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AUTOMATIC CONTROL MEANS FOR DREDGE BUCKETS

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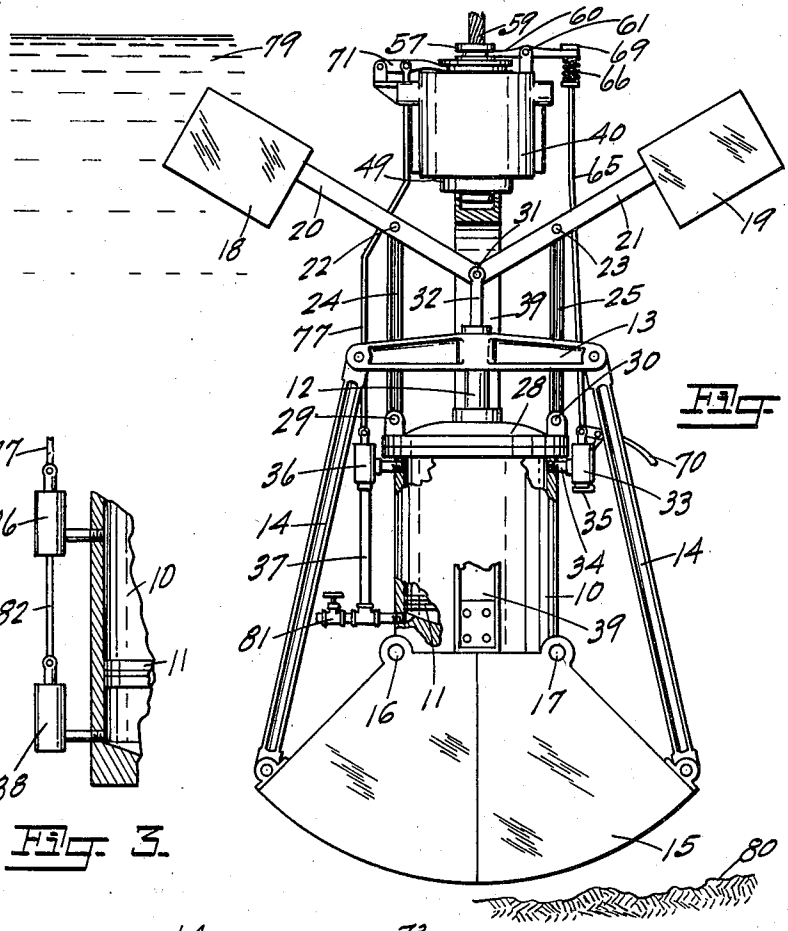


Fig. 1.

Fig. 3.

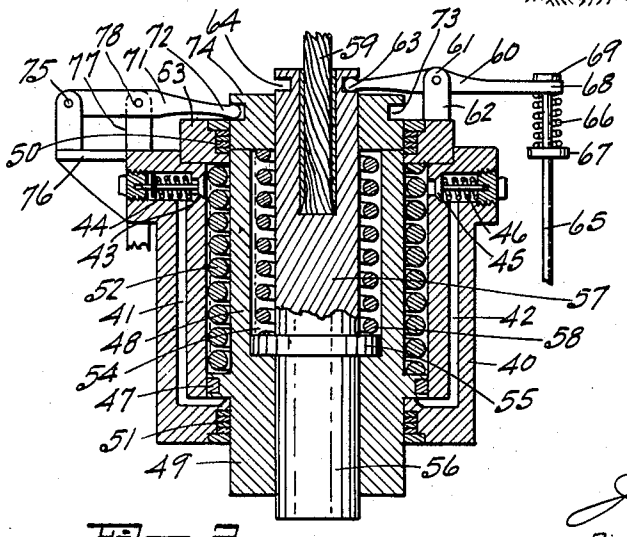


Fig. 2.

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AUTOMATIC CONTROL MEANS FOR DREDGE BUCKETS

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13 Claims. (Cl. 37—187)

This invention, an automatic control for dredge buckets is suitable for control of all types of power operated devices which are suspendedly transported and intended to operate when the transporting means deposits them on a supporting surface; however, this control is particularly designed for the control of deep-sea dredges, and particularly such dredges which are operated through the medium of the water of submergence. This control is specifically designed for use in connection with a dredge which is provided with a water-of-submergence-actuated prime mover, and in which the dredge is lowered to, and raised from a sub-sea surface through the medium of a hoisting cable.

In this connection, the hoisting cable, through this control, controls the admission of water-of-submergence to the prime mover for operation only when the dredge reaches a sub-sea surface, or when the cable is purposely excessively slacked to permit its operation at an intermediate depth, and which also automatically releases the dredge from an immovable object, and, which also fluid-locks the prime mover against operation except when the cable is slacked or excessively stressed.

The purposes of the invention are, to provide means in association with a water-of-submergence-operated prime mover mounted on a deep-sea dredge in which the hoisting cable functions as raising and lowering means, and, as control means for all operations of the dredge; to include in said control means a valve opened to the prime mover to admit water-of-submergence when the cable is slack and to lock the water in the prime mover when the cable is taut or under normal or predetermined stress, and to equalize the pressure in the prime mover in the event of excessive hoisting effort by the cable to release the dredge from a relatively immovable object, and to provide means for opening the dredge when released.

This invention is an improvement over copending applications, Serial Number 93,971, filed August 3, 1936, which issued as Patent No. 2, 129, 158, under date of September 6th, 1938, and Serial Number 173,840, filed November 10, 1937, both of which cover clamshell dredges, and, the first of which provided no means for releasing the dredge from an immovable object, and the second of which provided means controlled by separate cables, conduits, and pumps, for accomplishing the release.

This invention illustrates a different system of operating connections between the prime mover and the bucket than that of previous applications. However, the control system is as readily applied to either type of dredge, as well as other types which are not operated in water but by power from an external source, in which case the external source of power is connected to the water-of-submergence inlet.

In describing the invention, reference will be had to the accompanying drawing in which:

Fig. 1 is an end elevation of the invention as applied to a cylinder-and-piston-operated clamshell bucket, with portions broken away to clearly illustrate the connections.

Fig. 2 is a sectional elevation through the invention.

Fig. 3 is a modification of the system of balancing the pressure in the cylinder.

As illustrated, the prime mover consists of a cylinder 10 having a piston 11 provided with a piston rod 12 which is operatively connected through a crosshead 13 and links 14 to the clamshell bucket 15 for opening and closing the bucket, the two members of which bucket are respectively hinged at 16 and 17; the bucket and operative connections being overbalanced by, and the bucket being normally urged to open, by the counterweights 18 and 19 operating through the respective levers 20 and 21 which are respectively fulcrumed at 22 and 23 on the respective rocker links 24 and 25, and pivoted respectively at 26 and 27 to the head 28 of the cylinder 10, at 29 and 30; the inner ends of the levers 20 and 21 being pivotally connected at 31 to the extension 32 of the piston rod 12.

Water of submergence is admitted to the cylinder 10 by means of a valve 33 which has a connection 34 to the cylinder 10, and a port 35 in communication with the surrounding fluid, and is illustrated as consisting of a valve of the type illustrated and described in copending application Serial Number 224,968 filed August 15, 1938, for Valves, although any other type of valve suitable for the purpose may be used.

A second, similar valve 36 controls a bypass 37 between the opposite ends of the cylinder 10, although two valves in series, as 36 and 38, as illustrated in Fig. 3 may be used, the only requirement being that both valves shall operate to open and close simultaneously and both be in communication with the surrounding fluid and with the cylinder.

A bail 39 forms the suspensory support for the dredge and a mounting for the control device, although the mounting of the control device is not limited to such construction.

The control device comprises an overload release mechanism and resetting means therefore,

and, a trip, or valve control mechanism, both of which mechanisms are balanced to external fluid pressures.

The overload release mechanism consists of a cylinder 40 having two bypasses respectively 41 and 42 formed in the walls thereof and forming each a communicating passage between the opposite ends of the cylinder 40.

The bypass 41 is a reset bypass and has a valve 43 loaded by a light spring 44 and positively seating against pressure from within the cylinder 40, but opened to the inside of the cylinder through urgence of fluid under pressure within the bypass 41.

The bypass 42 is the overload release bypass and it has a valve 45 which is loaded by a heavy spring 46 and positively seats against pressure within the bypass 42 and is urged to seat against pressure within the cylinder, excessive pressure within the cylinder unseating the valve to permit fluid to pass from the upper to the lower end of the cylinder 40.

Mounted within the cylinder 40 is a piston 47 which has extensions from its opposite faces forming plungers 48 and 49 which are of equal cross-sectional area to balance the piston against external fluid pressures, and these plungers are effectively sealed against ingress and egress of fluid to or from the free spaces between cylinder, piston and plungers, the sealing means being indicated at 50 and 51.

A spring 52 cooperates between one face of the piston 47 and the head 53 of the cylinder 40 and provides means for automatically resetting the overload release.

The free spaces within the cylinder and bypasses 41 and 42 are filled with a liquid, preferably oil, although water or any other suitable medium may be used.

The trip, or valve operating mechanism consists of a cylinder 54 formed interiorly of the plunger 48, and a piston 55 operating therein and having plungers 56 and 57 extending from its opposite faces, these plungers having equal cross-sectional areas for balance against external or surrounding pressures, and a spring 58 urges the piston to the bottom of the cylinder, the hoisting cable 59 being attached to the plunger 57.

The bearings for the plungers 56 and 57 require no packing or sealing means, and the piston may operate loosely in the cylinder to permit fluid within the cylinder to bypass, and if desired, the plunger 57 may extend clear through the element 47, 48, 49, with the spring seating against the bottom of the plunger 48, 49, a construction similar to that illustrated at 59, 61, 63, in copending application, Serial Number 173,840, filed November 10, 1937, for Clam-shell dredge.

A control lever 60 is intermediately pivoted at 61 to a bracket 62 formed integral with the cylinder head 53 and has one end 63 cooperating with an annular groove 64 formed in the upper end of the plunger 57 and its other end slidably cooperating with the valve-actuating rod 65 which is downwardly urged by a spring 66 cooperating between a fixed collar 67 and the other end 68 of the lever 60, this spring acting also to compensate for overtravel of the lever. A collar 69 cooperates with the top face of the other end 68 of the control lever to cause lifting of the rod 65 when the piston 55 is depressed by spring 58. The spring 66 also functions to permit manual opening of the valve 33 through the medium of the hand lever 70 when the piston 55 is raised by the cable 59 under load.

The release lever 71 has its inner end 72 cooperating with an annular groove 73 formed in the head 74 of plunger 48, and is pivoted at its other end at 75 to a bracket 76 integral with or mounted on the cylinder 40, and a valve connecting rod 77 is pivotally connected at 78 intermediate the ends of the lever.

The operation of the invention is as follows:

Under normal conditions of operation, the dredge is suspended by the cable 59, and the weight of the dredge, even when submerged, compresses the spring 58 and the plunger 57 projects upwardly, raising end 63 and depressing end 68 of valve-control lever 60, and this lever through spring 66 and collar 67 forces the valve 33 to its seat or closes the valve to prevent admission of water of submergence 79 to the cylinder through a suitable port 35.

Since the liquid in cylinder 40 is incompressible, and the valve 45 is loaded sufficiently to prevent bypass of fluid from the upper to the lower end of the cylinder 40 under all ordinary conditions of loading on the cable 59, there occurs no movement of piston 48, and lever 71, through rod 77 keeps valve 36 closed and prevents bypass of fluid between the opposite ends of cylinder 10, therefore the opposite ends of cylinder 10 are isolated from each other and the fluid of operation cannot circulate between the opposite ends or be admitted to the cylinder through this valve.

When the dredge reaches a sub-seat surface 80, and the hoisting cable 59 is slacked, the spring 58 depresses plunger 57, forcing end 63 of lever 60 down and raising end 68, and this end, through collar 69, lifts the valve rod 65 and opens valve 33, admitting water of submergence or fluid of operation 79 to the upper end of cylinder 10, forcing the piston 11 to the position shown, which, through piston rod 12, crosshead 13 and links 14 close the bucket 15 as shown, against the urgence of the counterweights 18 and 19.

Air entrapped in the lower end of the cylinder is taken care of by permitting it to escape to a suitable breather tank (not shown) but located at a higher level to provide drainage of any water which might be forced into it, somewhat in accordance with the various systems illustrated and described in the previously-mentioned copending application and patent over which this present application is an improvement.

When the cable 59 is again drawn taut, the plunger 57 is again raised, closing valve 33 and locking the water admitted in the cylinder, thus hydraulically locking the prime mover, and consequently the dredge, against operation so long as the cable is loaded, and, when the dredge has been hoisted from the water and is ready for dumping, manual depression of handle 70 opens valve 33 against the action of spring 66 and permits the water to drain from the cylinder 10, as the counterweights 18 and 19 lift the piston, the operative connections and the bucket halves and open the clamshell bucket 15. Upon release of lever 70, the spring 66 again closes valve 33 with the bucket open, ready for a subsequent operation.

There is a possibility that the bucket might close on a sunken ship, projecting rock, or other relatively immovable object, trapping the dredge, and under such conditions, with the piston either water locked or subjected on one side only to the pressure of the water of submergence, the dredge would obviously be lost unless means was provided for its release, and for which this release means is provided.

It will be supposed that the dredge has clamped onto a relatively immovable object. The cable 59, with normal stress only closes valve 33 and has no effect on valve 36. Additional, excessive stress is thereby placed on the cable when an attempt is made to hoist the dredge, considerably above that required to hoist the free dredge with full load, and this additional stress acts on the liquid in cylinder 40 sufficiently to force valve 45 open against the action of spring 46, and the liquid escapes from the upper end of the cylinder through the bypass to the lower end, the pull raising piston 47 and compressing spring 52, while the plunger head 74 lifts end 72 of lever 71 and coincidently lifts the valve rod 77, opening valve 36 and thus opening the bypass 37, equalizing the pressure on opposite sides of the piston 11, and the counterweights 18 and 19 open the bucket, releasing it from the object of entrapment.

After the bucket is free, it is raised to the surface and out of the water and rested on a support, and as the cable 59 is slacked, the spring 52 depresses the piston and forces the liquid beneath the piston 47 through the bypass 41, past the lightly loaded valve 43, thus resetting the release mechanism and depressing valve rod 77 to close valve 36.

Valve 81 is then manually opened to drain water from the lower end of the cylinder 10, and valve 33 is manually opened to drain water from the upper end of the cylinder, while the counterweights 18 and 19 open the bucket fully for a subsequent operation.

Thus, the release mechanism is self-resetting and is operated only under conditions of excessive loading on the cable.

Instead of providing a bypass 37 controlled by a single valve 36, two valves, 36 and 38 may be supplied for the respective ends of the cylinder 10 and arranged for simultaneous operation, being connected together by means of a rod 82 or other suitable connection, and both having access to the water of submergence.

In this arrangement, water is admitted to both ends of the cylinder, and due to balance in pressure on opposite ends of the piston 11, the counterweights 18 and 19 readily open the bucket.

There is one advantage in this construction, in that the water will automatically drain from both ends of the cylinder when the dredge is removed from the water, and after the draining is completed, requires only that the dredge be lowered onto a support for a sufficient length of time to permit the spring 52 to reset the release mechanism.

If the dredge is to be operated out of water, and by a developed source of power, it is merely necessary to connect the source of power to the port 35, and use the two valves 36 and 38 for release instead of the bypass, and using one of these valves for draining the cylinder to open the bucket.

If the dredge is to be operated under water by a developed source of power, such as air under pressure, the bypass 37 is used, and the source of power is connected to the port 35.

I claim:

1. Control means for a dredge having a bucket comprising grab elements, and having a hoisting cable, and a prime mover for operating to close said grab elements, comprising; first control means operatively associated with said hoisting cable and with said prime mover and controlled by said hoisting cable and controlling operation of said prime mover for operation when said cable is slack and for locking said prime mover against operation when said cable is stressed to a normal degree; second control means operatively associated with said cable and with said prime mover for unlocking and creating an idle condition in said prime mover for permitting free and unrestricted movement of the operating elements thereof to permit free movement of said grab elements under conditions of abnormal stress on said cable to permit release of said dredge from an object of entrapment.

2. A structure as claimed in claim 1; and means associated with said grab elements and operating to open said grab elements when said prime mover is unlocked by said second control means and said idle condition is created in said prime mover, for freeing said dredge from the object of entrapment.

3. Control means for a dredge having a bucket comprising grab elements and having a fluid-operated prime mover having a fluid driven element therein for operating the grab elements to close the bucket, and having a hoisting cable; a valve and control means therefor associated with said cable and with said prime mover, said control means opening said valve for admitting fluid for driving said element for operation of said grab elements when said cable is slack and closing said valve and thereby locking said prime mover against admission or discharge of fluid and thereby locking said element against movement to maintain the instant condition of the grab elements, when said cable is drawn taut; and release means associated with said cable and with said prime mover and actuated under conditions of abnormal stress on said cable for unlocking said prime mover for non-selective admission and discharge of fluid and creating thereby an idle condition of said element for free movement for release of said grab elements from an object of entrapment; and opening means operatively associated with said bucket for opening said bucket when said unlocked and idle condition is created, to completely free said dredge from said object of entrapment.

4. A structure as defined in claim 3, in which resetting means is associated with said control means and operatively connected to said cable, for resetting said release means for subsequent operation when said cable is slacked following a condition of abnormal stress on said cable.

5. In a dredge having a bucket and a water-of-submergence-operated prime mover, and a cable for hoisting and lowering said dredge; a valve for admitting water-of-submergence to said prime mover; valve control means associated with and controlled by said hoisting cable closing and maintaining said valve closed when said dredge is supported by said hoisting cable to lock said prime mover against operation, and opening and maintaining said valve open to admit water-of-submergence to said prime mover for operation when said dredge is unsupported by said cable; and release means operating only under conditions of abnormal hoisting effort and associated with said cable and with said prime mover, freeing said prime mover internally for idle operation in either direction under the influence of external urgence other than said water-of-submergence; and counterweights creating said external urgence and normally urging said bucket to open.

6. A structure as claimed in claim 5, and means resetting said release means for subsequent release operation when said dredge is unsupported by said cable.

7. A structure as claimed in claim 5, said valve control means comprising a spring-depressed plunger having said cable attached thereto, a lever cooperating with said plunger and closing said valve when said plunger is raised through hoisting effort or support of the dredge by said cable, and opening said valve when said cable is slacked to a condition of non-support of the dredge.

8. A structure as claimed in claim 5, said release means comprising a cylinder, a piston operating within said cylinder, a spring urging said piston against the hoisting effort of said cable; two bypasses connecting the opposite ends of said cylinder and each having a valve for control thereof; one of said valves being loaded to open for transfer of fluid from the upper to the lower end of said cylinder only under conditions of abnormal hoisting effort on the part of said cable, and the other valve being lightly loaded for seating only against pressure in the upper part of said cylinder to permit transfer of fluid from the lower to the upper end of said cylinder under the influence of said spring.

9. Dredge control means, in combination with a prime mover and a hoisting cable; dredge release means comprising a cylinder having two bypasses connecting the upper and lower ends, said cylinder being sealed against surrounding fluid pressures; a release valve for one bypass resisting transfer of fluid from the upper end to the lower end of said cylinder under predetermined pressure and releasing for transfer of fluid when said predetermined pressure is exceeded; a reset valve for the other bypass for substantially unresisted transfer of fluid from the lower end to the upper end of said cylinder; a piston having a plunger extension and slidable in said cylinder and a spring depressing said piston and forming resetting means for said release means for subsequent operation; said cylinder and bypasses being filled with a liquid; said release means being associated with, and controlled by said cable, and, means controlled by and associated with said piston controlling said prime mover and converting said prime mover to an idle condition in the event of excessive hoisting effort on the part of the cable; and means opening said dredge when said prime mover is converted to an idle condition.

10. A structure as claimed in claim 9, in which said piston is provided with opposed plunger extensions of equal area and subjected to surrounding pressures externally of said cylinder for balancing the effect of said external pressures on said piston through said plunger extension first mentioned to insure normal operation irrespective of surrounding pressures on the cylinder.

11. A structure as claimed in claim 9, a cylinder formed in said plunger extension and a plunger in said cylinder; a spring depressing said plunger; said hoisting cable cooperating directly with said plunger; and means cooperating with said plunger controlling said prime mover for operation only when said plunger is depressed, and for locking said prime mover against operation when said plunger is raised through the effort of said cable to hoist the dredge.

12. A sub-sea dredge comprising, in combination with a hoisting cable; a clamshell bucket, and a prime mover comprising a cylinder having a piston and mounted on said bucket, and operative connections between said piston and said bucket, and counterweights normally urging said bucket to open; an operating valve for one end of said cylinder and communicating with surrounding fluid; a release valve for each end of said cylinder and in communication with the surrounding fluid, and an operative connection connecting said release valves for simultaneous operation; a bail for said dredge; control means associated with said bail and with said hoisting cable, and including, prime mover control means opening said operating valve when said cable is slack and closing said valve when said cable is supporting said dredge, and, release means opening both of said release valves to pressure-balance said piston for idle movement to permit said counterweights to open said bucket when said hoisting cable is subjected to abnormal hoisting stress, to release said bucket from a relatively immovable object.

13. A structure as claimed in claim 12; said release means maintaining said release valves open while the dredge is supported by said cable to drain the cylinder after removal from the surrounding fluid, and closing said release valves and resetting said release means for subsequent operation when said dredge is rested on a support and the cable is slacked.

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