disengagement can be realized mechanically only in a complicated manner, according to the invention, it is preferred to couple both swell compensators hydraulically. Disengagement of the connection between both compensators may be carried out in a simple manner.

The coupling may be achieved with a device in which the swell compensator of the anchor cable consists of a hydraulic cylinder, the operative space of which is connected to a pressure vessel and the cable of which is trained over a sheave of which one or more is/are connected to the movable part of the compensator, as is known, by the second compensator also being embodied according to the invention in the shape of a hydraulic cylinder, the movable part of which carries one or more cable sheaves guiding the load cable together with fixed sheaves, the operative space of said cylinder being connected hydraulically to the space of the cylinder of the first compensator facing away from the first operative space and the piston area of the side of the second compensator facing the operative space corresponds with the piston area of the side of the piston of the first compensator facing away from the operative space in such a way that the movements of the anchor and the load are equal relative to the vessel. It is thus achieved that each displacement of the compensator of the anchor cable will be followed accurately by the compensator of the load cable.

According to the invention, it is also possible to couple both winches to hydraulic motors of the displacement type, in which the motor of the anchor winch is connected to the pressure vessel on the one side and on the other side to the motor of the load winch, said motor of the load winch being also connected to a reservoir containing hydraulic fluid. It is thus accomplished that every displacement of the anchor motor will be followed accurately by the load motor. This solution is particularly attractive, as the winches are frequently and very well driven by hydraulic motors, which, in general, are already provided and the coupling with compensation will, thus, be accomplished by designing the hydraulic system so that a pressure vessel, both motors, as well as a reservoir may be connected in series. Separate cylinders as swell compensators will then not be necessary any more. In addition, it is then very well possible to design the system in such a way that the movements involved with the load may be carried out simultaneously with the swell compensation, because the compensation movements and the hoisting and lowering movements are superimposed on each other. In order to achieve this, according to the invention, a pump is provided, which may supply fluid from the reservoir via pipes provided with valves which can be operated separately, either to the pipe between pressure vessel and anchor motor, a valve being provided between the point of connection and the pressure vessel, or said pump may supply fluid from the reservoir to the pipe between both motors, said pipe being provided with a valve between said last point of connection and the anchor motor, as well as with a closable connection to the reservoir between said valve and the anchor motor.

By opening said connection to the reservoir and closing the connection to pressure vessel and load motor, the motor of the anchor winch may be driven by the above-mentioned pump in the sense of raising the anchor. By closing the connection between both motors and closing the first one and opening the second one of the pipes leading from the pump, the motor of the load winch may be driven in the sense of hoisting. If the connection between both hydraulic motors and the connection to the pressure vessel are open during the hoisting of the load, the compensation during hoisting of the load will function normally and the rising load will, thus, not be influenced

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by swell. When the load breaks surface the weight of it will change and the need of compensation may not be necessary any more, as the load brought to the surface e.g. when the load consists of a diving-bell, must be able, as a rule, to be put down on the floating structure and must follow the movements of said floating structure. By closing the connection between both hydraulic motors, which may be done by a signal from the load, and by opening a valve in the pipe leading from the anchor motor to the reservoir, the compensation is disengaged.

According to the invention, both motors may also be provided with a bypass with an adjustable flow regulator. These bypasses make it possible either that the anchor or the load is veered in a controlled manner, in which said veering action is again superimposed on the swell compensation of the load by the connection between both motors.

The invention will now be described more in detail, with reference to the accompanying drawings, wherein:

FIG. 1 is a diagram of a first solution according to the invention;

FIG. 2 is a diagram of a second solution;

FIG. 3 is a detailed working out of the system according to FIG. 2.

FIG. 1 shows a winch 1 for the anchor cable running over sheaves 2 and 3 placed fixedly on the device, and running also over the movable sheave 4 of swell compensator 5, said sheave 4 being placed between said sheaves 2 and 3. The cable 6 then runs over a sheave 7 towards the anchor 8, said sheave 7 overhanging outboard.

No. 9 is a second winch of a load cable 10 on which a diving-bell 11 is hung. Said cable runs over sheaves 12 and 13 placed fixedly, as well as over the movable sheave 14, positioned on the piston rod 15 of the swell compensator 16.

The swell compensator 5 is connected to a pressure vessel 18 via pipe 17, said pressure vessel containing a gaseous medium under pressure above the liquid level. Between swell compensators 5 and 16 a hydraulic connection 19 is provided, said connection ensuring that each displacement of volume in the compensator 5 is followed by a displacement of the same volume in the compensator 16. To that effect, the piston faces cooperating via said coupling are manufactured identical. Disengagement of swell compensator 16 is possible by interrupting connection 19 and by connecting the part of said connection 19 which connects to compensator 5 to an open barrel. In other words, with some pipes and valves, as well as a feeding pump and a reservoir, the device may easily be designed so that it fulfills the condition that the swell compensation for the load can be disengaged while maintaining the swell compensation for the anchor cable.

The device as shown in FIG. 2 consists of anchor winch 20 comprising a hydraulic drive motor 21, load winch 22 comprising a hydraulic motor 23, pressure vessel 24 and a reservoir 25.

The motors 21 and 23 are of the positive displacement type and, as to their fluid passage, they are tuned to each other and to the dimensions of the hoisting means so that the contemplated synchronization is accomplished. The anchor motor 21 is coupled to the pressure vessel via the pipe 26 and coupled to the motor 23 via the pipe 27, said motor 23 being connected to the open reservoir 25 via the pipe 28. In the case shown, each displacement of motor 21 results in an equal displacement of motor 23 either in one or in the other direction.

The system of FIG. 2 is shown more in detail in FIG. 3, in which same parts are designated by same numbers.

As shown in FIG. 3 a pump 29 is provided, which is connected to the reservoir 25 via pipe 30, said pump being able to supply fluid under pressure to the pipes 31 and 32 which, for that purpose, are provided with valves 33 and 34 respectively. In addition, a valve 35 is disposed in pipe 26 between the connection of pipe 31 to pipe 26 and the pressure vessel 24.

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Pipe 32 opens into connecting pipe 27 between motors 21 and 23 and a valve 36 is provided between said connecting point and the motor 21; a connecting pipe 37 is provided between said valve 36 and motor 21, said pipe comprising a valve 38 and leading to the reservoir 25.

No. 39 is a bypass with an adjustable closing means 40, with which the motor 21 may be bypassed. A similar bypass 41 for the motor 23 is also provided with an adjustable closing means 42. With normal compensation, i.e. when the anchor lies on the bottom and the diving-bell is hanging motionless or is standing on the bottom, the valves 33, 34, 38, 40 and 42 are closed and the valves 35 and 36 are open. The motor 23 will then follow the motor 21 in one or the other direction.

If the diving-bell 43 which constitutes the load in this case, has to be hoisted, the valve 34 will be opened, as a result of which the pressure fluid is supplied to motor 23, driving said motor to hoist the load. The displacements of volume resulting from the compensation movements of the motor 21 are superimposed on the volume which is supplied by the pump 29, as a result of which the compensation is maintained during the hoisting of the load. When the load breaks surface and has to be placed on the floating structure, the compensation of the diving-bell has to be disengaged; this is done by closing the valve 36 and opening the valve 38 simultaneously. The load itself may supply a proper signal, as the load above the surface weighs more than under water. The tension in the load cable or the force acting on the cable sheave may supply the signal. Also, the pressure at the inlet of the motor 23 may be used as a signal.

The tension in the anchor cable increases at the same moment when the valves 36 and 38 are switched. This is an advantage, as said anchor cable is used for guiding the bell i.e. the anchor cable will become more taut at the very moment when said bell has to be kept possibly motionless.

If the load must be veered, the valve 34 is, of course, closed and a circuit of the fluid through the motor 23 via the pipe 41 is accomplished by adjustment of the flow regulator 42, as a result of which said motor may veer in a controlled manner, under the influence of the pulling force exerted by the load.

If the anchor must be hoisted, valve 33 will be opened and valves 35 and 36 will be closed, whereas valve 38 has to be open. Only pressure fluid is then supplied to motor 21. The anchor will be veered by adjusting the flow regulator 40 in the bypass 39, and again valves 33, 35 and 36 will be closed.

It should be noted that the system shown in FIG. 3 is shown only in a very diagrammatic manner and all means known to those having ordinary skill in this art are left out, such as means for compensation of leakage losses, pressure limiting means, hydraulic brake valves and the like.

What is claimed is:

1. A floating structure having an anchor, a cable to which said anchor is secured, a winch by which said anchor cable is operated, a hydraulic swell compensator for said anchor comprising a first hydraulic cylinder having a first piston movable therein and at least one first sheave movable with said first piston with said anchor cable reeved about said at least one first sheave, a load separate from said anchor connected to a load cable and a load winch for operating said load cable, a hydraulic swell compensator for said load and comprising a second hydraulic cylinder having a second piston movable therein and at least one second sheave movable with said second piston with said load cable reeved about said at least one second sheave, said pistons having equal areas in hydraulic communication with each other, said first piston communicating with a closed pressure vessel on its side opposite the side which communicates with said second piston, whereby the movements of said floating structure are equal relative to the anchor and the load.

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2. A floating structure having an anchor, a cable connected to the anchor, a winch for operating said anchor cable, a load separate from said anchor, a cable connected to said load, a winch for operating said load cable, swell compensators individual to each of said cables, said swell compensators comprising hydraulic motors of the positive displacement type coupled one to each of said winches, the anchor winch hydraulic motor communicating at one side with a closed pressure vessel and at the other side with the load which hydraulic motor, the load winch hydraulic motor at the other side communicating with a hydraulic reservoir.

3. A device as claimed in claim 2, and a pump to supply hydraulic fluid from said reservoir selectively to a first point between said pressure vessel and said anchor motor or to a second point between said motors, valve means between said first point and said pressure vessel, and valve means between said second point and said anchor motor.

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4. A device as claimed in claim 3, in which said valve between said second point and said anchor motor has closing means to close said valve when the weight on the load cable exceeds a predetermined value.

5. A device as claimed in claim 4, in which both said motors have bypasses with adjustable flow regulators.

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U.S. Cl. X.R.

114—230; 254—172