

Sept. 6, 1938.

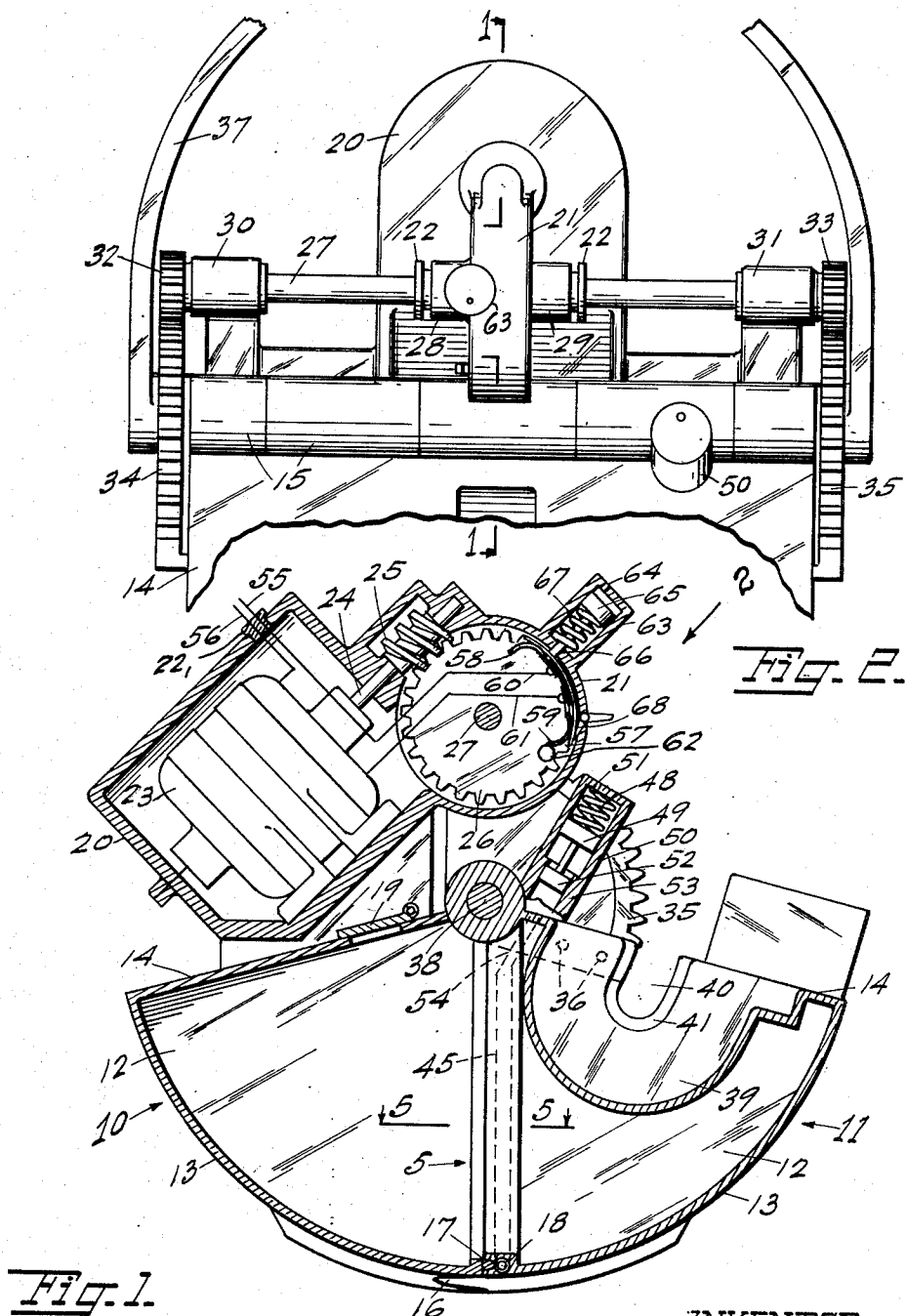
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2,129,158

CLAMSHELL DREDGE

Filed Aug. 3, 1936

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

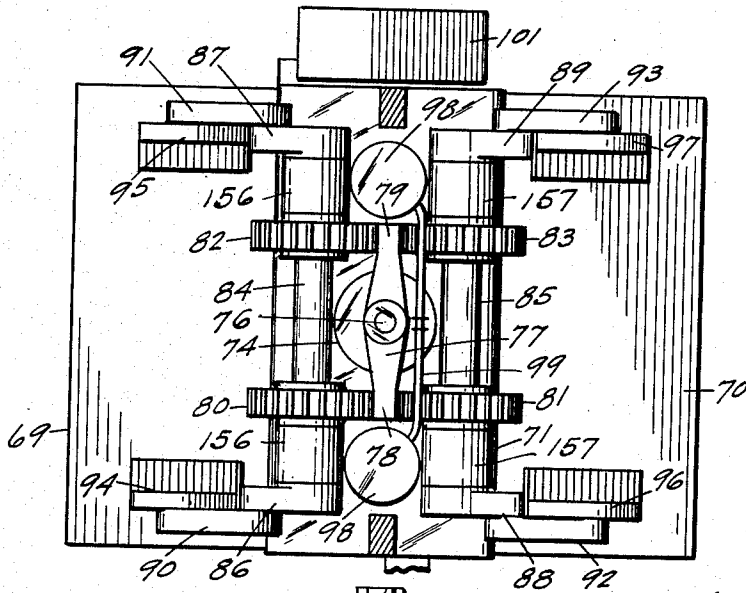


Fig. 4.

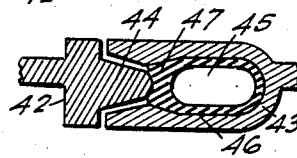


Fig. 5.

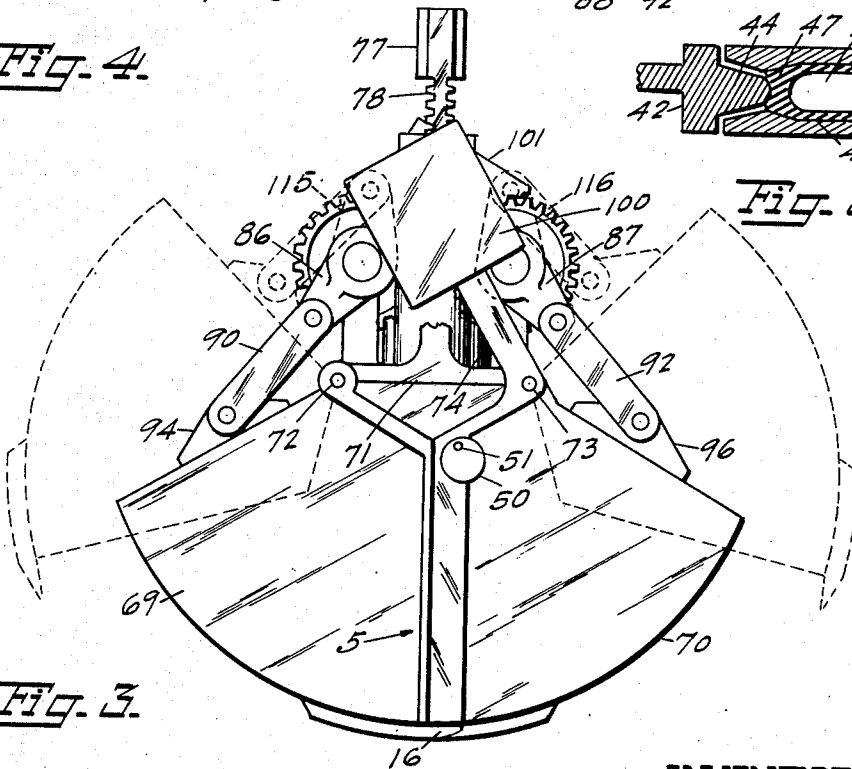


Fig. 3.

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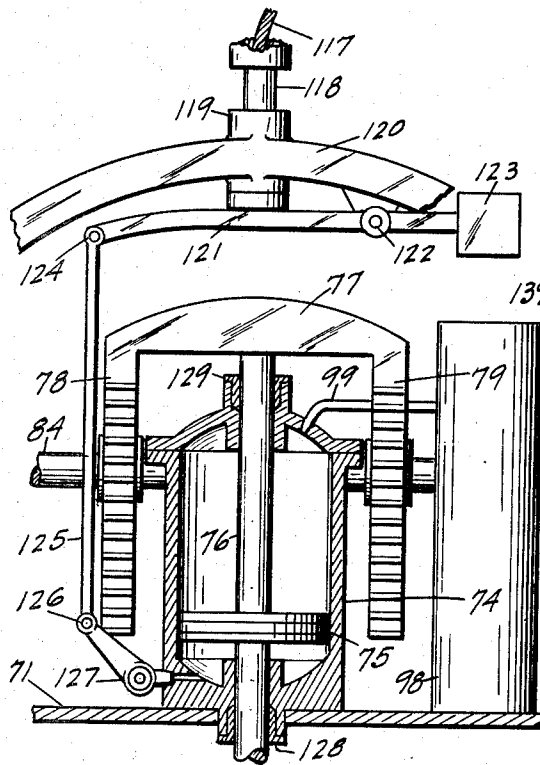


Fig. 6.

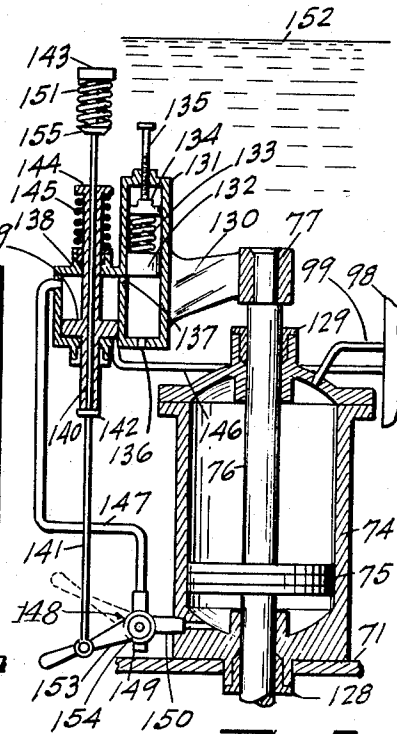


Fig. 7.

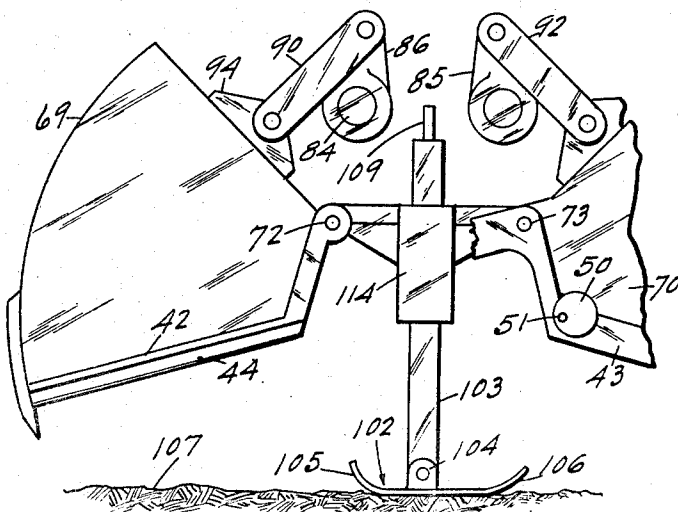


Fig. 8.

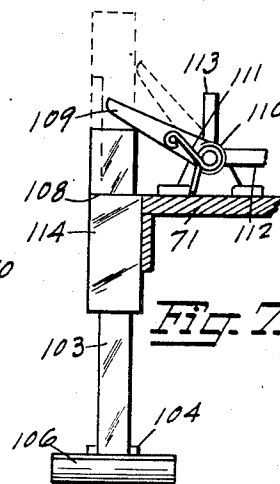


Fig. 9.

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UNITED STATES PATENT OFFICE

2,129,158

CLAMSHELL DREDGE

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Application August 3, 1936, Serial No. 93,971

18 Claims. (Cl. 37—71)

This invention, a clam-shell dredge, combines in a single unit, a clam shell bucket and its operating means and prime mover, and is particularly intended for submarine dredging for recovering values from the ocean and river bottoms; there being known areas in the depths of the ocean and deep rivers where large values in gold and other precious metals exist, and which can be recovered, provided the precious metal-bearing sand, silt or sludge can be brought to the surface and retained against washing out of the recovery means while being hoisted to the surface through the water, and provided the recovery means or dredge can be operated at great depths.

This invention is particularly designed for this specific purpose, though it can as readily be used under any conditions, in or out of water, and where there is sufficient depth, the dredge is self-operating, requiring only a hoisting cable for raising and lowering the dredge, and manual control means for dumping the dredge when it has reached the surface.

The objects of the invention are as follows:

First; to provide a clam-shell bucket with integral operating means including a prime mover.

Second; to seal said prime mover against fluids under high pressure.

Third; to seal the clam-shell bucket against loss of fine material, such as sludge, while the bucket is being hoisted to the surface.

Fourth; to provide such sealing means with internal pressure, and maintain the value of such pressure greater than the value of the pressure of submergence, to maintain a perfect seal irrespective of the depth of submergence.

Fifth; to provide automatic control means for controlling the closing of said bucket, and manual control means for controlling the opening of said bucket.

Sixth; to provide automatic control means which will operate only when a predetermined depth of submergence is attained or a subsurface is reached.

Seventh; to provide a prime mover for submersible devices which is operated by the pressure of submergence.

Eighth; to provide a dredge as outlined which will automatically close, seal and lock, when lowered to a predetermined depth or surface, and remain locked in closed position until manually released.

Ninth; to provide a static-fluid operated and controlled prime mover.

Other objects and advantages of the invention will become apparent as the following description is read on the drawings forming a part of this specification, and in which similar reference characters are used to designate similar parts throughout the several views, of which:

Fig. 1 is a vertical section through one form of the invention, with the bail removed, and is taken substantially on line 1—1 of Fig. 2.

Fig. 2 is a fragmentary view taken in the direction of the arrow 2 of Fig. 1.

Fig. 3 is a side or end elevation of the dredge equipped with a static-fluid operated prime mover, with bail broken away and control means not shown.

Fig. 4 is a plan view of Fig. 3.

Fig. 5 is an enlarged section through the sealing means for the bucket and corresponds to a section taken on line 5—5 of Fig. 1.

Fig. 6 is a fragmentary end elevation showing part of the dredge of Figs. 3 and 4, with one type of prime mover control which is controlled through cooperation with a surface.

Fig. 7 is a fragmentary front elevation of Fig. 6.

Fig. 8 is an enlarged fragmentary vertical section through the static-liquid operated prime mover with hoisting cable controlled prime mover control.

Fig. 9 is an enlarged sectional elevation through the fluid operated prime mover and control therefor, utilizing the pressure of external fluid as the control medium.

Figs. 1 and 2 show the simplest form of the invention which consists of a standard clam shell bucket and an electric motor mounted directly thereon and operating the bucket through a gear train. This type is most suitable for unsubmerged operation, and also for submerged operation when the depth of submergence is not sufficient to provide the necessary pressure for operating the fluid actuated prime mover.

The clam shell bucket consists of a bi-valve or two scoops 10 and 11, each of which have ends 12, bottom 13 and top 14, the two scoops being hinged together as shown at 15, and having digging teeth 16 integral with or secured to the lips or bottom edges.

The side and bottom edges of the cooperating valves or scoops are provided with cooperative sealing means, indicated at 5, the respective sealing members being indicated at 17 and 18, and which extend throughout the length of the side and bottom edges. This sealing means is shown in detail in Fig. 5, and will be fully described in connection with that figure.

While the dredge or bucket is digging into the muck or sludge, it is necessary to permit water

to escape through the top of the bucket, and while the bucket is being hoisted to the surface, it is necessary to prevent all ingress of water to the interior of the bucket. For this purpose, a flap valve 19 is provided, which permits passage of water from the interior of the bucket during closing and digging, and seals the bucket against ingress as the bucket is raised to the surface, since the dynamic pressure will hold the valve tight on its seat.

Mounted on the scoop 10 is a motor housing 20 including an integral worm and worm-wheel housing 21 the entire housing being sealed against external pressure, as by packing means 22 about the worm-gear shaft, which are the only points which require packing with the exception of the conductor passage, which is sealed by the plug 22, in which the conductors are sealed.

Mounted within the housing 20 is an electric motor 23, on the shaft 24 of which is mounted a worm 25, which cooperates with a worm-wheel 26, this worm-wheel being fixed on the shaft 27, the housing 21 having integral bearings 28 and 29 and spaced bearings 30 and 31 for the shaft 27. Fixedly mounted on each end of shaft 27 are the respective pinions 32 and 33, which mesh with the respective sector gears 34 and 35 which are fixedly secured to the respective ends 12 of the bucket 11 as indicated at 36. A bail 37 is mounted on the pintle shaft 38 for connection to a hoisting cable, (not shown).

A recess 39 is formed in the top of the scoop 11 to receive the worm-gear housing 21, and coaxial recesses 40 and 41 receive the shaft 27 and bearings 28 to 31 when the bucket is opened.

Sealing means for the edges or jaws of the bucket is shown in section in Fig. 5, and consists of the bottom and side encompassing jaws including for one scoop, the male member 42, and for the other scoop, the female member 43, the male member having an integral divergent member 44 which cooperates in the closed position of the bucket with a pneumatic insert 45 secured in the female member, this insert consisting of a rubber or other impervious resilient tube retained in a recess 46, one portion 47 being of considerable thickness to form a cushion and reinforcement for the member 44. This tube is inflated with air under a predetermined pressure, which pressure is maintained at a normal by the spring 48 acting on the piston 49, which operates in a cylinder 50 having a fluid inlet 51.

The piston is directly connected to a smaller piston 52 which operates in a second, coaxial cylinder 53, this cylinder 53 communicating with the tube 45 through a duct or tube 54.

Thus, as the external pressure is increased, as by lowering the dredge into water, the pressure of the water acting on piston 49 amplifies the pressure in the tube to a value greater than the existent surrounding pressure, making the seal effective irrespective of any external pressure.

The motor may be manually controlled in conjunction with overload switches from the hoisting base, (not shown), or may be automatically controlled by any of the various means shown in the various views.

As shown in Fig. 1, current is brought into the motor housing from a supply through conductors 55 and 56, and switch means is incorporated in the worm gear housing, and consists of a double ended spring contactor 57 mounted on, and insulated from the housing 21, and two cooperatively related spring contacts 58 and 59 insulated from each other and from the conductor 57 and

respectively connected through conductors 60 and 61 to one conductor 55 and to the motor 23, an insulating pin 62 on the worm gear being cooperatively related to the contact springs 58 and 59.

Mounted on, or integral with the housing 21, is a cylinder 63 having a fluid inlet 64, and a piston 65 has a piston rod 66 which is cooperatively related to one end of the conductor 57 and is urged outwardly by the spring 67. A manually operable lever 68 is cooperatively related to the other end of spring contact 57.

When the dredge bucket is open, pin 62 is in the opposite position from that shown and in contact with the contact 58, holding contact 58 away from contact 57 and maintaining this broken contact until the bucket is lowered to a sufficient depth to cause the external pressure on piston 65, through piston rod 66 to force the contact 57 to close to contact 58, while the contact between 59 and 57 is complete, thus completing the circuit to the motor through 55, 60, 58, 57, 59 and 61.

The motor is thus brought into operation, driving the worm gear counterclockwise until pin 62 contacts and forces contact 59 out of contact with 57, breaking the circuit with the bucket closed and locked by the worm and worm wheel.

As the dredge is raised to the surface, the pressure on piston 65 is reduced and the piston 65 and rod 66 are retracted, permitting the switch elements 57 and 58 to return to their normal position, the normal position of contacts 57-58 and 57-59 being closed or complete. Thus, the circuit remains broken only between 57 and 59.

When the bucket is to be opened and dumped, the lever 68 is manually moved to force contact 57 into cooperation with contact 59, starting the motor, pin 62 leaving contact 59 and permitting it to return to normal or closed position to contact 57.

In Figs. 3 and 4, and 6 to 9 are shown a fluid operated dredge and various types of control means therefore, which dredge may be operated by any fluid under pressure, or by the static pressure of a liquid of submergence, such as by operation by water in which the dredge is submerged. This type is particularly desirable in connection with deep-sea dredging, since no power is required for closing and opening of the bucket, the only power required being for hoisting, and even this power is reduced due to the buoyancy of the transfer tanks.

In these modifications, the bucket is modified by being divided into two scoops 69 and 70 with intervening mounting platform for the prime mover, as shown at 71, the scoops being hinged to the platform as shown at 72 and 73.

Mounted on platform 71 is a cylinder 74 in which operates a piston 75 having a piston rod 76 to which is attached a cross head 77, which terminates at its opposite ends in depending racks 78 and 79 which selectively and simultaneously cooperate with gears 80-81 and 82-83, which gears are fixed on the rocker shafts 84 and 85, suitable bearings being provided for these shafts, as shown, and indicated at 156 and 157.

Fixed on the opposite ends of shafts 84 and 85 are cranks 86, 87, 88 and 89, which are operatively connected to the respective scoops 69 and 70 through links 90, 91, 92 and 93, these links being hingedly connected to the bearings 94, 95, 96 and 97, which are secured to the respective buckets.

Additionally mounted on the platform or base 75

71 is one or more air receivers 98, the receiver or receivers being in communication with the upper part of the cylinder 74, as shown at 99, the receivers 98 forming fluid transfer means to diminish the pressure reacting in the cylinder below the natural value created through compression as the piston is forced upwardly by the liquid of submergence. This air under pressure is used during transfer in the return stroke for initially opening and assist the counter-weights 100 and 101 in fully opening the scoops.

The control shown in Figs. 6 and 7 is suitable for controlling operation of the motor in Fig. 1, in connection with an overload relay or circuit breaker, or in connection with the means shown in Fig. 1, by providing an electric switch in place of the valve shown.

As shown, this control is adapted for control of the fluid operated prime mover. The shoe 102 is curved upwardly at both ends, and pivotally attached to the drop bar 103 as shown at 104, at a point removed from the longitudinal center of the shoe to create a difference in length of the two ends to cause the shoe to pass substantially edgewise through the water during descent to prevent operation until an actual surface of non-liquid material is encountered, the curved ends 105 and 106 causing the shoe to seat when contacting a sub-surface 107.

A shoulder 108 on the drop bar limits the drop thereof, and the upper end of the bar cooperates with a lever 109, which may be made to operate an electric switch for the motor, or, as shown, operates a valve 110. This lever is normally maintained in lowered position through the medium of a spring 111, or counterweight, (not shown).

The water of submergence is delivered or admitted to the cylinder 74 through the pipe 112, the terminal 113 of the valve functioning as inlet during closing of the bucket, and as discharge during opening of the bucket.

When the bar is in dropped position, as shown, the shoe 102 will contact the sub-surface 107 in advance of the bucket, and as the bucket is lowered further, the bearing 114 slides down on the bar. The bar raising lever 109, opening the valve and admitting water to the cylinder 74, which forces the piston 75 up to the top of its stroke, coincidentally drawing the racks 78 and 79 up between the gears 80—81 and 82—83, rotating shafts 84 and 85 and cranks 86—87, 88—89, from the dotted position 115—116 to the full line position 86—87, closing the bucket from the dotted position Fig. 3, or full line position Fig. 6 to the full line position shown in Fig. 3.

As the hoisting cable 117 lifts the dredge from the subsurface, the bar 103 drops, permitting lever 109 to close valve 110 through the medium of spring 111, entrapping the liquid in the cylinder 74, locking the bucket in closed position.

As the piston is forced upwardly by the admitted fluid, the air above the piston is transferred through the bypass 99 to the air receiver 98, thus diminishing the normal pressure of compression while increasing the differential pressure between the opposite sides of the piston.

When the bucket is to be dumped, lever 109 is raised manually to the dotted position to permit escape of the fluid or water from the lower end of the cylinder, the air under slight compression in the transfer tank 98 being transferred back to the cylinder and assisting the counterweights 100 and 101 in opening the bucket and forcing the water out of the cylinder. When the bucket

is fully opened and the water all drained from the cylinder 74, the lever 109 is released, closing the valve 110 and locking the bucket in open position.

In Fig. 8, another control means is shown for automatic control of the bucket and prime mover. In this modification, the hoisting cable 117 is connected to a plunger or slide 118 which is slidable in a bearing 119 formed in the bail 120. This plunger cooperates with a counterweighted lever 121 which is pivotally mounted at 122 on the bail, the counterweight 123 normally maintaining the lever in contact with the underside of plunger 118, as shown.

The end 124 of lever 121 has pivotally connected thereto a connecting rod 125 which connects to valve lever 126. Thus, as the bucket encounters the subsurface 107, the hoisting cable is naturally slackened off, permitting the plunger 118 to drop, depressing lever 121 and opening valve 127, admitting water to cylinder 74, and operating in the manner previously described. When the hoisting cable is again drawn taut for hoisting, the plunger is drawn up, permitting the valve to close. Lever 121 may be connected directly to the plunger, if desired.

The two controls just described depend on the dredge contacting a subsurface for operation, and in both types, the bucket is hydraulically locked in both, closed and open position of the bucket.

Fig. 9 shows a depth control for the prime mover, which is particularly suitable for control where the subsurface is very sludgy, or where samples are to be taken at various depths, and since efficient sealing means is provided for the bucket, this control can be used for taking water samples at various depths. It is also suitable for dredging, by first ascertaining the depth of the water at the point to be dredged.

A through piston rod is shown to illustrate one method of equalizing the pressure, to prevent the unbalanced pressure on the piston rod from prematurely closing the bucket. Suitable hydraulic packing is provided as indicated at 128 and 129. All bearings exposed to the water of submergence are efficiently packed, but which packing does not form a part of this invention.

The control, Fig. 9, consists of a hydraulic control and a valve actuator, which are mounted on, or integral with, the cross-head 77, being carried on an arm 130.

The hydraulic control consists of a cylinder 131 having a piston 132 urged by a spring 133 which seats against an adjustable seat 134, the spring 133 being adjusted as to tension for depth by means of the screw 135, the adjustment being made for the depth at which the bucket 69—70 is to be closed.

An intake passage 136 is formed in the bottom of the cylinder, and an outlet 137 is normally closed by the piston, and communicates with the valve actuator cylinder.

The valve actuator consists of a cylinder 138 having a piston 139 and a through piston rod 140, which has a through axial bore in which the actuator rod 141 is slidable, and which is provided with an integral collar 142 and a head 143.

The upper end of the piston rod 140 has a head 144, a spring 145 cooperating between the head 144 and the top of the cylinder to normally maintain the piston 139 in its highest position in the cylinder 138.

A flexible conduit 146 communicates between the bottom of cylinder 138 and air transfer receiver 98, and another flexible conduit 147 com-

municates between the upper end of cylinder 138 and valve 148, this valve having an intake and discharge 149 communicating with the lower end of cylinder 74 through a pipe 150. A spring 151 is mounted on rod 141 for cooperation between the heads 143 and 144 to permit manual unloading of cylinder 74 for opening the bucket.

The operation of this control is as follows:

Screw 135 is first adjusted for the depth at which the bucket is to be closed. As the dredge is lowered into the water 152, the pressure of submergence gradually increases, water acting through the port 136 on piston 132 against spring 133, gradually raising the piston 132 to finally uncover the port 137, water then passing through port 136, cylinder 131, passage 137 into cylinder 138, depressing piston 139.

As the piston 139 is depressed with its piston rod, against the action of spring 145, the lower end of the piston rod cooperates with the collar 142, forcing rod 141 down and moving valve lever 153 from the dotted position to the full line position, opening the valve 154 and admitting water of submergence to the lower part of the cylinder 74 through passage 150, while also permitting equalization of pressure through conduit 147, entrapped air in the lower part of cylinder 138 having been transferred to receiver 98, and entrapped air in the upper part of cylinder 74 having also been transferred to cylinder or receiver 98.

As the piston 75 raises, the piston rod 76 and cross-head 77 coincidentally raise the control and actuator. After predetermined travel of piston rod 76, the head 144 cooperates with spring seat 155, the final movement of the piston raising rod 141 and lever 153, closing valve 154, hydraulically locking piston 75 at the top of its stroke with the bucket closed.

As the dredge is raised, the external pressure is reduced and piston 132 lowers and closes port 137, locking piston 139 in its lowest position.

When the bucket is to be opened for dumping, lever 153 is manually pulled down from the dotted position against the action of spring 151 and the water is drained from the lower end of cylinder 74, and through conduit 147 and passage 137, (which is now uncovered by the top of the piston 132), draining the water from the spring housing section of cylinder 131 and from the upper end of cylinder 138, counterweights 100 and 101, assisted by the return transfer of the air under slight pressure in transfer receiver 98, and spring 145 returning all parts to normal position with the bucket open, and hydraulically locked in open position, the lever 153 returning to the dotted position automatically when released and closing the valve 154 and sealing the lower part of the cylinder 74.

The clam shell bucket may be of any type in which cooperative scooping elements are employed. The seal for the scooping means may be of any type which is self compensating for variations in external pressures and which will build up its resistance as the pressure is increased, always at a value greater than the external pressure.

The simplest operative connections are shown between the prime mover and the dredge, and the static liquid operated prime mover may be adapted for operation of any type of device to be used in any case where external fluid pressure is available in a free state such as for deep-sea dredging.

It will be understood that variations in construction and arrangement of parts, which varia-

tions are consistent with the appended claims, may be resorted to, without detracting from the spirit or scope of the invention, or sacrificing any of the advantages thereof.

I claim:

1. In combination, scooping means having cooperative scooping elements, a prime mover mounted on said scooping means, an operative connection between said prime mover and said scooping means, and cooperative sealing means on the respective scooping elements, and means building up the internal resistance of said sealing means as the external pressure is increased, to a value greater than the external pressure.

2. In combination, a submersible device and a prime mover mounted thereon and operated through the medium of fluid in which said device and prime mover are submerged, pressure-controlled means controlling operation of said prime mover for one operation of said device, and manually controlled means controlling operation of said prime mover for another operation of said device.

3. In combination with a clam shell bucket or the like, sealing means for the cooperative edges of said bucket comprising a resilient element mounted in one cooperative edge for cooperation with the other cooperative edge, and means actuated through the medium of surrounding liquid under pressure maintaining the internal resistance of said resilient element at a value greater than said external pressure.

4. A submarine dredge comprising a clam shell bucket having cooperative scoop elements; a cylinder mounted on said bucket, a piston and piston rod for said cylinder; operating means connecting said piston rod with said scoop elements; a valve for controlling admission of water of submergence to one end of said cylinder; means opening said valve when said dredge has been submerged to a predetermined depth and closing said valve during hoisting of said dredge.

5. A submarine dredge comprising a clam shell bucket having cooperative scoop elements; a cylinder having a piston and piston rod and mounted on said bucket; operating means connecting said piston rod with said scoop elements; a valve controlling admission of water in which said dredge is submerged, to one end of said cylinder; a receiver in communication with the other end of said cylinder for transfer of fluid; means opening said valve when said dredge has been submerged to a predetermined depth and depth adjusting means therefor, said means closing said valve when said dredge is hoisted to a lesser depth, and manually operated means operable at will for discharging admitted water from said cylinder, said transfer fluid acting to open said bucket as the water is discharged, and counterweight means assisting in the opening of said bucket, said bucket being fluid locked in both its open and closed positions.

6. A submarine dredge comprising; scooping means having cooperative scooping elements; a fluid-actuated prime mover mounted on said scooping means; an operative connection between said prime mover and said scooping means for opening and closing said scooping means; and submergence controlled means controlling admission of fluid of submergence to said prime mover for operation thereof at a predetermined depth of submergence.

7. A structure as claimed in claim 6; cooperative sealing means on the respective scooping elements for sealing said scooping means when in

closed position against escape of sludge, the sealing means on one of said elements being formed of resilient material; and means actuated by fluid of submergence building up the internal resistance of said resilient material to a value greater than the fluid of submergence to maintain said resilient sealing means effective against its external fluid pressure.

8. A structure as claimed in claim 6; said submergence controlled means comprising; a valve and valve control means mounted on said dredge; said valve control means being fluid-actuated under a predetermined depth of submergence opening said valve for admission of fluid of submergence to said prime mover for closing said scooping means and closing said valve as said dredge is raised to a lesser depth of submergence for hydraulically locking said scooping means in closed position; said control means including manual control means for opening said valve to drain fluid of submergence from said prime mover after said dredge has been removed from said fluid of submergence.

9. In a device for submarine operation; a fluid-operated prime mover; a valve controlling passage of fluid of submergence to and from said prime mover for actuation thereof; and valve control means mounted on said device and actuated under a predetermined head of submergence opening said valve for passage of fluid of submergence to said prime mover for operation thereof and closing said valve as said device is raised to a lesser head of submergence for hydraulically locking said prime mover against further operation.

10. A structure as claimed in claim 9; said control means including manual control means for opening said valve to drain fluid of submergence from said prime mover after said device has been removed from said fluid of submergence.

11. In a device for submarine operation, a fluid-operated prime mover; valve means and control means therefor operated through the medium of fluid of submergence when said prime mover has been lowered into said fluid of submergence to a predetermined depth, admitting fluid of submergence to said prime mover for operation thereof and sealing admitted fluid in said prime mover when said prime mover is raised to a lesser depth to hydraulically lock said prime mover against further or retrograde operation.

12. In a device as claimed in claim 11; hand operated means for operating said means when said prime mover has been removed from said fluid of submergence for draining admitted fluid from said prime mover for a subsequent fluid of submergence operation of said prime mover; and means returning said hand operated means to its

initial position when manually released, for subsequent fluid of submergence operation of said means operated.

13. In a device as claimed in claim 11; a receiver in communication with said prime mover and mounted on said device and forming transfer means for transfer of prime-mover-contained fluid as fluid of submergence actuates said prime mover.

14. A submarine dredge comprising; a fluid-operated prime mover; valve means and control means therefor actuated upon cooperation of said dredge with a sub-sea surface to open said valve to admit fluid of submergence to said prime mover for operation thereof and releasing said valve to close when said dredge is raised out of cooperation with said sub-sea surface to lock contained fluid in said prime mover to prevent retrograde operation thereof, and including means closing said valve when released.

15. A structure as claimed in claim 14; and a breather chamber in communication with said prime mover for gas displaced in said prime mover through fluid of submergence operation thereof, for maintaining reactive pressure in said prime mover at a low value.

16. A structure as claimed in claim 14; and manually-controlled means associated with said valve and operable at will when said dredge is removed from said fluid of submergence for opening said valve for draining admitted fluid from said prime mover; said means closing said valve also acting to close said valve when said manually-controlled means is released.

17. A structure as claimed in claim 14; said dredge including cooperative scooping elements and operative connections between said prime mover and said scooping elements; and counterweight means associated with said scooping elements urging said scooping elements to open.

18. A structure as claimed in claim 14; said dredge including cooperative scooping elements and operative connections between said prime mover and said scooping elements; counterweight means associated with said scooping elements urging said scooping elements to open; manually-controlled means associated with said valve and operable at will when said dredge is raised from said fluid of submergence for opening said valve for draining admitted fluid from said prime mover to release said scooping elements to open, said means closing said valve also acting to close said valve when said manually-controlled means is released, to lock said scooping elements in open position and prevent operation of said prime mover while being lowered to said sub-sea surface.

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