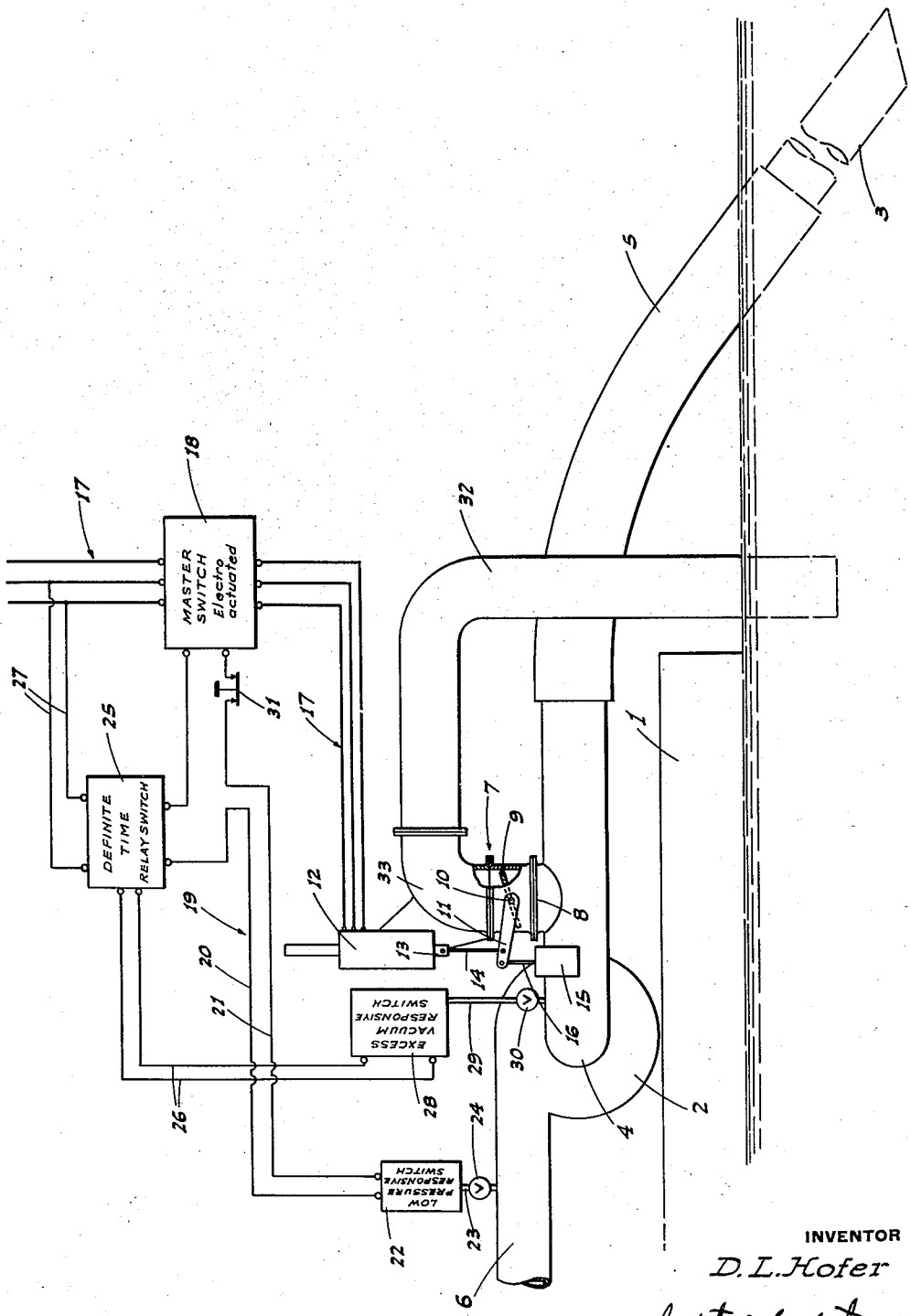
Oct. 23, 1951 D. L. HOFER 2,572,263

SUCTION DREDGE RELIEF VALVE SYSTEM

Filed May 2, 1949



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Patented Oct. 23, 1951

2,572,263

UNITED STATES PATENT OFFICE

2,572,263

SUCTION DREDGE RELIEF VALVE SYSTEM

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Application May 2, 1949, Serial No. 90,809

14 Claims. (Cl. 103—11)

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This invention relates generally to a safety system for suction dredges; the system being automatically operative to relieve excessive vacuum in the suction pipe resulting from plugging of the intake end thereof, and to correct velocity drop in the discharge pipe resulting from overloading thereof with material.

The present invention is a modification of the system shown in copending application, Serial No. 783,738, filed November 3, 1947.

One object of this invention is to provide a normally closed, safety relief valve unit in communication with the suction pipe of the dredge adapted to freely feed water thereto to relieve said plugging; the safety valve unit being mounted in connection with said suction pipe above water, as close to the suction pump on the dredge as possible, and with a minimum of passage between the valve and the interior of said suction pipe. It has been found that the application of a free flow of water into the suction pipe at a point very close to the suction pump produces the best results with respect to freeing of a plug at the lower end of the suction pipe; the column of water and material in the suction pipe above the plug tending to free the latter when the safety relief valve unit is opened and no material suction is being imposed on said column.

Another object is to provide a novel control system for the safety relief valve unit; said system including a normally energized electro-actuated device operative to hold the safety relief valve unit closed, and a mechanical device, such as a weight, operative—when the electro-actuated device is deenergized—to quickly and automatically open said safety relief valve unit. This is important, as positive opening of the valve unit is assured, even in the event of electric power failure.

A further object of this invention is to provide a relief valve system, for the purpose described, which is mounted entirely on the dredge, thus being readily and conveniently accessible for maintenance and repair.

It is also an object of the invention to provide a relief valve system which includes a novel control circuit, responsive to abnormal conditions in both the suction and discharge pipes, to cause the safety relief valve unit to open.

A further object of the invention is to provide a practical and reliable relief valve system, and one which will be exceedingly effective for the purpose for which it is designed.

These objects are accomplished by means of such structure and relative arrangement of parts as will fully appear by a perusal of the following specification and claims.

The figure of the drawing is a somewhat diagrammatic side elevation of the safety relief valve unit as mounted on a dredge; the control circuit being shown diagrammatically in connection therewith.

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Referring now more particularly to the characters of reference on the drawing, the system is adapted for use in connection with a suction dredge which includes a barge, indicated generally at 1, having a power driven, heavy-duty dredge pump 2 mounted thereon.

A suction pipe 3 leads from the pump intake 4 to an under-water point for dredge pick-up, and said suction pipe 3 includes a flexible portion 5 to permit of the necessary movements of the intake end of said pipe.

A discharge pipe 6 leads from the dredge pump 2, and it is through this pipe that the dredged material is delivered from the dredge barge 1.

The novel relief valve system comprises the following:

A relief valve unit, indicated generally at 7, is coupled, as at 8, to the suction pipe 3, on top of the latter, and as close to the pump intake 4 as is mechanically convenient; said relief valve unit 7 also being disposed so that a minimum of passage extends between said unit and the interior of the suction pipe 3.

The relief valve unit 7 includes therein a normally closed butterfly valve 9, mounted on a cross shaft 10 which extends out of the unit 7 through suitable seals.

A radial lever 11 is fixed on one exterior end portion of the cross shaft 10, and normally projects generally horizontally. This radial lever 11 is normally in a raised position, at which time the butterfly valve 9 is closed; the lever 11 being held in such raised position by a normally energized electro-actuator 12 including a plunger 13 connected to the radial lever 11 by a link 14.

The electro-actuator 12 is normally energized by a circuit arrangement hereinafter described, and upon deenergization of said actuator the plunger 13, link 14, and radial lever 11 swing downwardly to open the butterfly valve 9. This opening motion is caused by a mechanical device, such as a weight 15, suspended from the radial lever 11 by a link 16. The weight 15 thus always tends to open the butterfly valve 9, but under normal conditions is prevented from doing so by the energized electro-actuator 12.

The control or regulating circuit of the invention comprises the following:

The normally energized electro-actuator 12 is connected to a three-phase main, current supply 17 having a normally closed electro-actuated master switch 18 therein; said master switch being connected and responsive to a control circuit, indicated generally at 19; the latter including one lead 20 and another lead 21.

The control circuit 19 is connected, at the end opposite the master switch, to a normally closed, low pressure responsive switch 22 coupled by a conduit 23 to the discharge pipe 6. A normally open hand valve 24 is interposed in the conduit 23.

The lead 20 of the control circuit 19 has a definite time relay 25 interposed therein, the

switch of such relay being normally closed, but adapted to be opened for a predetermined, limited time upon energization of the relay. Such definite time relay 25 is under the regulation of a control circuit 26, and energizing current for said relay is supplied through a sub-circuit 27 which leads from the main current supply circuit 17 ahead of the master switch 18.

The relay control circuit 26 connects, at the end opposite said relay 25, with a normally open, excess vacuum responsive switch 28; the latter being of a type which is adjustable to respond at a selected vacuum. The excess vacuum responsive switch 28 is connected by a conduit 29 to the suction pipe 3 very close to the pump intake 4; there being a normally open hand valve 30 in the conduit 29.

A normally closed, manual switch 31 is interposed in the other lead 21 of the control circuit 19.

When the dredge is operating under conditions of normal vacuum in the suction pipe 3, and normal pressure in the discharge pipe 6, the relief valve 7 is closed.

Upon the suction pipe 3 becoming clogged or plugged at its intake end, with resultant creation of excessive and dangerous vacuum in the suction pipe 3, the excess vacuum responsive switch 28 closes the relay control switch 26. When this occurs the relay 25 opens for a definite period of time, breaking the control circuit 19 and resulting in opening of the master switch 18.

When the master switch 18 is opened, the electro-actuator 12 is deenergized, its plunger falls, and the weight 15 immediately opens the butterfly valve 9. The instant that the butterfly valve 9 opens, free-flowing, excess vacuum relief water feeds into the suction pipe 3 adjacent the pump intake 4 from a water intake pipe which leads from below water to connection with the upper end of the relief valve unit 7 by means including an elbow 33.

As such free flowing water surges into the suction pipe 3, with resultant relief of excessive vacuum therein, the plug at the lower end of the suction pipe 3 is relieved. This relief is due in part to the column of water and dredged material in the downwardly inclined suction pipe 3 above the plug. It is extremely advantageous that the excess vacuum relief water be fed into the suction pipe 3 as close to the pump intake 4 as possible. This is for the reason that the closer the point of relief to the pump 2, the lesser the likelihood of damage to the latter upon occurrence of vacuum in said suction pipe 3.

After passing of the predetermined definite time, the relay 25 returns to its normally closed position, whereupon the master switch 18 closes and all the parts return to their normal position; assuming, of course, that the plug at the lower end of the suction pipe 3 cleared during said time interval. Otherwise, the safety system will repeat the opening of the relief valve unit 7 for another time interval.

Another condition of danger which sometimes occurs, either by improper control by the dredge operator or due to working conditions, is loss of velocity in the discharge pipe 6, with resulting over-loading thereof; this resulting in a pressure drop in said discharge pipe.

The system automatically functions to prevent damage under these circumstances, as follows:

Upon a dangerous pressure drop in the discharge pipe 6, the normally closed, low pressure responsive switch 22 opens, breaking the control

circuit 19, with resultant opening of the master switch 18. Here again the opening of the master switch results in immediate opening of the relief valve unit 7, whereupon free flowing water feeds into the suction pipe 3 closely adjacent the pump intake 4, which water, as it passes through the pump 2 and into the discharge pipe 6, relieves the over-loading in the latter, so that the velocity of the discharge may be increased and normal conditions re-established.

As soon as such normal conditions re-establish, the switch 22 returns to its normally closed position, resulting in closing of the master switch 18, and responsive closing of the relief valve unit 7.

The described system is a practical, effective, and reliable one for the automatic relief of dangerous operating conditions occurring in the pumping assembly of a suction dredge, including the suction pipe, the discharge pipe, and the pump interposed therebetween.

As the relief valve unit is above water, and on the barge 1, and not on the suction pipe 3 adjacent its under-water intake end as before, it is not subject to possible interference by cave-ins, etc.

Additionally, said relief valve unit 7 and the controls therefore are readily accessible for maintenance and repair.

If, for any reason, the dredge operator desires to open the relief valve unit 7 under conditions where its opening is not automatic, the manual switch 31 is opened, which breaks the control circuit 19 and causes opening of the master switch 18, as previously described.

From the foregoing description it will be readily seen that there has been produced such a system as substantially fulfills the objects of the invention as set forth herein.

While this specification sets forth in detail the present and preferred construction of such system, still in practice such deviations therefrom may be resorted to as do not form a departure from the spirit of the invention, as defined by the appended claims.

Having thus described the invention, the following is claimed as new and useful, and upon which Letters Patent are desired:

1. In combination, on a dredge, of a pump, a suction pipe leading to the intake of the pump, and a discharge pipe extending from the outlet of the pump; a relief valve system comprising a normally closed safety relief valve unit mounted in communication with the suction pipe above water, a water intake pipe leading from below water adjacent the dredge to said valve unit, and means responsive to excess vacuum in the suction pipe operative to open said valve unit.

2. In combination, on a dredge, of a pump, a suction pipe leading to the intake of the pump, and a discharge pipe extending from the outlet of the pump; a relief valve system comprising a normally closed safety relief valve unit mounted in communication with the suction pipe above water, a water intake pipe leading from below water adjacent the dredge to said valve unit, and means responsive to excess vacuum in the suction pipe operative to open said valve unit; the valve unit communicating with the suction pipe close to the intake of the pump.

3. In combination, on a dredge, of a pump, a suction pipe leading to the intake of the pump, and a discharge pipe extending from the outlet of the pump; a relief valve system comprising a normally closed safety relief valve unit mounted in communication with the suction pipe above water, a water intake pipe leading from below

water adjacent the dredge to said valve unit, and means responsive to excess vacuum in the suction pipe operative to open said valve unit; the valve unit communicating with the suction pipe close to the intake of the pump, and there being only a short flow passage between the valve unit and the interior of said suction pipe.

4. A system, as in claim 3, in which the valve unit is on top of the suction pipe.

5. A system, as in claim 4, in which the water intake pipe couples to the valve unit from above.

6. In combination, on a dredge, of a pump, a suction pipe leading to the intake of the pump, and a discharge pipe extending from the outlet of the pump; a relief valve system comprising a normally closed safety relief valve unit mounted in communication with the suction pipe above water, a water intake pipe leading from below water adjacent the dredge to said valve unit, a mechanical device connected to the valve unit tending at all times to open the same, a normally energized electro-actuator connected to the valve unit normally holding the latter closed in opposition to said mechanical device, and means responsive to excess vacuum in the suction pipe operative to deenergize said electro-actuator whereby the mechanical device then opens the valve unit.

7. In combination, on a dredge, of a pump, a suction pipe leading to the intake of the pump, and a discharge pipe extending from the outlet of the pump; a relief valve system comprising a normally closed safety relief valve unit mounted in communication with the suction pipe above water, a water intake pipe leading from below water adjacent the dredge to said valve unit, a mechanical device connected to the valve unit tending at all times to open the same, a normally energized electro-actuator connected to the valve unit normally holding the latter closed in opposition to said mechanical device, and means responsive to excess vacuum in the suction pipe operative to deenergize said electro-actuator whereby the mechanical device then opens the valve unit; said mechanical device including a weight movable downward to open the valve unit.

8. In combination, on a dredge, of a pump, a suction pipe leading to the intake of the pump; a relief valve system comprising a normally closed safety relief valve unit mounted in communication with the suction pipe above water, a water intake pipe leading from below water adjacent the dredge to said valve unit, a mechanical device connected to the valve unit tending at all times to open the same, a normally energized electro-actuator connected to the valve unit normally holding the latter closed in opposition to said mechanical device, a control circuit for said electro-actuator, and means responsive to excess vacuum in the suction pipe or low pressure in the discharge pipe operative to cause the control circuit to function in a manner to deenergize the electro-actuator whereby the mechanical device then opens the valve unit.

9. In combination, on a dredge, of a pump, a suction pipe leading to the intake of the pump; a relief valve system comprising a normally closed safety relief valve unit mounted in communication with the suction pipe above water, a water intake pipe leading from below water adjacent the dredge to said valve unit, a mechanical device connected to the valve unit tending at all times to open the same, a normally energized electro-actuator connected to the valve unit normally holding the latter closed in opposition to

said mechanical device, a control circuit for said electro-actuator, and means responsive to excess vacuum in the suction pipe or low pressure in the discharge pipe operative to cause the control circuit to function in a manner to deenergize the electro-actuator whereby the mechanical device then opens the valve unit; said means including an excess vacuum responsive switch in communication with the suction pipe, and a low pressure responsive switch in communication with the discharge pipe.

10. In combination, on a dredge, of a pump, a suction pipe leading to the intake of the pump, and a discharge pipe extending from the outlet of the pump; a relief valve system comprising a normally closed safety relief valve unit mounted in communication with the suction pipe above water and adjacent the pump, said valve unit including a normally closed butterfly valve and a projecting valve supporting shaft, a radial lever on said shaft, a weight suspending from the lever always tending to lower the same and open the valve, a normally energized electro-actuator connected to the valve unit normally holding the latter closed in opposition to said weight, and means responsive to abnormal conditions of vacuum and pressure in the suction and discharge pipes, respectively, operative to deenergize the electro-actuator whereby the weight opens the valve unit.

11. In the combination, on a dredge, of a pump, a suction pipe leading to the intake of the pump, and a discharge pipe extending from the outlet of the pump; a relief valve system comprising a normally closed safety relief valve unit mounted in communication with the suction pipe, said safety relief valve unit being arranged, when open, to deliver water to the suction pipe above its lower end, and means responsive to abnormal pumping pressure conditions in at least one of the pipes operative to open said safety relief valve unit.

12. In the combination, on a dredge, of a pump, a suction pipe leading from below water to the intake of the pump, and a discharge pipe extending from the outlet of the pump; a relief valve system comprising a relief valve connected in communication with the suction pipe, said relief valve being arranged, when open, to deliver water into the suction pipe above its lower end, self-acting mechanical means connected to and tending to open the relief valve, and releasable power means resisting said mechanical means and normally holding the relief valve closed.

13. A relief valve system, as in claim 12, in which said mechanical means is a gravity displaced weight.

14. In the combination, on a dredge, of a pump, a suction pipe leading from below water to the intake of the pump, and a discharge pipe extending from the outlet of the pump; a relief valve system comprising a relief valve connected in communication with the suction pipe, said relief valve being arranged, when open, to deliver water into the suction pipe above its lower end, self-acting mechanical means connected to and tending to open the relief valve, and releasable power means resisting said mechanical means and normally holding the relief valve closed; said power means being automatically releasable in response to abnormal pumping pressure conditions in at least one of the pipes.

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No references cited.