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Onderka

[11] **3,837,312**

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[54] **HYDRAULIC CONTROL MECHANISM FOR HOPPER BARGES**

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[52] **U.S. Cl.** **114/29**

[51] **Int. Cl.** **B63b 35/30**

[58] **Field of Search** 114/26–31

[56] **References Cited**

UNITED STATES PATENTS

3,404,650 10/1968 Miller et al. 114/29

FOREIGN PATENTS OR APPLICATIONS

1,278,270 9/1968 Germany 114/29

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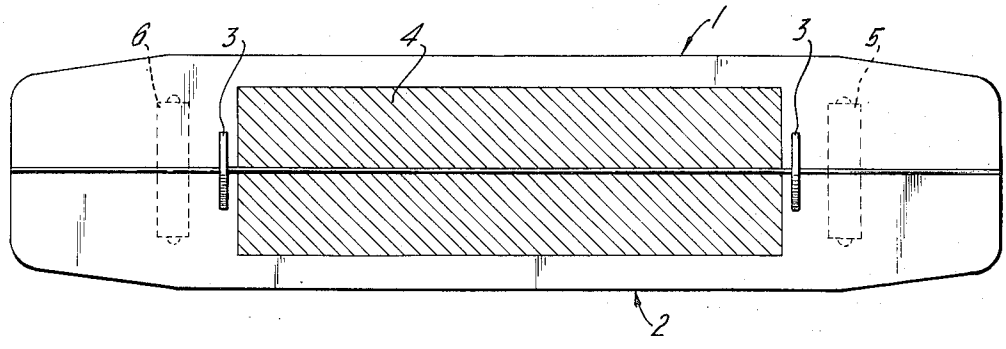
[57] **ABSTRACT**

A hopper barge consists of two barge halves articulated to each other along a longitudinal axis of the barge. First and second cylinder-piston actuators are mounted in respective opposite ends of the barge and connected between the two barge halves. Respective first and second pressure fluid tanks are located adjacent each actuator. A pressure fluid pump is connected by a suction line to the first tank and by a pressure line to a three-position switching valve, and the first tank is connected by a return line to the three-position switching valve. The valve is selectively operable to connect these lines alternately to respective opposite ends of the cylinder of the first actuator. The second pressure fluid tank is connected to the second actuator by a suction line, and an interconnection line extends between the first and second tanks. A common pressure line interconnects corresponding ends of the cylinders at the actuators. A flow line interconnects the opposite ends of the cylinder of the second actuator and has a check valve therein, and a check valve is also provided in the common pressure line. The three-position switching valve has a first position, for opening the hopper barge when the latter is loaded, a second position, for closing an empty hopper barge, and a third position for opening the hopper barge when the latter is empty.

4 Claims, 4 Drawing Figures



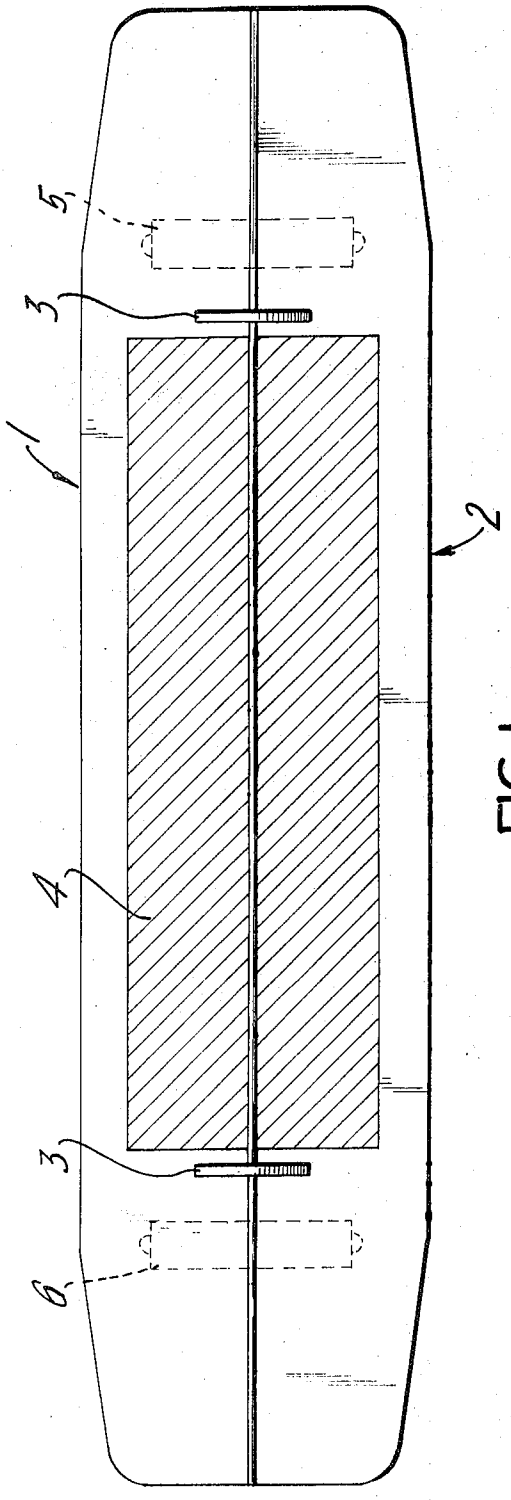


FIG.1

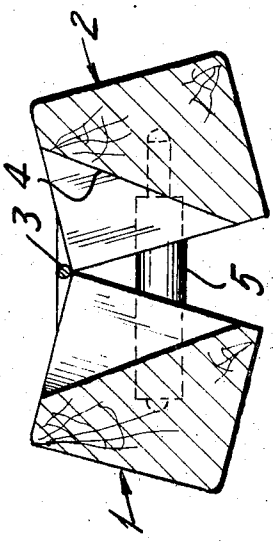


FIG.3

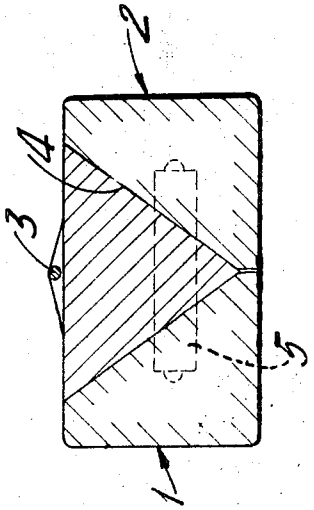


FIG.2

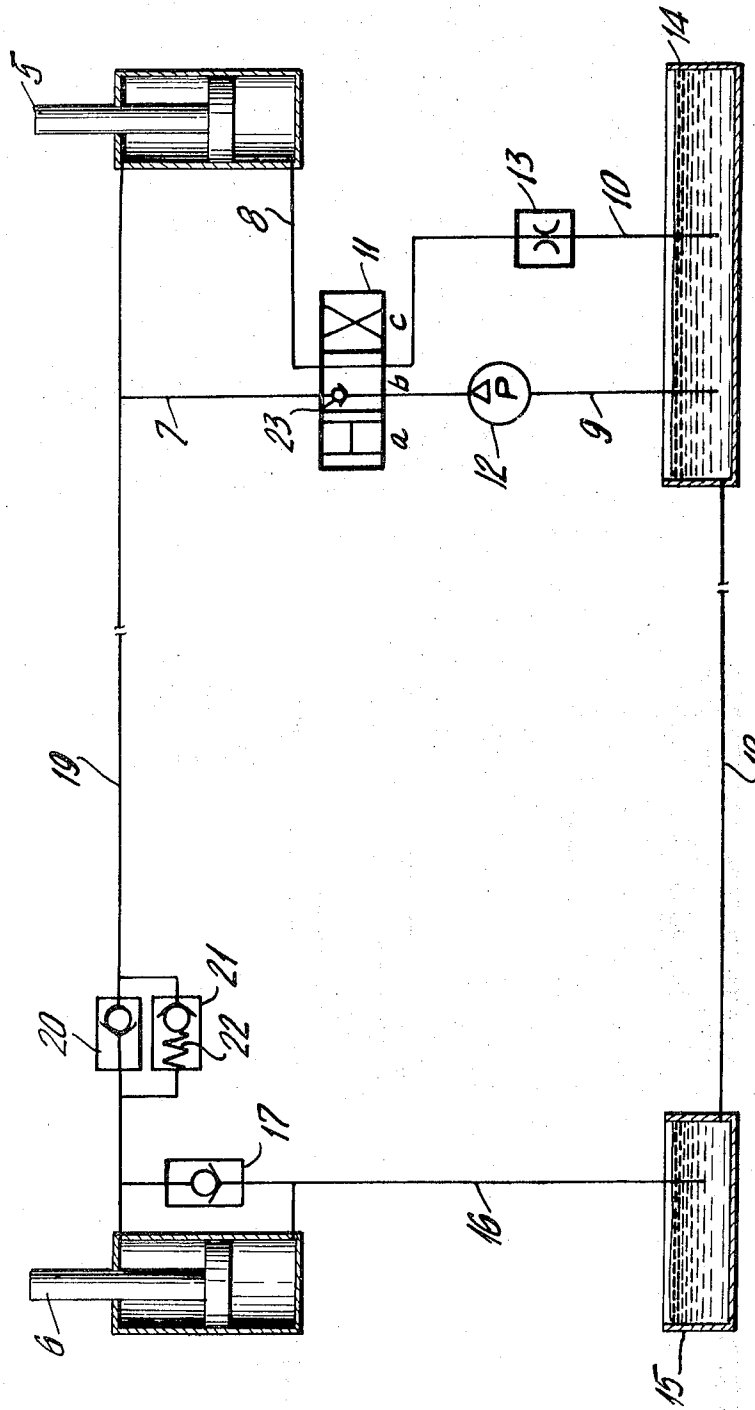


FIG.4

HYDRAULIC CONTROL MECHANISM FOR HOPPER BARGES

FIELD AND BACKGROUND OF THE INVENTION

This invention relates to a hydraulic control mechanism for hopper barges consisting of two barge halves hinged or articulated to each other along a longitudinal axis of the barge. The two barge halves can be spread apart to a certain angle, to provide a gap of corresponding width in the bottom of the loading space or hopper. For the purpose of opening and closing such a hopper barge, hydraulic cylinders usually are provided in one of the end portions of the barge, and are mounted either below or above the axis of articulation in dependence on whether the latter is at the deck level or is below the deck level.

There is a known device, comprising a working cylinder communicating with a pressure fluid tank through lines connected to both ends thereof, and a pressure fluid pump mounted in one of these lines, whose piston is controllable by a three-position switching valve for reversing the strokes of the working cylinder, such a device being shown in German Pat. No. 1,278,270.

There is also known a device comprising two working cylinders, each mounted on a respective end of the hopper barge, and having their cylinder chambers connected in parallel through corresponding lines, as shown in German Pat. No. 1,998,878.

In other known actuating devices, aside from a hydraulic tank which is held under pneumatic pressure, an additional or second hydraulic tank is included which can be put under pressure by means of a pump, as shown in French Pat. No. 1,240,850.

Finally, it is well known to provide double-acting control valves and check valves in the pipe systems for putting hydraulic pistons under pressure alternately, as shown in U.S. Pat. No. 3,404,650.

Taking into account the above-mentioned state of the art, it is known from experience that, in the larger hopper barges, which are primarily used in coastal waters or even on the open sea, and in whch such a bottom opening device must be provided with at least two hydraulic cylinders located in respective end portions of the barge in front of and behind the loading space, operational difficulties may occur. These difficulties are due to the possibility that, while opening the loaded hopper barge, a vacuum may appear at one side of the piston of one or the other of the two hydraulic cylinders, and has the effect of a braking force because, as the arrangement may be, the distance of the common pressure tank from one or both of the hydraulic cylinders is so great that, through the long lines, the oil or other hydraulic fluid used as the pressure fluid cannot refill the respective spaces quickly enough within the required brief time.

SUMMARY OF THE INVENTION

The present invention therefore is directed to the problem of finding a solution which obviates such a drawback. It is of no consequence whether or not the component parts used in the invention system are new, as the main consideration is, instead, the general arrangement which is necessary for the operation of the device under all switching conditions. Accordingly, the objective of the invention is to provide, in addition to

the first hydraulic cylinder-piston actuator, a second hydraulic pressure actuator mounted, in a known manner, in the other end portion of the hopper barge and connected, through a common pressure line to the first actuator, together with an additional pressure fluid tank located near the second actuator and connected thereto through a suction line and to the first or main pressure fluid tank through an interconnection line. A flow line extends between opposite ends of the cylinder of the second actuator and is provided, in a known manner with a check valve therein, and two check valves, connected in parallel and opening in mutually opposite directions, are provided in the common pressure line interconnecting the two actuators, one of the these two check valves being spring-loaded.

In the arrangement of the invention, the switching valve advantageously may be brought into three positions. In the first position, for opening the loaded hopper barge, the piston rod sides of both hydraulic cylinders are connected to the piston head side of one cylinder and also to the return line eading to the main or first pressure fluid tank. In the second position, for closing the empty hopper barge, the pressure side of the pump is connected to the pressure line leading to the piston rod side of both hydraulic cylinders, and the piston head side of one hydraulic cylinder is connected to the return line. In the third position, for opening the empty hopper barge, the pressure side of the pump is connected to the piston head side of only one hydraulic cylinder, and the pressure line leading to the piston rod sides of both hydraulic cylinders is connected to the return line.

In addition, it is preferable to provide a throttling section in the return line, in a manner known per se.

An object of the invention is to provide an improved hydraulic control mechanism for a hopper barge consisting of two barge halves articulated to each other along a longitudinal axis of the barge.

Another object of the invention is to provide such a mechanism which obviates the disadvantages of known mechanisms for this purpose.

A further object of the invention is to provide such a mechanism including respective fluid pressure actuators at opposite ends of the barge and each connected to a respective fluid pressure tank, with one fluid pressure actuator being connected to a fluid pressure pump, and with a switching valve controlling the interconnection and operation of the two fluid pressure actuators in a novel manner.

For an understanding of the principles of the invention, reference is made to the following description of a typical embodiment thereof as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a top plan view of a hopper barge;

FIGS. 2 and 3 are transverse sectional views through the barge illustrating, respectively, the closed position and the discharge position of the two barge halves; and

FIG. 4 is a schematic diagram of the hydraulic system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The hopper barge, shown in FIGS. 1, 2 and 3, com-

prises, in the usual manner, tow barge halves 1 and 2 which are articulated to each other, in the central longitudinal plane of the barge and at the deck level, by means of hinges 3. In the central zone of the hopper barge, a load trough 4 is provided, and is illustrated hatched in FIGS. 1 and 2. This load trough 4, after the barge halves 1 and 2 have been spread apart as shown in FIG. 3, opens downwardly so that the load, consisting of loose material, is automatically discharged, the discharge being favored by the inclined lateral faces of the trough.

The hydraulic actuating means comprises two hydraulic actuators, of the piston-cylinder type, indicated at 5 and 6, and these are mounted at the opposite end portions of the hopper barge outside load trough 4 and below the hinge axis, to extend transversely of the hinge axis. At one end of each actuator, the cylinder is hinged to one of the barge halves, and the free ends of the associated piston rods, extending from the other end of each cylinder, are hinged to the other half of the barge.

Referring to FIG. 4, in addition to the hydraulic actuators 5 and 6, the hydraulic control mechanism of the invention includes a circulation line mounted in the zone of one of the hydraulic cylinders 5, i.e. in the end portion of the hopper barge in hich cylinder 5 is provided. The circulation line comprises four line portions 7, 8, 9 and 10, of which portions 7 and 8 are connected to opposite ends of the cylinder of actuator 5, at one end, and, at the opposite end, to a switching valve 11. The line portions 9 and 10 connect switching valve 11 through a pump 12 and a throttle section 13, respectively, with a main or first pressure-fluid tank 14. A check valve 23 is provided between pump 12 and line portion 7.

In the zone of the other cylinder-piston hydraulic actuator 6, a suction line 16, leading into an additional or second pressure-fluid tank 15, is connected to the piston head side of the cylinder directly, and to the piston rod side of the cylinder through a check valve 17 opening only in the direction of the piston rod side of the cylinder. Pressure-fluid tank 15 communicates with the first pressure-fluid tank 14 through an interconnecting line 18.

In addition, the piston rod sides of both actuators 5 and 6 are interconnected by a pressure line 19 in which two check valves 20 and 21 are mounted in parallel so as to open in mutually opposite directions. One check valve, namely the check valve 21 opening in the direction of the hydraulic actuator 6, is loaded or biased by a spring 22 acting in the closing sense.

The switching valve 11 can be brought into any one of three positions a, b and c in which the line portions 7, 8 and 9, 10 of the circulation line connected thereto may be interconnected through passages provided in the different parts of the switching valve and in accordance with the desired operation to be effected.

As illustrated, the switching valve 11 is in its intermediate position *b* in which pump 12 is connected to line portion 7 and line portion 8 is connected to line portion 10 having the throttling device 13 therein. The position *a*, in which switching valve 11 is shifted to the right, corresponds to an opening operation produced solely by the weight of the load placed in the load trough 4 of the barge, and without any action of pump 12. In switching position *a*, hydraulic fluid can flow from the piston rod sides of the cylinders of both actuators 5 and 6 through pressure line 19 to the piston head side of the cylinder of hydraulic actuator 5, the volume in excess flowing through line portion 10 and throttle section 13 into the main or first pressure-fluid tank 14. At the same time, the hydraulic fluid volume necessary for the piston head side of the cylinder of hydraulic actuator 6 is drawn in from the additional or second pressure-fluid tank 15.

The position *b* of switching valve 11, illustrated in FIG. 4, is provided for closing of the empty barge. In this position, pump 12 furnishes hydraulic fluid under pressure from tank 14 through line portions 9 and 7 of the circulation system to the piston rod side of the cylinder of hydraulic actuator 5, and the hydraulic fluid from the piston head side of the cylinder flows back into tank 14 through line portions 8 and 10 and throttle section 13. During this operation, the piston of hydraulic actuator 6 is entrained, in the respective direction, by the closing movement of the two barge halves. Thereby, the hydraulic fluid from the piston head side of the cylinder of hydraulic actuator 6 is displaced, *a* part of its volume passes through check valve 17 to the piston rod side of this cylinder and the excess volume returns, through suction line 16 into tank 15. As soon as the barge is closed and the two pistons of the hydraulic actuators are in their lower end positions, pump 12 furnishes a closing pressure, which is necessary for secure hermetic sealing of the two barge halves. This closing pressure is supplied, through pressure line 19, to the pistons of both hydraulic actuators. The closing pressure is higher than the spring pressure in check valve 21 which is positioned in the line leading to hydraulic actuator 6.

Position *c*, in which switching valve 11 is shifted to the left, corresponds to the operation producing opening of the empty barge. In this position, pump 12 furnishes hydraulic pressure fluid from tank 14 through the crosswise interconnected line portions 9 and 8 of the circulation system to the piston head side of the cylinder of hydraulic actuator 5, and the hydraulic fluid from the piston rod side of this cylinder can flow through the other two also crosswise interconnected line portions 7 and 10 of the circulation system and the throttle section 13 back into tank 14. During this operation, the piston of hydraulic actuator 6 is again entrained in the respective direction by the opening movement of the barge halves. Thus, the hydraulic fluid on the piston rod side of the cylinder of actuator 6 is displaced and passes through pressure line 19, check valve 20 and line portions 7 and 10 of the circulation system into tank 14. The volume at the piston head side of the cylinder of actuator 6 which increases during this motion, is refilled by suction from tank 15 through line 16.

As will be clear from the foregoing explanation of the different switching positions of switching valve 11, and operations corresponding to the desired effect, in two cases only, one of the hydraulic actuators, namely the actuator 5, is used to produce the opening of the two barge halves, while the other hydraulic actuator, namely the retention actuator 6, serves only to assure a sufficient sealing pressure over the entire length of the barge. Additionally, by providing the two pressure-fluid tanks 14 and 15 it is made certain that no vacuum can develop in the cylinders of either of the two hydraulic actuators.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A hydraulic control mechanism, for a hopper barge consisting of two barge halves articulated to each other along a longitudinal axis of the barge, comprising, in combination, a first working cylinder-piston actuator mounted in one end of the barge and connected between the two barge halves; a first pressure fluid tank adjacent said first actuator at said one end of the barge; a pressure fluid pump adjacent said one end of the barge and connected by a suction line to said first pressure fluid tank; a pressure line connected to said pump; a return line connected to said first pressure fluid tank; a three-position switching valve at said one end of the barge connected to said pressure line and to said return line and selectively operable to connect said lines alternately to respective opposite ends of the cylinder of said first actuator; a second working cylinder-piston actuator mounted in the opposite end of the barge and connected between the two barge halves; a common pressure line interconnecting corresponding ends of the cylinders of said first and second actuators; a second pressure fluid tank adjacent said second actuator; a suction line connecting said second tank to said second actuator; an interconnection line extending between said first and second tanks; a flow line interconnecting opposite ends of the cylinder of said second actuator; a first check valve in said flow line; and a second check vlave in said common pressure line.

2. A hydraulic control mechanism for a hopper barge, as claimed in claim 1, including a throttle section provided in said return line.

3. A hydraulic control mechanism for a hopper barge, as claimed in claim 1, including a third check valve connected in parallel with said second check valve in said common pressure line; said second and third check valves opening in mutually opposed directions and one of said second and third check valves being loaded with a spring.

4. A hydraulic control mechanism, for a hopper barge consisting of two barge halves articulated to each other along a longitudinal axis of the barge, comprising, in combination, a first working cylinder-piston actuator mounted in one end of the barge and connected between the two barge halves; a pressure fluid pump; a pressure line connected to said pump; a first pressure fluid tank; a return line connected to said first pressure fluid tank; a three-position switching valve connected to said pressure line and to said return line and selectively operable to connect said lines alternately to respective opposite ends of the cylinder of said first actuator; a second working cylinder-piston actuator mounted in the opposite end of the barge and connected between the two barge halves; a common pressure line interconnecting said first and second actuators; a second pressure fluid tank adjacent said second actuator; a suction line connecting said second tank to said second actuator; an interconnection line extending between said first and second tanks; a flow line interconnecting opposite ends of the cylinder of said second actuator; a first check valve in said flow line; and a second check valve in said common pressure line; said switching valve having a first position, serving to open the loaded hopper barge, in which the piston rod sides of the cylinders of both hydraulic actuators are connected to the piston head side of the cylinder of one hydraulic actuator and also to said return line leading to said first tank; a second position, serving to close the empty hopper barge in which the pressure side of said pump is connected to said common pressure line communicating with the piston rod sides of the cylinders of both actuators, and the piston head side of the cylinder of one actuator is connected to said return line; and a third position, serving to open the empty hopper barge, in which the pressure side of said pump is connected to the piston head side of the cylinder of only one hydraulic actuator, and said common pressure line is connected to said return line.

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